The University Of Sheffield.

Understanding the relationship between Social Determinants of Health and Anxiety and Depression

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology

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May 2024

Declaration

I, the author, confirm this thesis is my own work and that I am aware of the University of Sheffield guidance on unfair means (www.sheffield.ac.uk/new-students/unfair-means). This thesis is submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology. This work has not been submitted for any other degree or to any other institution.

Structure and Word Count

Section One: Literature Review

Excluding references and tables:	7990
Including references and tables:	10452

Section Two: Empirical Study

Excluding references and tables:	8000
Including references and tables:	10509

Total

Excluding references and tables:	15990
Including references and tables:	20961

Lay Summary

The World Health Organization describes social determinants of health (including mental health) as “the conditions in which people are born, grow, live, work and age, and people’s access to power, money and resources”. Understanding how social determinants impact anxiety and depression may generate recommendations in how to reduce the impact of social determinants on mental health.

The first chapter explores the relationship between subjective social status (SSS) and mental health disorders, specifically anxiety and depression. Subjective social status refers to how an individual perceives their social standing (e.g., in relation to their employment and income) relative to others. A search of existing literature for published studies in this area was conducted. Studies were required to include participants who were 18 years or older, who had completed a specific measure of subjective socials status called the Macarthur ladder and a measure relating to anxiety and/or depression. In total, 65 studies were identified. Of these, 41 could be analysed quantitatively using meta-analysis. The findings suggested SSS is weakly associated with mental health, whereby lower SSS is associated with increased depressive and anxiety symptoms (i.e., small effect size). This did not appear to differ according to whether different versions of the Macarthur Ladder were used for neither anxiety nor depression. For depression, it also appeared this did not differ according to where the study was conducted or how old participants were. However, when considering the results of all 65 studies (descriptively, not quantitatively), there was some evidence to suggest the relationship between SSS and mental health may differ when looking at subgroups of individuals, according to how identity characteristics interact (e.g., race/age). Additionally, certain social factors and thinking styles appear to play an important role in influencing the relationship between SSS and mental health. However, further research in these areas is

needed to quantitively summarise whether/how different variables impact the relationship between SSS and mental health.

The second chapter aimed to characterise the relationship between various social determinants of health with anxiety and depression, in a sample of individuals who closely represent the English population. A network model approach was used, which is a graphical and statistical way of exploring which factors are connected and how strongly. Two models were created, one looking at the relationship between social determinants and anxiety and another with depression. Overall, each model explained a noticeable amount of variance in anxiety and depressive symptoms. The determinants having the greatest direct impact on both anxiety and depression related to how lonely someone is, how many positive childhood experiences they have experienced, whether they are in receipt of benefits, and how old they are. Other determinants relating to socioeconomic status appeared to have an indirect effect on anxiety and depression. Overall, the study highlights that social determinants contribute to population-level mental health, and interventions which address relational and socioeconomic factors will likely reduce anxiety and depressive symptoms in adults in England.

Acknowledgements

I would firstly like to thank my supervisors, Vyv Huddy and Richard Bentall. Richard, thank you for the curiosity and creativity that sparked the initial inspiration for this project. Vyv, I have really appreciated your help in finding ways to combine my personal values with my interest in research. Thank you also for finding the right balance between the independence that I so enjoy and the support and scaffolding that I needed!

Thank you to everyone who participated in the COVID-19 PRC study, without you, this project would not exist. Thank you also to those involved with the dataset who could point me in the right direction and answer questions, even when you were no longer using the data!

To Mum, Dad, and Laurie, thank you for always believing in me, even when I am telling you all the reasons that I think that you shouldn't. I can always count on your blind faith!

To my friends at home, thank you for listening, laughing, and always cheering me on, even when it means moving to a whole new city! An especially big thank you to Elsa, words won't do you justice.

To Rachel, Guillame, and Eva, thank you for making Sheffield feel like home. I can't wait to celebrate with you.

And lastly, to Luke, you are endlessly patient, constantly hilarious, and unconditionally supportive. Thank you for reminding me that there is so much in life to enjoy and for enjoying it with me.

Contents

Part I: Literature Review

The Association Between Subjective Social Status and Anxiety and Depression: A Systematic Review and Meta-Analysis

Abstract

Background

Subjective social status (SSS) refers to how an individual perceives their social status relative to others. This systematic review and meta-analysis examined the association between SSS and anxiety and depression.

Methods

PsycInfo, Scopus, Pubmed, and Medline were searched in October 2023. Published (English-language) studies were included if adult participants had completed a Macarthur measure of Subjective Social Status and a measure of anxiety and/or depression, and analyses assessed SSS's association between these conditions. Critical appraisal was based on study design (i.e., cross-sectional or longitudinal). Two random-effects meta-analyses which included moderator analyses quantitatively assessed SSS's association with anxiety and depression, these results were considered alongside narrative synthesis.

Results

Sixty-five studies were reviewed; of which 41 were eligible for the depression meta-analysis and 11 the anxiety meta-analysis. There were small but significant associations between SSS and depression (r^{avg} = -0.22, 95% CI [-0.261, -0.1825]) and anxiety (r^{avg} = -0.1902, 95% CI [-0.2396, -0.1407], $p < .001$). Moderator analyses of individual variables were non-significant. The narrative synthesis identified that intersecting variables may act as moderators. Early work attempted to incorporate SSS into cognitive theories of depression and understand its use in psychotherapy for anxiety. Critical appraisal identified two primary limitations within the literature: sampling biases affecting generalizability and possible risks of type 1 errors due to absent power analyses.

Discussion

SSS is significantly associated anxiety and depression, however clinically, SSS may not be a useful direct target due to small effect sizes.

Practitioner Points

- Subjective social status is significantly associated with anxiety and depression.
- This association is small, and it is currently unclear whether it would be a worthwhile target in therapy.
- There is very early evidence to suggest that it could be used indirectly to understand diversity in the therapeutic relationship.
- Further research is required to characterise whether/how SSS should be incorporated into therapeutic interventions.

Key words: 'Subjective Social Status', 'Macarthur Ladder', 'Anxiety', 'Depression'

Introduction

Anxiety and depressive disorders are highly prevalent worldwide, causing substantial burden to both the individual and society (GBD Mental Disorders Collaborators, 2022). There is significant interest in understanding how social determinants of health, understood as "the conditions in which people are born, grow, live, work and age, and people's access to power, money and resources" (WHO, 2024), impact anxiety and depression, amongst other mental health disorders (Kirkbride et al., 2024).

Objective measures of socioeconomic status (OSES), such as education status, employment status, and, income, constitute key social determinants of mental health. Generally, these factors have a buffering or deleterious effect on mental health: when OSES is higher, anxiety and depression are less prevalent and less severe (e.g., Esch et al., 204; Lund et al., 2018; Virgolino et al., 2022). However, research suggests that there may be demographic differences in how these factors impact individuals (e.g., Ostler et al., 2001). Since the impact of these variables (amongst other social determinants) is both pronounced and unequally distributed, organisations like the World Health Organization and Public Heath England have, in the attempt to reduce inequity in the prevalence of anxiety and depressive disorders and improve outcomes, identified social determinants of health as key intervention and policy targets (e.g. Lund et al., 2018; Public England, 2017.

Subjective Social Status and Mental Health

In addition to OSES, subjective social status (SSS) is also predictive of mental health outcomes (e.g., Zell et al., 2018; Cundiff & Matthews, 2017). Subjective social status refers to how individuals perceive their status relative to others (Hoebel & Lampert, 2020). Preliminary research, such as Adler et al.'s (2000) paper, found that lower SSS was negatively correlated with psychological variables such as negative affect and stress. Multiple

studies have replicated and extended Adler et al.'s (2000) research, observing that lower SSS typically equates to higher levels of depression (e.g., Demakakos et al., 2008; Hoebel et al., 2017; Madigan & Daly, 2023), a finding which appears to be consistent across multiple countries (Scott et al., 2014). Evidence also suggests that downward changes in SSS (often referred to as social mobility) also have negative consequences for mental health (e.g., Kim et al., 2023). Notably, whilst most SSS studies are cross-sectional and correlational, there exists supportive research which is both experimental (Schubert et al., 2016) and longitudinal (Madigan & Daly, 2023).

Measuring SSS and its Association with Mental Health

SSS is measured by asking participants to rate how they perceive themselves in relation to others in society. One of the most frequently used measures is the MacArthur Scale of Subjective Social Status, which is a 10-rung ladder upon which individuals place themselves. The top rung represents those in society with "the most money, education, and respected jobs, and the bottom rung represents those in society with the least money, education, and respected jobs" (Adler et al., 2000; figure 1). The 'society' ladder has adequate test-retest reliability (Operario et al., 2003) and has been developed in multiple ways, with another popular option being the 'community' ladder, where individuals rate themselves in comparison to others in their self-defined community (Adler & Stewart, 2007). The predictive value of both the society and community ladders was examined in a systematic review and meta-analysis, which found that whilst both ladders correlate with objective indicators of SES, they each uniquely predict health outcomes, including mental health (Zell et al., 2018).

Figure 1

Example of the Macarthur Ladder (Community Version)

Research has sought to establish whether these ladders represent unique determinants of health, or whether their effect is reflective of underlying processes which lead to the individual's appraisal of their social status. Cundiff et al. (2013) compared the strength of the relationship between the community and US ladders with household income, depression, neuroticism, and optimism, with results indicating that the scales possess both convergent and discriminant validity relative to OSES and psychosocial vulnerability. However, the society ladder was more strongly correlated with OSES than the community ladder. A separate study considered the relationship between SSS, health outcomes, and negative affect, finding that temporary changes in negative mood did not influence SSS ratings, nor impact the relationships between SSS and depression. However, chronic negative affect partially accounted for the associations between SSS and depression. Taken together, these findings suggest that SSS scales possess at least partial discriminant validity.

Relatedly, there is still some debate pertaining to construct validity. Specifically, research has queried whether the ladders measure status in relation to an individual's economic circumstances or non-economic social status/rank. In a series of structural equation models which assessed the relative contribution of components of economic and social status to ratings on the Macarthur ladder, Galvan et al., (2023) found that two latent variables, reflecting economic and social status both impacted SSS. However, there appeared to be a greater impact of the social status latent variable.

Research highlights a potentially complex relationship between SSS, OSES, and potential mediators of the relationship between SSS and mental health. Typically, it appears

that SSS is predictive of mental health, even when incorporating measures of OSES (Zell et al., 2018). However, there is some variation in the literature: some studies find SSS partially mediates the relationship between OSES and mental health (e.g., Madigan & Daly, 2023) whilst others have found that OSES can account for the relationship, and that SSS may even impact depression, rather than the other way around (Diaz et al., 2014).

Other variables have also been implicated in the SSS-mental health relationship. Seely et al. (2023) found that negative cognitive style mediated the relationship between SSS and mental health, and, in some cases, different ladders have had a greater or lesser association with mental health within different demographics (e.g., Chen et al., 2022b). In sum, whilst it appears that SSS is predictive of depression and anxiety, some questions remain as to whether this is at least partially to do with how SSS is measured and what mediates this relationship.

In addition to the term 'subjective social status', extant literature also refers to 'subjective social rank', or 'social rank' (e.g., Wetherall et al., 2019). One of the most frequently used measure of social rank is the Social Comparison Scale (Allan & Gilbert, 1995), which asks respondents how they feel about themselves in comparison to others according to dimensions designed to reflect concepts around social rank, social attractiveness, and group fit (e.g., inferiority-superiority, incompetence-competence, likeability-unlikability). Importantly, these appear conceptually different from the McArthur Scale, which explicitly prompts respondents to compare themselves to others according to money, education, and jobs, or more broadly in relation to their status within a particular context (e.g., their community). This review is specifically interested in the association between SSS, as measured by the McArthur Scales as opposed to social rank more broadly (e.g., whether one sees themselves as stronger and more attractive than others, as measured by the SCS).

Review Aims

Reviews and meta-analyses do exist in this area; however, their purpose and remit vary. In a meta-analysis considering what association SSS (including Macarthur scale measurements) has with health/mental health, a small but statistically significant effect on mental health was found for both the community and society ladders (Zell et al., 2018). However, this meta-analysis included a limited number of studies relating to mental health and did not distinguish between mental health disorders, aggregating mental health outcomes across a small number of studies ($k = 26$). McCarthy and Morina (2020) completed a meta-analysis that looked at the association of social comparison (i.e., the process of acquiring, evaluating, and reacting to comparison information) as opposed to SSS, with anxiety and depression finding a large, significant effect of social comparison on depression and a medium, significant effect of social comparison on anxiety. However, the focus of their review was the cognitive process of self-evaluation itself, rather than the specific appraisals of social status (i.e., SSS scales were not incorporated).

A separate review considered the relationship between self-perceptions of social rank and depressive symptoms, suicidal ideation, and suicidal behaviour (Wetherall et al., 2019). Because this review focused on social rank more broadly, papers including the social comparison scale, the MacAurthur ladder, and other measure of social rank were included. Results from the 32 papers examining the relationship between SSS and depressive symptoms indicated a consistent relationship whereby lower SSS resulted in increased depressive symptoms. A limitation of this review is that it did not include a meta-analysis (due to the heterogeneous measures of rank included). A meta-analysis was conducted which assessed the association between objective and subjective social status and mental wellbeing specifically, finding a statistically significant but small association (Tan et al., 2020). Thus, there is currently no meta-analysis which specifically considers the association between SSS on depression and anxiety, as captured by the MacArthur Scales.

This paper aims to update and extend prior research by incorporating both a systematic view and meta-analysis of the association between SSS, as measured by the Macarthur Ladder, has specifically upon anxiety and depression. The meta-analysis includes moderator analyses, which consider ladder type, age, and study location, as these have previously been identified as potential moderators (e.g., Chen et al., 2022b; Weiss & Kunzman, 2020; Zell et al., 2018).

Method

This systematic review and metanalysis was guided by the PRISMA 2020 reporting guidelines (Page et al., 2021), the PRISMA 2020 checklist is available in appendix A and a figure summarising the search process in figure 2. The protocol for this review can be found on Prospero **(**https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=456342**).** Any revisions from the protocol are discussed within appendix B.

Eligibility criteria

The following inclusion criteria were applied: studies must be peer reviewed and published in English, participants must be adults, who have completed a measure relating to anxiety, depression, or both. Participants must have completed a version of the Macarthur Ladder of Subjective Social Status (e.g., community ladder, society ladder). Analyses must include an assessment of the association between subjective social status on anxiety or depression (univariate or multivariate); these analyses may be secondary to the study's primary objectives. Studies were excluded if they were not published in English, included participants 17 years or younger, did not use a version of the MacArthur Ladder of Subjective Social Status, or did not quantify the relationship between the Macarthur Ladder and depression and/or anxiety. For the quantitative synthesis, studies were considered according to mental health outcome (i.e., anxiety or depression).

Information sources and search strategy

This strategy was developed by considering previous reviews that exist in this area and the remit of this current review. PsycInfo, Scopus, Pubmed and Medline were searched 27th October 2023 using the following terms:

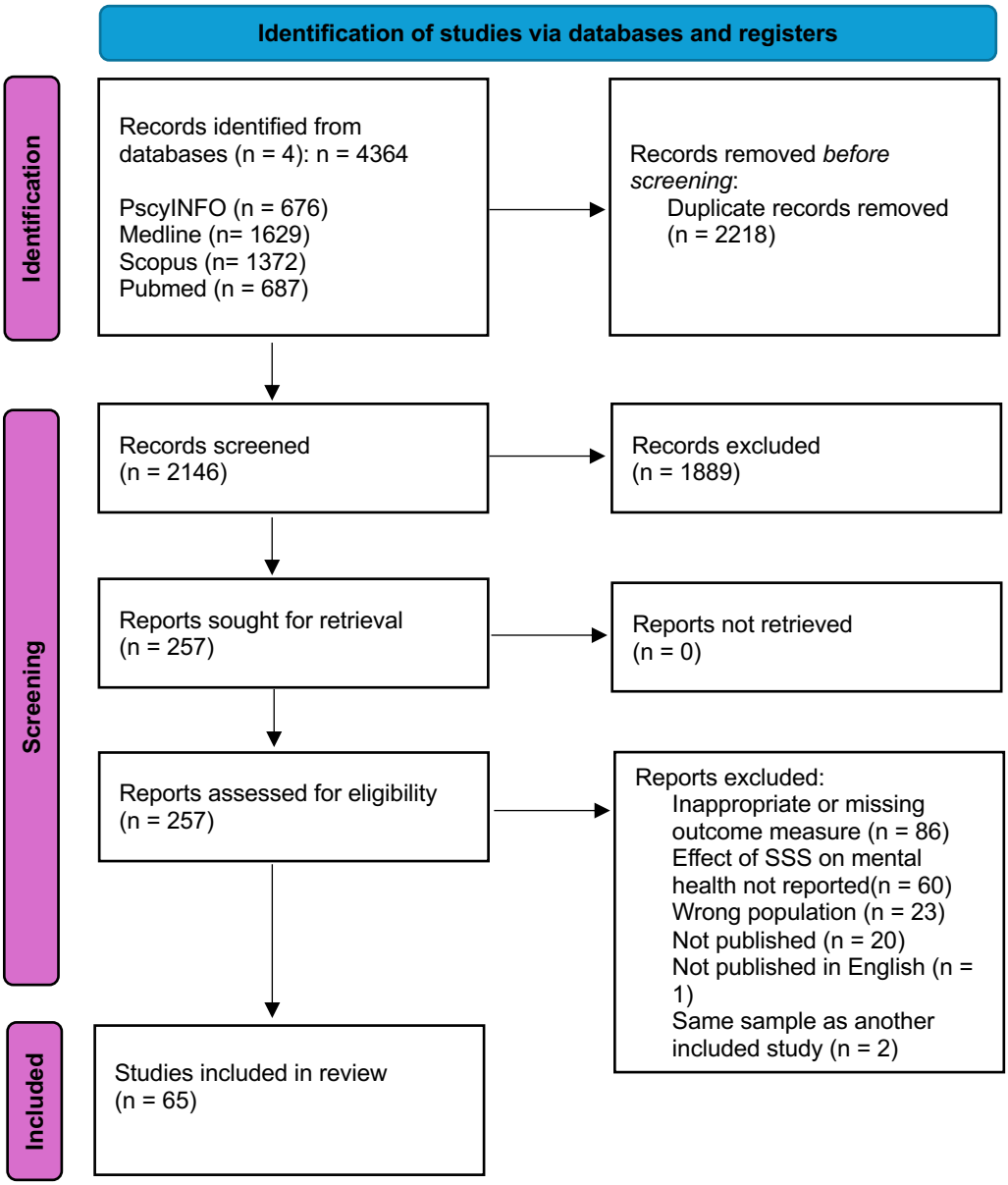
("depress*" OR "affective" OR "mood" OR "distress" OR "emotional disturbance" OR "anxiety" OR "mixed anxiety" OR "generalized anxiety" OR "social phobia" OR "specific phobia" OR "panic disorder" OR "OCD" OR "obsessive compulsive disorder" OR "depression" OR "depressive disorder" OR "internalizing disorder") AND ("subjective social status" OR "subjective social position" OR "social rank" OR "social comparison" OR "macarthur scale" OR "perceived social status" OR "perceived socioeconomic status").

Selection process

After searches were completed, records were imported into the software Rayaan. Two researchers independently reviewed titles and abstracts of all records. Inconsistencies were discussed with a third reviewer until consensus was obtained. Records identified as requiring full text screening were reviewed independently by the author of this report.

Figure 2

PRISMA Flow Diagram Outlining the Screening Process



Data collection process

References were exported from Rayan, and data was extracted and recorded in Microsoft Word by a single reviewer who authored this report. No automation tools were used in this process.

Data items

Any analyses specifically considering the association between subjective social status on anxiety and/or depression were included; this could include any effect measure (e.g., risk ratio, correlation coefficient, etc.). Where these analyses were secondary to the study's primary aim (e.g., a correlation coefficient for subjective social status and the mental health measure is reported, but the mental health measure is not used specifically as an outcome), this was noted. In addition to these specific analyses, data was also extracted to summarise the study design (e.g., cross-sectional, longitudinal), the sample characteristics (relating to age and sex), and the measures used to assess subjective social status (i.e., which ladder(s) was utilised) and mental health (i.e., how was anxiety and/or depression measured).

Quality assessment

Quality assessment was undertaken to facilitate comment on the overall quality of the literature. Consistent with prior reviews (Wetherall et al., 2019), quality assessments were based on analyses relevant to this review. For cross-sectional studies, the AXIS tool was used (Downes et al., 2016). This is a 20-item measure which has been specifically developed to assess areas of cross-sectional studies which may introduce a risk of bias. Following recommendations by Von Elm et al. (2005), the tool developed by Tooth et al. (2005) was used, which has been recommended for longitudinal designs and can also be used with prospective research.

Data analysis

Two random-effects meta-analyses for anxiety and depression were completed using correlation coefficients. Raw effect sizes were converted to fisher-z, and a summary effect calculated. Studies were weighted by the inverse of their variance. Certainty assessments were based on the magnitude of the overall effect, alongside its 95% confidence intervals

(Hultcrantz et al., 2017). The overall effect magnitude will be considered in line with Cohen's (1992) guidelines, whereby $r = 0.10$ is considered a small effect size, $r = 0.30$ medium, and $r = 0.50$ large.

In line with Bornstein et al.'s (2010) guidance, statistical significance was determined by an alpha value of <0.05. Heterogeneity across studies was assessed using both the 'Q' and 'I^2' statistics. Where Q is statistically significant, this indicates that variance between studies is greater than expected if solely due to sampling error (Higgins et al., 2003). Q may be vulnerable to the number of studies included (Higgins et al., 2003), hence the inclusion of 'I^2', which assesses whether study variability is due to heterogeneity. Specifically, a higher percentage indicates greater heterogeneity; when the 'I^2' is greater than 75%, this reflects high heterogeneity (Higgins et al., 2003). Publication bias was assessed by trim and fill method, fail-safe N analyses, and analyses of funnel plots, both visually and according to Egger's regression test (Egger et al., 1997).

Where no correlation coefficient was available, authors were emailed to request the correlation coefficient; one author replied. Where there was no response, but studies report either standardized beta weights in linear regressions or odds ratios in logistic regressions, then these effect sizes were converted to allow for a wider meta-analysis, using Psychometrica (Lenhard & Lenhard, 2022). Study effect sizes were checked to ensure they followed the same direction. In cases where multiple effect sizes were reported (i.e., the study reported effect sizes for two ladders), the community ladder was extracted as a preference. This was based on the rationale that the ladder is typically less associated with measures of OSES, and may better capture the contribution of SSS to anxiety and depression.

Sensitivity analyses were conducted whereby the converted effect sizes were removed to ascertain whether these effect sizes impact the overall effect of subjective social status on

depression and anxiety. In line with a previous meta-analysis, the following moderators were considered: ladder type, age, and study location.

Results

Study Selection

In total, four databases were searched, generating a total of 4364 records. After duplicates were removed, 2146 remained. Two reviewers screened titles and abstracts concurrently, agreement was present for 95% of papers, the remaining papers were discussed with a third reviewer. In total, 65 papers were included in the systematic review, of which 42 were included in the depression meta-analysis and 11 in the anxiety meta-analysis. An overview of the papers, including the study design, sample details, measures, and findings are available in table 1.

Author, year, country	Design	Sample characteristics	Measures (subjective social status measure, mental health measure)
Adler et al., 2008, comparison of British and US sample	Cross-sectional	Whitehall study: N = 6981 Aged 47-67 66% male CARDIA: N = 3632 Aged 33 - 48 55.83% female	SSS-US and SSS-Society CES-D
Alcántara et al., 2014, America	Cross-sectional	N = 1561 (Latino Immigrants or those not born on US mainland). Mean age not reported 54.56% female	SSS-US and SSS-Country of Origin. SSS shifts = SSS-home country compared with SSS-US World Mental Health Composite International Diagnostic Interview used to establish Major Depressive Episode
Aroke et al., 2020, America	Cross-sectional; secondary focus	N = 105 adults with chronic low back pain Mean age = 45.8 (SD=14.03) 62% female	SSS-US CES-D
Callan et al., 2015; America	Cross-sectional (6 studies, but depression only considered in study 1)	N = 356 Mean age = 33.81 (SD = 11.74) Female = 64%	SSS-US CES-D
Chen et al., 2021, America	Cross-sectional	N = 257 Chinese Immigrant Mothers Mean age = 37.87 (SD = 5.87)	SSS shifts = SSS-home country compared with SSS-US Chinese American Depression Scale
Chen et al., (2022a), America	Longitudinal	N = 130 bereaved spouses	SSS-US CES-D

		Mean age not reported. Distribution of ages: Age range: 35 -85 1 participant between ages of 35–39, 4 participants between ages 40–49, 18 participants between ages 50–59, 43 participants between ages 60–69, 52 participants between ages 70–79, and 12 participants between ages 80–85 67.7% female	
Chen et al., 2022b, China	Cross-sectional	N = 3716 Chinese Older Adults 65–69 (33.99%), 70–74 (34.98%), and 75 or older (31.03%). 52.5% Male	SSS-Community and Society Geriatric Depression Scale
Collins & Goldman, 2008, China	Longitudinal, including cross-sectional analyses	N = 1056 participants in the longitudinal Survey of Health and Living Status of the Near-elderly and Elderly in Taiwan. Mean age = 67.7 (SD = 8.1). 57% male	SSS-Taiwan CES-D
Costa et al., 2020, Germany	Cross-sectional	N = 560 asylum seekers and refugees living in Baden-Wurttemberg, Germany. 29.3% aged 18 – 25 years old. 29.3% male	SSS-Country of Origin SSS-Germany Mobility = SSS-Germany – SSS-Country of Origin GAD2 PHQ2

Cundiff et al., 2011, America	Cross-sectional	N = 600 older adults (300 couples) Mean age = 52.4 (SD not reported) 50% female	SSS-US CES-D
Cundiff et al., 2013, America	Cross-sectional	N = 300 middle aged and older married couples Mean age middle aged men = 45.8 (4.0) Mean age middle aged women = 43.9 (3.8) Mean age older men = 64.7 (4.3) Mean age older women = 62.2 (4.5) 50% female	SSS-US SSS-Community CES-D
Demakakos et al., 2008, England	Cross-sectional	N = 7433 individuals aged 52 years or older Mean age = 66 (SD not reported) 45.3% male	SSS-Society CES-D
Diaz et al., 2014, America	Longitudinal	N = 634 women aged 31 – 54 in the San Franciso Bay Area, with non-cancerous pelvic problems. Mean Age 43.55 (SD = 4.55)	SSS-C and SSS-US PHQ9
Dolbier et al., 2013, America	Prospective	N = 299 post-pregnant women Mean Age 23.6 (SD = 4.2) Female = 100%	SSS-US Edinburgh Postnatal Depression Scale

Euteneuer & Schäfer 2018, Germany	Cross-sectional	N = 164 male refugees in Germany Mean age = 28.84 (SD = 8.15)	SSS- Germany, SSS-Country of Origin, Mobility = SSS-Germany – SSS-Country of Origin PHQ9
Euteneuer et al., 2019, Germany	Cross-sectional (two studies)	Single mothers: N = 124 Mean age = 38.95 years (SD= 8.09) Unemployed persons N = 310 Mean age = 46.15 (SD = 12.88) Female = 51.9%	SSS-Germany ('factual' SSS) Counterfactual SSS = what participants would rate their standing if they had not become a single parent/unemployed. Discrepancy = SSS-Counterfactual – SSS factual PHQ9
Fleuriet & Sunil, 2014, America	Cross-sectional	N = 292 pregnant women in South Texas Mexican Immigrants Mean age = 28.3 (SD = 6.2) Mexican Americans Mean age = 24.0 (5.4)	SSS-Community PHQ-9
Fleuriet & Sunil, 2018, America	Cross-sectional; secondary focus	N = 571 low-income women in South Texas Mean age not reported, age range: 18 – 35	SSS-US and SSS-C PHQ9
Garbarski, 2010, America	Longitudinal	N = 5731 Mean age not reported 53% female	SSS-US and SSS-C CES-D
Hamad et al., 2008, South Africa	Cross-sectional	n = 257 Low-income adults	SSS-South Africa and SSS-C

		Age, % in each category (male + female) < 20: 1.6, 0.3 20 – 29: 33.3 + 33.6 30 – 39: 37.4, 31.6 40-49: 18.7 + 25.6 50 – 59: 4.1 + 7.5 >59: 4.9 + 3.0 48% male	CES-D
Hoebel et al., 2017, Germany	Cross-sectional	N = 4952 Mean age = 49.9 (SD = 18.1) 66% Female	SSS-German PHQ8
Hurwich-Reiss et al., 2019, America	Cross-sectional	N= 978 racially/ethnically diverse caregivers of young children enrolled in Early Head Start programming from six sites across the United States. Age not reported 97% female	SSS-US and SSS-C CES-D GAD7
Jaggers & MacNeil, 2015, America	Cross-sectional	N = 581 Latinos born outside the US, who migrated to the US by age 17. Mean age = 35.67 years 54% female	SSS-community and US Modified checklist from the World Mental Health Initiative Composite International Diagnostic Interview assessed depressive symptoms. 12-month prevalence rate of major depressive episode was also established using the CIDI.
Jin & Tam, 2015, China	Cross-sectional	N = 10,828 adults who had completed	SSS-Society SSS-aged 14 years old

		the China General Social Survey Urban participants: Mean age = 48 (SD = 14) Female 53% Rural Mean age = 50 (43) 51% female	Participants reported how often they had felt depressed in the past four weeks (always, often, sometimes, rarely, never).
John-Henderson et al., 2013, America	Cross-sectional (Depression not primary focus, was used as a control variable)	N = 209 Mean age = 19.62 (SD = 2.11) Female = 55.98%	SSS-US BDI
Kim et al., 2023, America	Cross-sectional Study 1 only (as this included the SSS measure)	N = 567 adults Mean age = 36.81 (*SD* = 11.16). 51.1% female	SSS-Society and Society in childhood (CUSS and CHSS respectively) CES-D
Kwong et al., 2020, China	Longitudinal	N = 3153 Chinese Older adults Aged 64 – 74 72.2% aged 75+ Male = 49.7%	SSS-Hong Kong Community Geriatric Depression Scale (GDS)
Lau et al., 2013, America	Cross-sectional	N = 1030 US born women (nationally representative), Of these, 368 were early-life immigrants (arrived before 25 years of age), and 477 were late-life immigrants. Early life immigrants Mean age = 35	SSS-US and SSS-C The World Health Organization Composite International Diagnostic Interview (World Mental Health Survey Consortium, 2004) was used to assess lifetime prevalence of psychiatric disorders

		Later life immigrants Mean age = 38.3	
Leu et al., 2008, America	Cross-sectional	N = 1451 Weighted mean age: 44.86 46% male	SSS-US and SSS-C Mood dysfunction was a composite formed by the presence of at least one clinical or sub-clinical symptom of anxiety or affective disorder, as measured by the Composite International Diagnostic Interview
Lilly et al., 2018, America	Cross-sectional	N = 325 minority graduate-level students Mean age = 38.4 (SD = 7.4) 77.4% female	SSS-Community (although written as SSS-US in results) PHQ2
Liu et al., (2022), America	Cross-sectional	N = 1637 Perinatal women Mean age = 32.9 (SD = 3.70)	SSS – US CES-D GAD7
Lorini et al., (2023), Italy	Cross-sectional	N = 3001 Students (University of Florence) Median age = 22 67.9% female	SSS-S Future Anxiety Scale
Madigan & Daly, 2023, America	Longitudinal and cross-sectional.	N = 4948 at baseline and 3509 at follow-up Mean age 28.8 and 37.8 respectively. 49.8% females	SSS-US CES-D
McGovern & Nazroo, 2015, England	Longitudinal	N = 6241older adults Mean age = 62.8 (SD not reported)	SSS-Society CES-D

		Sex proportion not reported.	
Michelson & Johnson, 2016, America	Cross-sectional	N = 162 Black African American mothers of 5-year-old children Mean age = 33.27 (SD = 6.72)	SSS-US SSS-C CES-D Spielberger State-Trait Anxiety Inventory-Form
Miyakawa et al., 2012, Sweden	Cross-sectional	N = 5023 Mean age (males) = 47.4 (SD = 11.0) Mean age (females) = 47.4 (10.7) 46.9% Male	SSS-Society Symptoms Checklist-90
Mutyambizi et al., 2019, South Africa	Cross-sectional	N = 3027 Mean age not reported, 52% of the sample were aged 18 – 34. 48% male	CES-D Society
Nadler et al., 2020, America	Cross-sectional (Study 2 only)	N = 301 participants Mean age = 34.8 years 51.0% female	SSS-Society GAD-7
Nakash et al., 2021, America	Cross-sectional	N = 312 clients receiving care from outpatient mental health clinics. Mean age (control arm) = 32.79 (15.32) Mean age (intervention arm) = 44.18 (14.63) 67.9% female	SSS-US GAD7
Nicklett & Burgard, 2009, America	Cross-sectional	N = 3056 Mean age = 39.84 (SD = not reported) Female = 54%	SSS-Society SSS-country-of-origin To establish changes in SSS (mobility) SSS-US

			was subtracted from SSS-country of origin WHO diagnostic interview (Major Depressive Episode in past 12 months)
Niu et al., (2023), America	Cross-sectional	N = 401 college students Mean age = 19.29 (SD = 1.48) 26.9% Male	SSS-Society –modified to ask about past, present, and future SSS. CES-D
Nyberg et al, 2019, Sweden	Longitudinal	N = 1813 Mean age (male) = 64.7 (SD not reported) Mean age (female) = 64.5 (SD not reported) 50% female	SSS-Society Symptom Checklist-Core Depression Scale
Perreira et al., 2015, America	Cross-sectional	N = 15004 Hispanic/Latino adults Mean age not reported Sex not reported	SSS-US CES-D STAI-10
Pössel et al., 2022, America	Cross-sectional	N = 243 college students Mean Age = 23.95 58.6% female	SSS-Community CES-D
Rarick et al., 2018, China	Cross-sectional	N = 2282 caregivers of first-grade children in public schools Mean age = 35.47 (SD =5.25) 64.72% female	SSS-Regional CES-D
Reitzel et al., 2017, America	Cross-sectional	N = 124 Black adults Texas church Mean age = 49	SSS-US and SSS-C Beck Anxiety Inventory

		79% female	CES-D
Ropret et al., (2023), Slovenia	Cross-sectional	N = 3468 university students in Slovenia Mean age = 22 (SD=3) 70% female	SSS (Unclear which ladder, likely society) WHO-5: cut-off point of <=50 to indicate the likely presence of depressive symptoms.
Schubert et al., (2016), Germany	Experimental	N = 72 German university students Students reporting low status Mean age = 22.78 (SD = 2.27) 77.78% female Students reporting high status Mean age = 23.67 (4.60) 80.56% female	SSS-S Depressive Cognitions Scale
Seely et al., 2023, America	Cross-sectional	N = 216 community college students Mean age =23.92, SD=9.49), 57.9% female	SSS-Community CES-D
Shaked et al., 2016, America	Cross-sectional	N = 2077 adults Mean age = 47.85 (SD = not reported) 57% female	SSS-US CES-D
Sturgeon et al., 2016, America	Cross-sectional (not primary focus)	N = 688 middle-aged adults Mean age = 53.91 years (SD = 7.232). Female = 52.3%	SSS-Community Mental Health Inventory (anxiety and depression subscales).
Talavera et al., 2018, America	Cross-sectional	N = 265 Latinos accessing primary care Mean age = 39.2, SD = 11.1 Female = 86.4%	SSS-US IDAS

Tan et al., 2023, China	Cross-sectional	N = 1347 Mean Age = 32.33, SD = 7.75 75.28% female	SSS-S PHQ-9
Tan et al., 2021, International (Malaysia, Japan, India)	Cross-sectional (secondary analysis)	N = 1108 undergraduate students from Malaysia (n = 444), Japan (n = 316) and India (n = 348) Mean age = s 22.04 (SD=3.05) 68.2% female	SSS-S Mini-Social Phobia Inventory
Timmerman, 2023, America	Cross-sectional	N = 386 undergraduate college students attending college in the northeastern United States Mean age = 19.59 (SD = 1.22) 60.88% Female	SSS-College Community CES-D State Anxiety Scale
Tran et al., (2023), Vietnam	Cross-sectional (not primary focus)	N = 664 Vietnamese Adults Mean age = 21.95 (SD=5.68) 72% female	SSS-Community and Vietnam Vietnamese version of the Depression, Anxiety, and Stress Scale (depression subscale)
Uecker & Wilkinson, 2020, America	Cross-sectional	N = 1528 young adult college graduates Mean age = 27.29 (SD = 1.50) 55.5% female	SSS-US CES-D 4-item, Likert anxiety scale, measuring agreement with the statements like “I worry about things.
Worthen et al., 2023, America	Cross-sectional	N = 338 public health students at a university in Northern California	SSS-US and SSS-C PHQ9

		Mean age = 22 (SD = 3.24) 77% female	
Yang et al., 2021, China	Cross-sectional	N = 1807 students Mean age = 20.25 (SD = 1.54). 44.1% Male	SSS-Youth version BDI
Zahodne et al., (2018), America	Longitudinal Secondary rather than primary focus	N = 8530 Mean age = 72.7 (SD = 6.1) 51.6% women	SSS-S CES-D
Zhang et al., (2023), China	Cross-sectional (secondary rather than primary focus)	N = 305 Heart failure patients Mean age = 64.41 (SD = 8.38) 60.7% male	SSS-Society and SSS-SES (scores combined) PHQ-9
Zou et al., 2016, China	Cross-sectional	N = 321 patients with heart failure Mean age = 63.6 (SD = 10.6) 51% male	SSS-S (in Chinese) Chinese version of the Depression Subsacle of the HADS
Zvolensky et al., 2020, America	Cross-sectional (non-primary focus)	N = 401 young Latinx college students Mean age = 21 (SD = 2.02) 83% female	SSS-C Inventory of Depression and Anxiety Symptoms (IDAS)
Zvolensky et al., 2023, America	Cross-sectional	N=205 Non-Hispanic Black adults Mean age =21.67 (SD = 5.39) 82.0% female	SSS-C IDAS
Zvolensky et al., (2024), America	Cross-sectional (not primary focus)	N = 1343	SSS-C IDAS

	Mean age = 21.28 (SD = 4.38) 81.1% female

Study Characteristics

Of the studies included in this review, the relationship between subjective social status and mental health was a primary focus for all bar seven papers. Most studies (*n* = 47) included a measure of depression but not anxiety, some included a measure of both anxiety and depression (*n* = 15), and only three included a measure of anxiety, but not depression. Most studies were cross-sectional (*n* = 54), with a limited number of longitudinal (n = 9), prospective (*n* = 1) and experimental papers (*n* = 1). The most frequently used ladder was the SSS-US ladder, which was used in 24 studies, followed by the community ladder in 23 studies. Eighteen studies utilised the society ladder and 6 used a ladder pertaining to the country wherein the research was conducted. For one paper it was unclear which ladder was used as the ladder described in the methods differed from the ladder described in the results (Lilly et al., 2018), for another paper it was also unclear which ladder was employed (Ropret et al.,2023).

The research included in this review was conducted in a variety of contexts and locations. Most of the research occurred in the USA (61.54%), with other locations including China, Germany, England, South Africa, Italy, Sweden, Slovenia, and Vietnam. Research considered many different populations, including the general population (or approximation of), students, asylum seekers and refugees, immigrants, adults across the life span (from young adulthood to older adulthood), adults in and out of work, mothers and other parents/caregivers, individuals accessing physical healthcare, individuals who had experienced a bereavement, and those who exhibit compulsive shopping behaviour. Early

work incorporating SSS into clinical work at a theoretical and practical level was also present.

Quality Assessment

Across the included papers, there was some variation in study quality, with key themes emerging regarding strengths and limitations of the evidence base. A summary of all studies in relation to the critical appraisal tools is available in appendix C and D.

Cross-sectional

Most papers had clearly described aims and objectives and target populations were clearly identifiable. Statistical analyses were well described and consistently reported, with clear identification of the applied significance level. Typically, outcome measures were used appropriately, meaning there was low risk of misclassification bias. There were some exceptions to this, for example where SSS was utilised as a proxy for OSES. Regarding weaknesses of the cross-sectional papers, the sample size was rarely justified, and the target population was frequently not represented in the sample and/or the selection procedure favoured certain demographics. Additionally, non-responders were rarely categorised. There were often issues of internal consistency, whereby the paper's reported *n* did not line up with results (e.g., within basic data), raising questions about what data is missing, why, and to what extent this introduces bias to the result.

Longitudinal Research

Strengths of this research base lie in its clear reporting of aims, hypotheses, and definition of the target population, sampling frame, study population and employed analyses. Generally, authors provided a qualitative assessment of bias within the study (e.g., through identifying limitations related to measures used or generalisability of the sample). Consistent with the cross-sectional research, weakness include insufficient justification of the sample

size. Additionally, there was inconsistent reporting the validity/reliability of measures and poor descriptions of consenters versus non-consenters. Lastly, there was frequently unclear or incomplete reporting of levels of, and reasons for, attrition.

Meta-analysis Results

Two random-effects meta-analyses (inverse variance weighted) were completed, one for outcomes relating to depression, another for outcomes relating to anxiety. Analyses were completed in R version 4.3.3, using the package 'Metafor'.

Depression

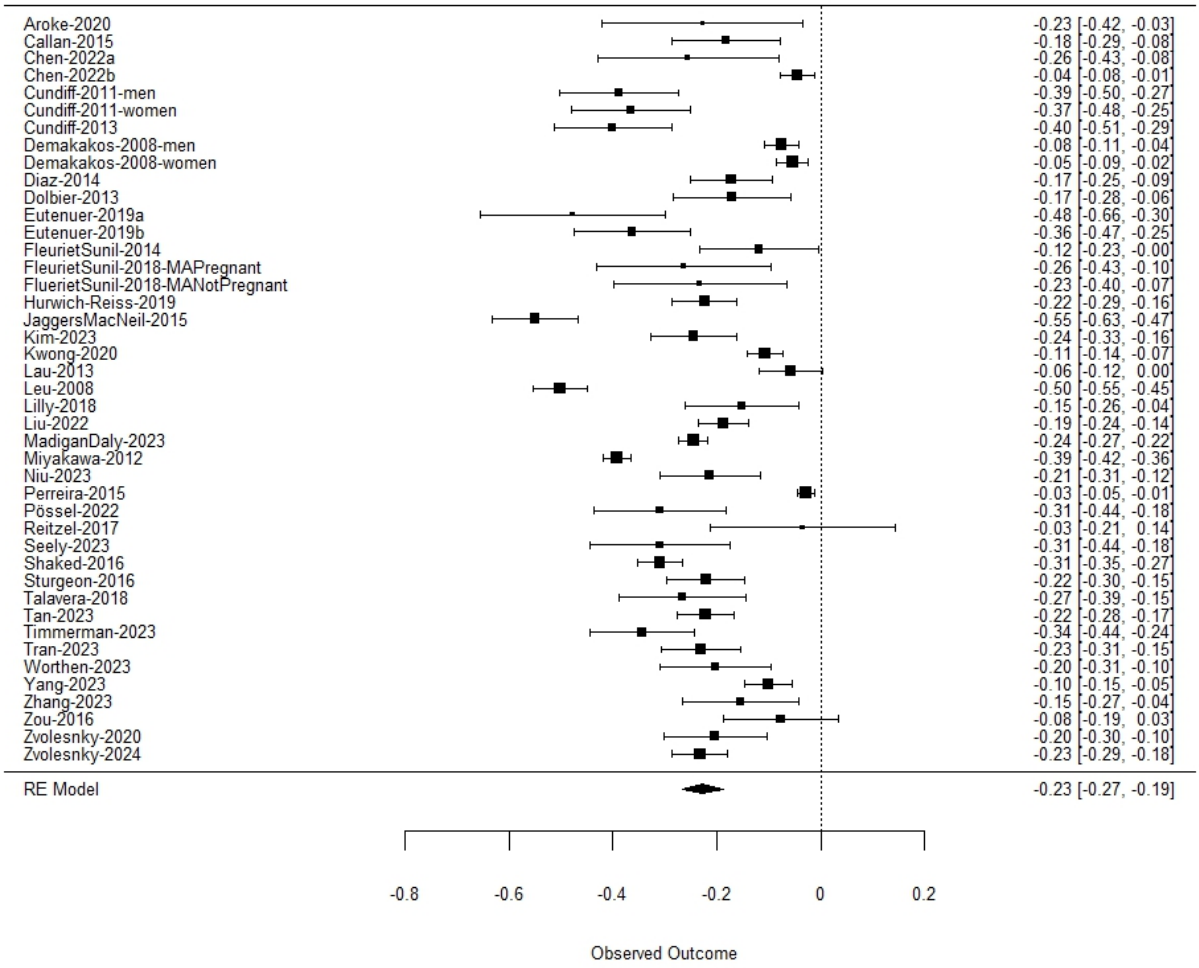
Over half of the studies in the systematic review included correlation coefficients (n = 34), accordingly, the meta-analyses were completed using correlation coefficients. Where correlation coefficients were unavailable, authors were emailed, which generated one additional correlation coefficient. It was possible to convert effect sizes from 12 studies which either reported standardized beta weights or odds-ratios.

Overall results

The data comprises of 40 studies with 43 effects (3 studies split results according to demographics), with a pooled total sample of 60213 participants. The meta-analysis revealed a significant but small negative association between subjective social status and depression (r_{avg} = -0.227, 95% CIs [-0.266, -0.188], $p < .001$), the forest plot is visible in figure 3.

Figure 3

Forest Plot for Subjective Social Status and Depression Meta-analysis



Tests of Heterogeneity

The tests of heterogeneity were significant (Q_{total} (42) = 1144.369, $p < .001$, I^2 = 94.94 0%). Because the I^2 value was above the 75% threshold, moderator analyses were conducted to assess the source of heterogeneity among the associations of SSS and depression.

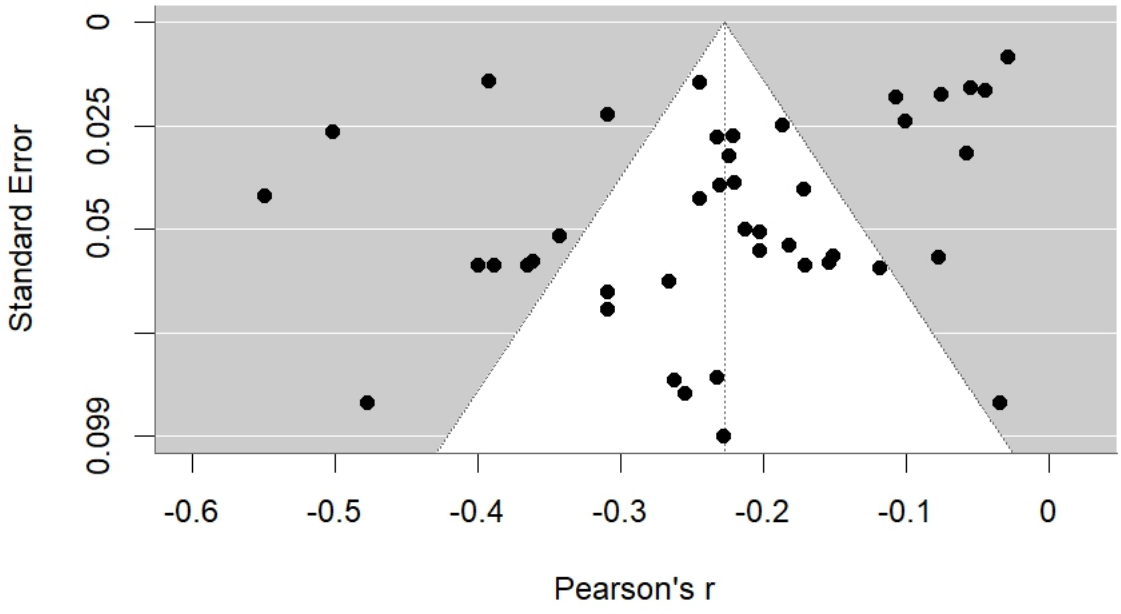
Publication bias

The fail-safe *N* analysis (Rosenthal's approach) found that 22928 studies with null results would be required to increase the significance level to greater than $p < .05$, which far

exceeds the limit of 65 identified by Rosenthal (1979). Fail-safe N analyses according to Orwin's approach identified that 87 studies with null results would be required to reduce the effect size to a negligible level (r = -0.051). Regarding the funnel plot (figure 4), visually there was some evidence of asymmetry, for example, many data points occur externally to the funnel itself and these appear to be spread across the graph (as opposed to datapoints reflecting one another symmetrically). However, Egger's regression test (Egger et al., 1997) was non-significant (although approaching significance; $t(41) = -1.87$, $p = 0.0557$) and no studies were identified according to the trim-and-fill method (indicated by no open circles in figure 3). Taken together, these results suggest an absence of publication bias.

Figure 4

Funnel Plot for Subjective Social Status and Depression Meta-analysis



Moderator Analyses

Two categorical moderators were examined: ladder type and study location. To avoid extremely imbalanced groups according to ladder type, the ladders were grouped as SSS-C (k = 14), SSS-US (k = 14), and SSS-Other (k = 15). The subgroup analysis suggested that ladder type was not a significant moderator ($Q(2) = 0.947$, $p = 0.623$). Regarding study location, to minimise imbalance in moderator groups as far as possible, location was categorized as either US (k = 30) or Non-Us (k = 14). The subgroup analysis suggested that study location was not a significant moderator ($Q(1) = 2.019$, $p = 0.1553$). Effect sizes for both subgroup analyses are available in table 2.

Table 2

Subgroup Analyses Results

Moderator	*k*	*n*	*r*	*95% CI*	Q_{model}(df)	I^2
Ladder Type					0.9470(2)	94.45%
SSS-US	14	28042	-0.2440	[-0.3137, -0.1743]		
SSS-C	14	12568	-0.1990	[-0.2687, -0.1294]		
SSS-Other	15	19603	-0.2375	[-0.3034, -0.1715]		
Country					2.0191(1)	94.37%
USA	30		-0.460	[-0.2925, -0.1996]		
Non-USA	14		-0.1865	[-0.2543, -0.1187]		

Note: SSS-US = Macarthur Ladder for US; SSS-C = Macarthur Community Ladder; SSS-S = Macarthur Society Ladder, SSS-Other = any other Macarthur Ladder used within the remaining studies.

In addition to categorical moderators, a meta-regression considered the influence of the continuous variable (mean) age on the association between SSS and depression. Not all studies reported the mean age (k = 33), it was possible to obtain weighted means for 4 papers, and accordingly this analysis was completed using a subsection of the data (k = 37). The

effect of the overall model was almost identical to the full model (r_{avg} = - 0.234, 95% CI [- 0.274, - 0.193], p < .001). When investigating age as a moderator of the relationship between SSS and depression, the results were non-significant (b = 0.0019 [-0.0006, 00.0043], $Q_m(1)$ = 2.298, p = 0.1295, $Q_r(35)$= 616.868, p = < .001). A sensitivity analysis was completed excluding the studies where weighted means were calculated, these results are described below.

Sensitivity analyses:

Two sensitivity analyses were completed. Firstly, to establish whether converting effect sizes distorted the relationship observed between SSS and depression, a sensitivity analysis was completed wherein the papers with converted effect sizes were excluded (k =12). After removing these studies, the association between SSS and depression was largely unchanged, (tending towards a slightly larger effect size: r_{avg} = - 0.251, 95% CIs [- 0.281, - 0.221], p < .001), supporting the decision to retain these studies in the meta-analysis.

Given that weighted means were calculated for 4 studies, a sensitivity analysis was conducted to ascertain whether including these converted means impacted upon the results. Regarding the overall effect size, the results were only marginally larger than the original, full model, and essentially the same as the same as the 'age' model (r_{avg} = - 0.249, 95% CIs [- 0.291, - 0.208], p < .001), and the test of moderation remained insignificant ($Q_M(1)$ = 0.5996, p = 0.539). These results suggest that reduced k was appropriate, and that including weighted means did not significantly bias the results.

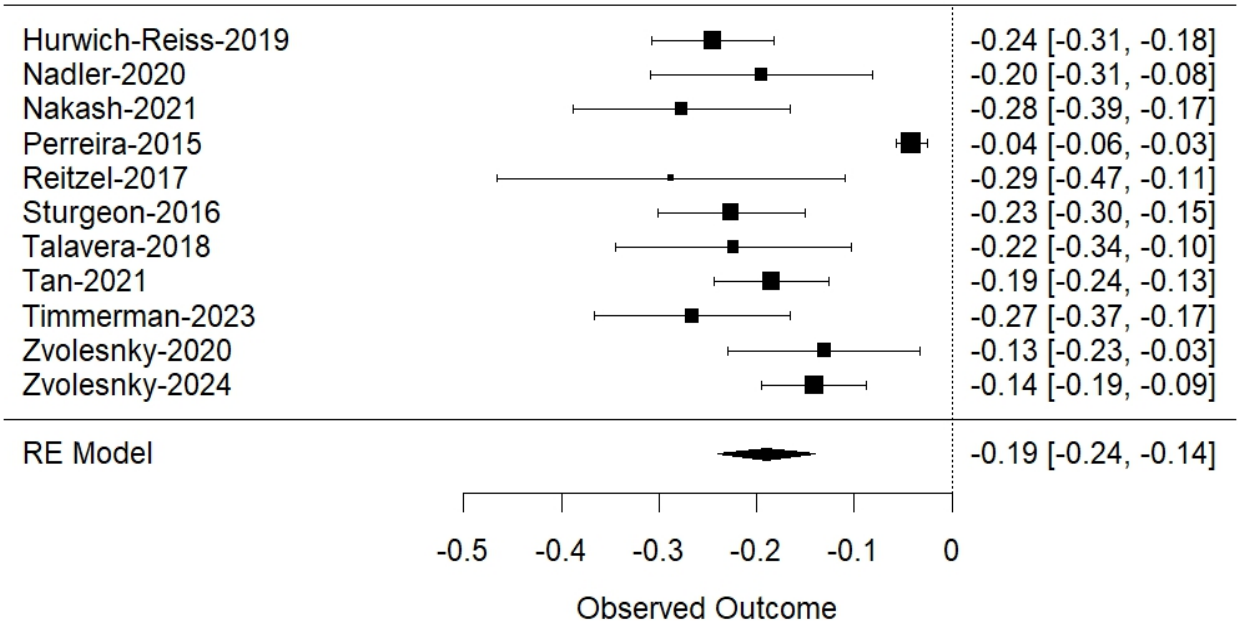
Anxiety

The data comprises of 11 studies with 11 effects, with a pooled total sample of 20910 participants, of these studies 9 were also included in the depression meta-analysis. The meta-analysis revealed a significant but small negative association between subjective social status

and anxiety (r_{avg} = -0.1902, 95% CIs [-0.2396, -0.1407], $p < .001$). The forest plot is available in figure 5.

Figure 5

Forest Plot for Anxiety and Subjective Social Status Meta-analysis



Tests of Heterogeneity

The tests of heterogeneity were significant (Q_{total} (10) = 120.4563, $p < .001$, I^2 = 82.96%). Because the I^2 value was above the 75% threshold, moderator analyses were conducted to assess the source of heterogeneity among the associations of SSS and anxiety.

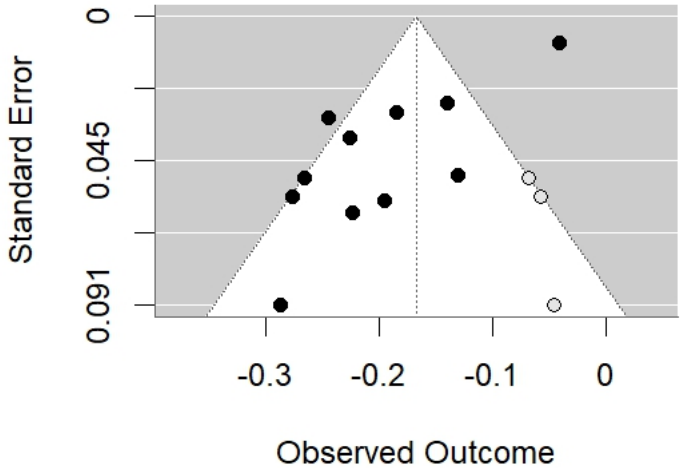
Publication Bias

The fail-safe *N* analysis found that 1020 studies with null results would be required to increase the significance level to greater than $p < .05$, which exceeds below the limit of 65 identified by Rosenthal (1979). Fail-safe N analyses according to Orwin's approach identified that 8 studies with null results would be required to reduce the effect size to a negligible level

(r = -0.051). Regarding the funnel plot (figure 6), visually there was some evidence of asymmetry and Egger's regression test (Egger et al., 1997) was significant ($t(9)$ = -3.696, p = 0. 005). Three studies were identified according to the trim-and-fill method (indicated by no open circles in figure 6). Taken together, these results suggest a presence of publication bias towards a larger effect.

Figure 6

Funnel Plot for Anxiety and Subjective Social Status Meta-analysis



Moderator Analysis

A single moderator analysis was run, which examined the impact of ladder type on the association between SSS and anxiety (table 3). To balance the categories, ladder type was classified as either SSS-C (k = *5)* or SSS-Other (k = *6).* The result of the subgroup analysis was insignificant ($Q(1)$ = 0.063, p = 0.801). Indicating that age did not moderate the relationship between SSS and anxiety.

Table 3

Subgroup Analysis Results for Ladder Type

	k	*n*	*r*	*95% CI*	Q_{model}(df) 0.063(1)	I^2 80.52%
SSS-C	5	3534	-0.198	-0.274, -0.122		
SSS-Other	6	17376	-0.185	-0.254, -0.116		

Note: SSS-C = Macarthur Community Ladder; SSS-Other = any other Macarthur Ladder used within the remaining studies.

Sensitivity Analysis

Consistent with the analyses regarding depression, a sensitivity analysis that removed papers which used converted effect sizes (k = 1) was completed. The overall effect was essentially unchanged, (r^{avg} = -0.207, 95% CI [-0.241, -0.172], $p < .001$), supporting the inclusion of this study within the analysis.

Narrative Synthesis

Given it was not possible to include all studies identified for the review (n = 65), in the meta-analysis, the following provides a brief overview of results which were not captured by the meta-analysis. For example, whilst the results of the meta-analysis indicated that ladder type did not moderate the relationship between SSS and depression/anxiety. However, a subsection of studies highlighted the possibility of a nuanced relationship between demographics, ladder type, and depression. Because the meta-analysis would have been underpowered to complete further subgroup analyses (i.e., ladder/demographic interaction effects), these results are described in this narrative synthesis.

Several studies reported that after adjusting for OSES, community but not national ladders influenced depressive symptoms (Diaz et al., 2014; Hamad et al., 2008; Hurwich-

Reiss et al., 2019; Michelson & Johnson, 2016); although it was notable that most other studies reported that after controlling for OSES, SSS remained a significant predictor. Seven studies reported on differences according to sex (Adler eta l., 2008; Chen et al., 2022b; Demakakos et al., 2008; Miykawa et al., 2012; Mutyambizi et al., 2019; Nyberg et al., 2019; Zahodne et al., 2018), with somewhat inconsistent patterns of results observed. For example, Miyakawa et al. (2012) found that after adjusting for OSES, SSS remained a significant predictor only for men, whilst Chen et al. (2022b) found that after accounting for OSES, negative association between depressive symptoms and the community ladder were strongest amongst women. Similarly, when considering the impact of race, ethnicity, or nativity, SSS appeared to have differential effects within different contexts. For example, Fleuriet & Sunil's (2014) paper reported that the correlation between SSS and depressive symptoms was only significant for Mexican Americans, not Mexican Immigrants, and Uecker & Wilkinson (2020) reported that the negative association between SSS and depressive symptoms is stronger for Hispanic individuals than for White individuals, however the negative association between anxiety symptoms and SSS is not maintained for Hispanic participants.

Other Factors Relating to SSS and Mental Health (moderating and mediating effects)

Subjective Social Status and Childhood Trauma

Two studies highlighted that childhood trauma may either moderate (Chen et al., 2022a) or mediate (Yang et al., 2021) to some extent, the association between SSS and depressive symptoms.

Subjective Social Status Attenuates Other Variables

High SSS was found to moderate (specifically, attenuate) the development of depression when family-work conflict increased for medical workers (Tan et al., 2023); For

Chinese Immigrant Mothers in the US, upward shifts in SSS mediated the association between English Proficiency and depressive symptoms (Chen et al., 2021).

Subjective Social Status and Cognitive Factors

Several cognitive factors were identified as having either a moderating or mediating effect on the relationship between SSS, anxiety, and depressive symptoms. Seely et al. (2023) identified that negative cognitive style moderated the relationship between SSS and depressive symptoms; Specifically, lower SSS was related to higher depressive symptoms when negative cognitive style was higher. Talavera et al. (2018) found that rumination moderated the relationship between SSS and both depressive and social anxiety symptoms, whereby the impact of rumination on depression was higher for those with lower SSS; this relationship did not hold for symptoms relating to anxious arousal. Reitzel et al. (2017) found that anxiety sensitivity appeared to moderate the relationship between SSS-C and SSS-US and anxiety symptoms; for depressive symptoms, anxiety sensitivity only moderated the relationship between SSS-US. Regarding mediation, Timmerman et al. (2023) noted that hypervigilance mediated the relationship between SSS, anxiety and depressive symptoms; Specifically, lower SSS was associated with greater hypervigilance and greater hypervigilance was associated with more significant symptoms of anxiety and depression. Lastly, in addition to finding a direct effect of SSS on depressive symptoms, Pössel et al.'s (2022) mediation analyses indicated that SSS has an indirect effect on depressive symptoms via negative views of the self and world.

Other Variables Accounting for The Relationship Between SSS and Depression

Other studies indicated that in some contexts, the relationship between SSS and depressive symptoms could be entirely mediated by other factors. Two factors were health related: Zou et al. (2016) found that health literacy entirely mediated the relationship between

SSS and depressive symptoms for patients with heart failure, and Liu et al. (2022) found that SSS was only negatively associated with depressive symptoms for those reporting low COVID-19 related health worries. Callan et al. (2015) found that Personal Relative Deprivation entirely dominated the relationship between SSS and depression. Lastly, some research also indicated that the relationship occurred in the other direction, whereby depressive symptoms predicted SSS (Garbarski et al., 2010).

Social Status Mobility

Eight studies reported on social status mobility, which refers to changes in social status from one timepoint and/or location to another. Kim et al. (2023), Jin & Tam (2015), and Niu et al. (2023) cross-sectionally assessed the association between changes in SSS between childhood and adulthood. Whilst Niu's paper did not identify a downward trajectory in SSS, for those experiencing downward mobility in Kim's sample, depressive symptoms were greater than those experiencing stable or upward trajectory. Both studies found that upward trajectories of SSS (i.e., SSS improving) were also associated with increased depressive symptoms. Jin & Tam (2015) reported that downward shifts in SSS were only associated with frequency of depressive symptoms for participants living in rural areas.

Euteneuer et al. (2019) established the extent to which participants' SSS had changed according to new life circumstances (single-motherhood and unemployment), finding that when individuals perceived their SSS to have decreased due to their circumstances (i.e., a form of downward mobility) depressive symptoms increased. This association was greater than the relationship between current SSS and depressive symptoms.

The remaining studies (Alcántara et al., 2014; Costa et al., 2020; Euteneuer & Schäfer, 2018; Nicklett & Burgard, 2009) examined the relationship between mental health and changes in SSS between a country of origin and current country. All studies found that downward mobility increased the likelihood of having experienced depression or having

increased depressive symptoms. Costa et al., (2020) also noted that anxiety increased as SSS mobility decreased. Alcántara et al. (2014) found that the strength of association differed according to subethnicity; these results were highlighted earlier in this review.

Discussion

To update and extend previous research, this paper completed both a systematic review and meta-analysis, synthesizing and analysing research investigating the relationship between subjective social status (measured by the Macarthur Ladder) and anxiety and depression. In total, 65 papers were included in the systematic review; a subsection of these papers were eligible for the meta-analyses (depression meta-analysis: $k = 41$; anxiety meta-analysis: $k = 11$).

Summary of Findings in Relation to Prior Reviews/Meta-analyses

In keeping with prior reviews (e.g., Wetherall et al., 2019; Zell et al., 2018), low SSS is associated with increased anxiety and depressive symptoms. The meta-analyses indicated the effect was statistically significant but small; the effect size for anxiety was marginally smaller, however both fell within the same magnitude of effect according to Cohen (1992), and confidence intervals overlapped. Accordingly, it is possible to say with some certainty that overall, SSS likely has a similarly small association across anxiety and depression. The visual and statistical analyses of heterogeneity indicated there was slightly less heterogeneity for data concerning anxiety (e.g., lower I^2 statistic). This may partly be due to less heterogeneity in the sample frame (all participants were either young/working age adults) and the ladder type included. Publication bias analyses indicated that the results for the depression model were likely much less susceptible than those of anxiety, for which there appeared to be quite a significant risk of bias.

The meta-analyses included in this paper extend prior research by focussing specifically on anxiety and depression, as opposed to mental wellbeing (Tan et al., 2020) or an aggregation of mental health disorders (Zell et al., 2018). Whilst the effect size of this paper's meta-analyses were in keeping with the meta-analysis pertaining to mental wellbeing (r = .22; k = 586; Tan et al., 2020), they differed from a meta-analysis examining the relationship between SSS and mental health more broadly. Specifically, in Zell et al.'s (2018) meta-analysis, the observed effect of SSS on mental health (k = 162) was much smaller (r = .13 and .11 for the community and society ladder respectively). There are several ways of contextualising the different results. Firstly, Zell et al. aggregated multiple measures of 'mental health' and conducted the meta-analyses separately for each ladder, whereas the present paper distinguished between disorders and considered ladder type as a moderator. Given the moderator analysis for ladder type was non-significant, it could be that anxiety and depressive disorders are more susceptible to the impact of SSS than other outcomes included in Zell's meta-analysis (e.g., cognitive impairment).

Zell et al. also included participants under the age of 18, noting a stronger relationship between SSS and mental health in older participants. This is consistent with research indicating that SSS may become more relevant, and therefore more impactful, in adulthood (particularly middle-age; Weiss & Kunzman, 2020). The present paper's meta-regression examining the impact of age was non-significant. As this meta-analysis only included adult participants, a slightly larger effect size may be expected, with age exerting less influence over the relationship between SSS and anxiety/depression when compared to Zell et al.'s results.

Interestingly, this meta-analysis did not replicate Zell et al.'s finding that study location moderated the relationship between SSS and mental health. Their analyses found that North American studies had a more pronounced relationship between SSS and mental

health, however the present subgroup analyses did not identify study location (US vs non-US) as a significant moderator. However, it should be noted that collapsing all non-US studies is a limitation of the present paper, as there may be significant heterogeneity within these papers that cannot adequately be captured through their aggregation. Lastly, Zell et al. completed 10 moderation analyses each for the society and community ladder (i.e., 20 analyses in total); whilst they had 162 effects for mental health, these were not independent, as multiple effects were extracted from single studies (study $k = 26$). Accordingly, their analyses may be underpowered and susceptible to type 1 errors, meaning some of their findings could be due to chance.

Overall Quality of Evidence

Overall, there were consistent limitations in relation to sampling and non-response, which suggest the evidence base may be susceptible to selection bias and/or non-response bias. Accordingly, there may be issues with generalising from the included studies. An additional limitation which occurred across most studies was the absence of power analyses and sample size justifications, which were present in only 12% of papers. Whilst in principle this may not be an issue for studies with notably large sample sizes (e.g., Ropret et al., 2023), for smaller samples, particularly those with multiple analyses, there is increased risk of type one errors. For example, Fleuriet & Sunil (2018) report multiple correlations for the same variables, whilst splitting the sample in different ways. Such an approach may warrant a Bonferroni corrected p-value; however significant correlations were identified at $p < .05$. Of note, the studies which reported power analyses consistently identified a statistically significant association between SSS and mental health.

Despite variation in the quality of some studies, this did not appear to translate to a pattern whereby weaker studies reported noticeably larger effect sizes. For example, in

studies which were identified as having less risk of bias across many domains, correlation coefficients were generally equivalent to studies of lower quality. Indeed, the largest reported effect size (in terms of correlation coefficients) was r = -.444, in Euteneuer & Schäfer's (2019) sample of single mothers, whilst the smallest effect sizes were closer to r = .10 (e.g., Yang et al., 2021; Zhang et al., 2023). Whilst there was greater evidence of risk of bias within Yang et al.'s (2021) paper, the risk of bias within Zhang et al.'s (2023) and Euteneuer & Schäfer's (2019) papers appeared to be equivalent to most included studies.

Evidence Synthesis

SSS Mobility and Mental Health

The findings from studies examining SSS mobility consistently found that downward shifts from childhood, country of origin, and life circumstances were negatively associated with depressive and anxiety symptoms (Kim et al., 2023; Jin & Tam, 2015; Euteneuer et al., 2019; Alcántara et al., 2014; Costa et al., 2020; Euteneuer & Schäfer, 2018; Nicklett & Burgard, 2009). There was also evidence suggesting that upwards shifts were negatively associated with depressive symptoms (Kim et al., 2023; Niu et al., 2023). This is in keeping with a recent systematic review of OSES mobility, which found both downward and upward shifts have a small, but significant, negative relationship with mental health (Islam & Jaffee, 2024).

SSS, Mental Health, and Potential Moderating/Mediating Factors

As highlighted above, the meta-analysis indicated that the effect of SSS does not appear to be moderated by which ladder is used (for anxiety and depression), nor where the research was conducted, nor what age participants were (for depression). However, when considering the results across included studies there appeared to be some variation in the strength of the relationship between SSS and mental health, according to the intersection of ladder type and

demographic variables. For instance, gender disparities were observed, with SSS-C typically exhibiting a larger effect on depressive symptoms for women compared to men (Cundiff et al., 2013; Chen et al., 2022b). Similarly, race, ethnicity, and nativity further influenced the predictive power of SSS ladders on depressive and anxiety symptoms, with research tending to find a more consistent or influential relationship between SSS-C and symptoms for Hispanic and Black participants (e.g., Fleuriet & Sunil, 2018; Michelson & Johnson, 2016).

Research pertaining to moderating and mediating factors indicated a complex relationship between SSS, other determinants of mental health, and cognitive variables. When measures of OSES were included in analyses, the relationship between SSS and anxiety/depressive symptoms generally persisted. These results are in keeping with research suggesting that the Macarthur ladders assess more than an individual's OSES (e.g., Galvan et al., 2023) and gives weight to assertions that the ladders demonstrate adequate construct validity. Of the cognitive variables assessed, negative cognitive style and rumination mediated the relationship between SSS and depression, whilst anxiety sensitivity and hypervigilance moderated the relationship between SSS, depression, and anxiety.

To avoid underpowered analyses, the quantitative assessment of mediating/moderating variables discussed above were not conducted. However, it could tentatively be speculated that the findings indicate an interaction, whereby the relationship between SSS and depression/anxiety is impacted by intersecting identity characteristics, which can be influenced by a range of social (e.g., OSES) and cognitive factors. A possible explanation for the findings is that the concept of SSS relies partially on cognitive style, alongside personal context. From this perspective, it makes sense that individual factors did not moderate the relationship between SSS and anxiety/depression within the present meta-analyses. Moreover, if the association between mental health symptoms and SSS is reliant on how SSS intersects with personal context, this may also explain why concepts which are unlikely to be

universally relevant (e.g., health literacy; Zou et al., 2016) play a significant mediating role for some demographics (i.e., patients with heart failure). With further research, it may be possible to compare the impact of individual moderators with interacting moderators across the evidence base.

Clinical Implications

There is growing interest in understanding how to incorporate the impact of social determinants of mental health in clinical work (Pauling et al., 2023). It has been suggested that SSS could be integrated into cognitive theories of depression and may represent a target for clinical or policy level intervention (e.g., Pössel et al., 2022; Galvan et al., 2023; Zvolesnky et al., 2015). The findings of this review highlight questions concerning whether/how to target SSS in therapies for depression and/or anxiety. Whilst the overall effect sizes were significant for depression and anxiety, they were also small and, for anxiety particularly, susceptible to publication bias. This could indicate that whilst SSS is associated with depressive and anxiety symptoms, it may not be the most impactful target in therapy. Several cognitive variables were implicated in the relationship between SSS and depression and anxiety: negative cognitive style (NCS) was uniquely predictive of depression and interacted with SSS, where those reporting low SSS and moderate to high NCS had greater depressive symptoms (Seely et al., 2023). Meta-analyses typically find that maladaptive cognitive styles (e.g., 'interpretation biases') significantly impact depression, with medium effect size (Everaert et al., 2017; Nieto et al., 2020). It may be preferable to target NCS specifically, as it is currently unclear from the literature whether this may generate changes in SSS and, consequently, symptoms of anxiety/depression.

There may be alternative ways in which the concept of SSS can inform clinical practice. Nakash et al. (2021) found that divergence between therapist and client SSS ratings

correlated with poorer working alliance, which resulted in heightened anxiety symptoms. These results could reflect recommendations that therapists must understand and adjust to how the client's context shapes their life experiences and influences their mental health, as means of enabling the therapeutic relationship (Pauling et al., 2023). Perhaps a better clinical application of the concept of SSS is to use it to understand diversity within the therapeutic relationship, and when/how this can cause challenges to therapeutic work.

In sum, it may be preferable to consider SSS's impact at an indirect level (e.g., in relation to the therapeutic relationship and cognitive style) rather than a direct level. However, given the extremely early nature of this work, conclusions should be considered tentative.

Limitations

Several limitations bear consideration. Regarding evidence included within this paper, most was cross-sectional, and there was a distinct paucity of longitudinal research concerning anxiety symptoms. Accordingly, conclusions regarding the causal relationship between low SSS and anxiety are limited. There were also methodological limitations identified in the quality appraisal which highlighted the risk of type one errors within the evidence base and potential limitations in generalising findings to target populations. Regarding the methodology of this paper, grey literature was not included, meaning the review may be more susceptible to publication bias (although this risk is somewhat quantified by the publication bias assessment in the meta-analysis). The use of different tools for assessing risk of bias make it harder to draw like-for-like comparisons of the quality of evidence across study designs. Concurrently, no independent ratings of the risk of bias were conducted. In addition, full-text screening was only completed by one reviewer. Lastly, the inclusion criteria that specified studies should only include anxiety and depression measures, and not externalising

measures, resulted in a narrower review of available evidence (although notably the number of studies included in this review is double that of the most recent review by Wetherall et al., 2019).

Future Research

The results of this review highlight several gaps in the literature, which future research may wish to consider. Further longitudinal research is necessary: there was no longitudinal research concerning anxiety and regarding depression; It may be that researchers seek to prioritise young-to-middle aged adulthood, as most longitudinal studies were focussed on older adults. Given the utility of experimental research in establishing causality, further research in depression that includes samples other than students would be useful, and the evidence base would benefit from any experimental research regarding anxiety. To allow for more confident conclusions regarding study location as a moderator, further research in other countries (e.g., England) would be beneficial. Lastly, further research concerning how SSS is associated with clinical interventions, particularly in relation to the working alliance, is warranted.

Summary

This systematic review and meta-analysis found a largely consistent relationship between SSS and anxiety and depression, whereby lower SSS resulted in increased symptoms/prevalence of depression and anxiety. Whilst most research was cross-sectional, the presence of experimental and longitudinal work allows for tentative conclusions regarding causality with depression, but not anxiety. However, this should be considered in the broader context of the literature, which included some evidence that the relationship may occur bi-directionally. Additionally, when synthesizing the 65 studies identified for the review, it appeared that the association between SSS and mental health may differ according

to the intersection of different demographics, alongside which aspect of SSS (society/community/national etc.) is assessed. However, the meta-analytic moderator analyses suggested that at least some of these variables (age, ladder type) may not have a statistically significant influence. Accordingly, conclusions about the specific relationships or interactions between SSS, anxiety/depression, and demographic variables are limited and warrant further investigation.

Appendices

Appendix A

Prisma Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pages 4 - 9
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 9
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 10
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 10
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Pages 10 - 11
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 11
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 12
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 12
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 12
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 12
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 12

Section and Topic	Item #	Checklist item	Location where item is reported
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 13
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 13
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 13
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 13
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 13
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 14
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	NA
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 13
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Pages 11 and 14
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Summary diagram, page 11
Study characteristics	17	Cite each included study and present its characteristics.	Pages 15 – 28
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 29 (plus appendices)
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	NA following discussion with supervisor
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 29
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Pages 30 and 34.
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Pages 31 and 35

Section and Topic	Item #	Checklist item	Location where item is reported
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Pages 34 and 37
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	NA
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Summary effect sizes reported (pages 30 and 34)
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Pages 41 – 43
	23b	Discuss any limitations of the evidence included in the review.	Pages 43
	23c	Discuss any limitations of the review processes used.	Page47
	23d	Discuss implications of the results for practice, policy, and future research.	Page 46
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 10
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Details contained in prospero
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Appendix B
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	NA
Competing interests	26	Declare any competing interests of review authors.	NA
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	NA

Appendix B

Revisions to Protocol

Originally it was stated that discrepancies in screening at abstract/title level would be discussed between the two reviewers. The second reviewer was pregnant and accordingly to reduce the load on her, a third reviewer was brought in to discuss discrepancies.

Appendix C

Cross-sectional Critical Appraisal Tool and Results

Note: the questions are numbered 1 – 20 and these are reflected in the results table below.

	Question	Yes	No	Don't know/ Comment
Introduction				
1	Were the aims/objectives of the study clear?			
Methods				
2	Was the study design appropriate for the stated aim(s)?			
3	Was the sample size justified?			
4	Was the target/reference population clearly defined? (Is it clear who the research was about?)			
5	Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?			
6	Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?			
7	Were measures undertaken to address and categorise non-responders?			
8	Were the risk factor and outcome variables measured appropriate to the aims of the study?			
9	Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?			
10	Is it clear what was used to determined statistical significance and/or precision estimates? (e.g. p-values, confidence intervals)			
11	Were the methods (including statistical methods) sufficiently described to enable them to be repeated?			
Results				
12	Were the basic data adequately described?			
13	Does the response rate raise concerns about non-response bias?			
14	If appropriate, was information about non-responders described?			
15	Were the results internally consistent?			
16	Were the results presented for all the analyses described in the methods?			
Discussion				
17	Were the authors' discussions and conclusions justified by the results?			
18	Were the limitations of the study discussed?			
Other				
19	Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?			
20	Was ethical approval or consent of participants attained?			

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Adler, 2008	Yes	Yes	No	Yes	Yes	Unclear	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Alcántara, 2014	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - not discussed	Yes	Yes	Yes	Yes	No	Yes
Aroke, 2020	Yes	Yes	No	yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA	Yes	Yes	Yes	Yes	No	Yes
Callan, 2015	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	Yes	NA - not discussed	Not discussed	Unclear	Yes	Yes	Yes	No	Yes

Chen, 2021	Yes	yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	Na	Yes	Yes	Yes	Yes	No	Yes
Chen, 2022b	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - not discussed	Yes	Yes	Yes	Yes	No	Yes
Costa, 2020	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Comment - lots mentioned but doesn't discuss the missing data or any reason for that	No	Yes
Cundiff, 2011																				
Cundiff, 2013	Yes	Yes	No	No	Unclear	Unclear	No	Yes	Yes	Yes	Yes	Yes	Unclear	No	Yes	Yes	Yes	Yes	No	Yes
Demakakos, 2008	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	NA - not discussed	No	No	Unclear	Yes	Yes	No	Yes

Euteneuer & Schäfer, 2018	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	no	Unclear	Yes	Yes	Yes	No	Yes
Euteneuer, 2019	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes but the measure of discrepancy is new and there was no reporting reliability	Yes	Yes	Yes	NA - not discussed	No	Unclear from reporting	Yes	Comment - but possibly slightly overstated, could've acknowledged limitation of sample size etc.	Yes	No	Yes
Fleuriet & Sunil, 2014	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	NA - not discussed	No	No	Yes (but ES not noted)	Yes	Yes	No	Yes
Fleuriet & Sunil, 2018	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	NA - not discussed	No	Unclear based on reporting	Yes	Yes	Yes	No	Yes
Hamad, 2008	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Unclear from reporting	Yes	Yes	Yes	No	Yes

Hoebel, 2017	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	Comment - it's discussed in the dicussion and suggest that there was a significant level of non-response	Yes	Yes	Yes	Yes	No	Yes
Hurwich-Reiss, 2019	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA	Yes	Yes	Yes	Yes	No	Yes
Jaggers & MacNeil, 2015	Yes	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	NA – not discussed	NA - not discussed	Yes	Yes	Yes	Yes	No	Yes
Jin & Tam, 2015	Yes	Yes	No	No	Unclear	Unclear	Unclear	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	yes	yes	No	Yes

John-Henderson, 2013	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	No	Yes	NA - not discussed	NA - not discussed	Unclear based on reporting	Yes	NA - secondary result not discussed	Yes	No	Yes
Kim, 2023	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - not discussed	NA - can't establish that based on the information provided	Yes	Yes	Yes	Unclear	Yes
Lau, 2013	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	yes	No	Yes	NA - not discussed	NA	NA - can't establish that based on the information provided	NA	Yes	yes	No	Yes
Leu, 2008	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA	Yes	Yes	Yes	Yes	No	Yes
Lilly, 2018	Yes	Yes	No	Yes	No	No	No	No	Unclear	Yes	Yes	Yes	NA - not discussed	Not discussed	No	Yes	Yes	Yes	Unclear	Yes
Liu, 2022	Yes	Yes	No	Yes	Yes	Maybe	Yes (in limitations)	Yes	Yes	Yes	Yes	Yes	Yes	NA	Unclear	Yes	Yes	Yes	No	Yes

Lorini, 2023	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Michelson & Johnson, 2016	Yes	Yes	No	Yes	No - one urban area	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes
Miyakawa, 2012	Yes	Yes	Yes	Yes	Yes	Yes	Comment - yes in general terms but not in relation to who didn't answer the SSS measure	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes
Mutyambizi, 2019	No	Unclear	No	Yes	Not reported in this paper (original study not linked)	Not reported in this paper	Not reported in this paper	Yes	Yes	No	Yes	Yes	NA - not discussed	NA	Yes	Yes	Yes	Yes	No	Yes

Nadler, 2020	Yes	Yes	Yes	No	NA	NA	No	Yes	Yes	Yes	No	Yes	NA - not discussed	Yes	NA - can't establish that based on the information provided	NA	Yes	Yes	Unclear	Yes
Nakash, 2021	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	NA - not discussed	No	yes	Yes	Yes	Yes	No	Yes
Nicklett & Burgard, 2009	Yes	Yes	No	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Niu, 2023	Yes	No	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Perreira, 2015	Yes	yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No	NA	Yes	Yes	Yes	Yes	No	Yes
Pössel, 2022	Yes	Yes	No	No	NA	NA	No	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Rarick, 2018	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - Not discussed	NA - can't establish	Yes	Yes	Comment - but didn't mention sample limitation	Unclear	Yes

Reitzel, 2017	Yes	Yes	Comment - reported advised n but not method for obtaining this	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes

Ropret, 2023	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Ucnlear	Yes	Yes	Comment - don't discuss that the removal of people identifying as 'other gender' and small response rate from this population anyway is a limitation, in addition to the nonresponders described previously	No	Yes
Schubert, 2016	Yes	Yes	Yes	No	NA	NA	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - not discussed	Yes	Yes	Yes	Yes	No	Yes

Seely, 2023	Yes	Yes	No	No	NA	NA	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA - not discussed	Na - not reported in a way that you can establsih	Yes	Comment - could have discussed that the direct results aren't in keeping with lots of other literature)	Yes	No	Yes
Shaked, 2016	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Unclear based on reporting	Yes	Yes	Yes	No	Yes
Sturgeon, 2016	Yes	Yes	No	Yes	No	Not clear	Not discussed	Yes	No	Yes	Yes	Yes	NA - not discussed	NA - not discussed	Yes	Yes	NA - secondary result not discussed	Yes	No	Yes

Talavera, 2018	Yes	Yes	No	Yes	Yes	Unclear	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	Not discussed	NA - can't establish that based on the information provided, missing data not discussed	Yes	Yes	Yes	No	Yes
Tan, 2021	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	No	No	NA - not discussed	NA	Unclear	Yes	NA - secondary result not discussed	Yes	No	Yes
Tan, 2023	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Unclear	NA - not discussed	No	No	Yes	Yes	Yes	No	Yes
Timmerman, 2023	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes
Tran, 2023	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Unclear - possibly overstated	No	No	Yes
Uecker & Wilkinson, 2020	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	yes	Yes	Yes	NA - not discussed	NA	Yes	Yes	Yes	Yes	No	Yes

Worthen, 2023	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No	Yes	Yes	Yes, but only briefly, could've done with more attention paid to it	No	Yes
Yang, 2021	Yes	Yes	No	No	Unclear	Unclear	No	No	No	Comment: Partially - described for SEM but not the rest	Yes	Yes	NA - not discussed	NA - not discussed	Yes	Yes	No	Yes	No	Yes
Zhang, 2023	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes
Zou, 2016	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes
Zvolesnky, 2020	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	Yes	Yes	Yes	Yes	No	Yes
Zvolensky, 2023	Yes	Yes	No	Yes	No - university population	Yes	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	NA	NA - not described them in a way you could clarify	Yes	Yes	Yes	No	Yes

Zvolensky, 2024	Yes	Yes	No	Yes	No	Unclear - sampling process isn't described.	No	Yes	Yes	Yes	Yes	Yes	NA - not discussed	No	No	Yes	Yes	Yes	No	Yes

Appendix D

Longitudinal Risk of Bias Tool and Results

Criterion	Definition
1. Are the objectives or hypotheses of the study stated?	Self-explanatory.
2. Is the target population defined?	The group of persons toward whom inferences are directed. Sometimes the population from which a study group is drawn.
3. Is the sampling frame defined?	The list of units from which the study population will be drawn. Ideally, the sampling frame would be identical to the target population, but it is not always possible.
4. Is the study population defined?	The group selected for investigation.
5. Are the study setting (venues) and/or geographic location stated?	Comment required about location of research. Could include name of center, town, or district.
6. Are the dates between which the study was conducted stated or implicit?	Self-explanatory.
7. Are eligibility criteria stated?	The words "eligibility criteria" or equivalent are needed, unless the entire population is the study population.
8. Are issues of "selection in" to the study mentioned?†	Any aspect of recruitment or setting that results in the selective choice of participants (e.g., gender or health status influenced recruitment).
9. Is the number of participants justified?	Justification of number of subjects needed to detect anticipated effects. Evidence that power calculations were considered and/or conducted.
10. Are numbers meeting and not meeting the eligibility criteria stated?	Quantitative statement of numbers.
11. For those not eligible, are the reasons why stated?	Broad mention of the major reasons.
12. Are the numbers of people who did/did not consent to participate stated?	Quantitative statement of numbers.
13. Are the reasons that people refused to consent stated?	Broad mention of the major reasons.
14. Were consenters compared with nonconsenters?	Quantitative comparison of the different groups.
15. Was the number of participants at the beginning of the study stated?	Total number of participants (after screening for eligibility and consent) included in the first stage of data collection.
16. Were methods of data collection stated?	Descriptions of tools (e.g., surveys, physical examinations) and processes (e.g., face-to-face, telephone).
17. Was the reliability (repeatability) of measurement methods mentioned?	Evidence of reproducibility of the tools used.
18. Was the validity (against a "gold standard") of measurement methods mentioned?	Evidence that the validity was examined against, or discussed in relation to, a gold standard.
19. Were any confounders mentioned?	Confounders were defined as a variable that can cause or prevent the outcome of interest, is not an intermediate variable, and is associated with the factors under investigation.
20. Was the number of participants at each stage/wave specified?	Quantitative statement of numbers at each follow-up point.
21. Were reasons for loss to follow-up quantified?	Broad mention and quantification of the major reasons.
22. Was the missingness of data items at each wave mentioned?	Differences in numbers of data points (indicating missing data items) explained.
23. Was the type of analyses conducted stated?	Specific statistical methods mentioned by name.
24. Were "longitudinal" analysis methods stated?	Longitudinal analyses were defined as those assessing change in outcome over two or more time points and that take into account the fact that the observations are likely to be correlated.
25. Were absolute effect sizes reported?	Absolute effect was defined as the outcome of an exposure expressed, for example, as the difference between rates, proportions, or means, as opposed to the ratios of these measures.
26. Were relative effect sizes reported?	Relative effects were defined as a ratio of rates, proportions, or other measures of an effect.
27. Was loss to follow-up taken into account in the analysis?	Specific mention of adjusting for, or stratifying by, loss to follow-up.
28. Were confounders accounted for in analyses?	Specific mention of adjusting for, or stratifying by, confounders.
29. Were missing data accounted for in the analyses?	Specific mention of adjusting for, or stratifying by, or imputation of missing data items.
30. Was the impact of biases assessed qualitatively?	Specific mention of bias affecting results, but magnitude not quantified.
31. Was the impact of biases estimated quantitatively?	Specific mention of numerical magnitude of bias.
32. Did authors relate results back to a target population?	A study is generalizable if it can produce unbiased inferences regarding a target population (beyond the subjects in the study). Discussion could include that generalizability is not possible.
33. Was there any other discussion of generalizability?	Discussion of generalizability beyond the target population.

	Chen et al. (2022a)	Collins & Goldman (2019)	Diaz et al. (2014)	Dolbier (2013)	Garbarski et al. (2010)	Kwong et al. (2020)	Madigan & Daly (2023)	McGovern & Nazroo (2015)	Nyberg et al. (2019)	Zahodne et al. (2020)
Aims/hypotheses stated	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Target population define	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sampling frame defined	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Study population defined	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Study settings stated	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Dates stated/implicit	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Eligibility criteria stated	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Issues of 'selection' mentioned	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No
Sample justified	No	No	No	No	No	No	No	No	No	No
Numbers meeting and not meeting eligibility criteria stated?	No	Yes	No	No	No	No	No	No	No	No
If not eligible, reasons stated?	No	No	No	No	No	No	No	No	No	No
Are the reasons people refused to consent stated?	No	Yes	No	No	No	No	No	No	No	No
Were consenters compared with non-consenters?	No	Yes	No	No	No	No	No	No	No	No
Was the number of participants at the	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes

beginning of the study stated?										
Were methods of data collection stated?	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Was the reliability of measurements methods mentioned?	Not for all measures	Yes	No	Not for all measures	No	No	Not for all measures	No	No	Not all
Was the validity of measurement methods mentioned?	Not for all measures	Yes	No	Not for all measures	No	Not all	Not for all measures	No	No	Not all
Confounders mentioned?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of participants at each wave specified?	No	Yes	No	No	No	Yes	Yes	Yes	Yes	No
Reasons for loss to follow up quantified?	No	Yes	No	Yes	No	Yes	No	No	No	No
Missingness of data at each wave mentioned?	No	Yes	No	No	Yes	No	No	Yes	No	Yes
Type of analyses conducted stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were 'longitudinal' analysis methods stated?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Absolute effect sizes reported?	Yes	No	No	Yes	No	Yes	No	No	Yes	Yes
Relative effect sizes reported?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loss to follow-up taken into	No	Yes	No	No	No	No	Yes	NA (excluded)	NA	No

account in the analysis?										
Confounders accounted for in analysis?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Missing data accounted for in analysis?	Yes	Yes	No	No	Yes	No	Yes	NA (excluded)	Yes	Yes
Impact of biases assessed qualitatively?	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Impact of biases estimated quantitatively?	No	Yes	No	No	Yes	No	Yes	No	No	Yes
Authors relate back to target population?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other discussions of generalizability	Yes	No	Yes	No	Yes	Yes	No	No	Yes	No

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Part 2: Empirical Project

Understanding Social Determinants of Mental Health in England: A Network Model Approach

Abstract

Objectives

This study sought to understand how social determinants of health contribute to anxiety and depressive symptoms in England, at a population level.

Design

This study was cross-sectional and utilised a pre-existing data set (McBride et al., 2022).

Methods

Data from 1698 adult participants living in England was analysed using a network model approach. Due to the inclusion of mixed datatypes, mixed graphical models were created to assess the relationship between social determinants and mental health (anxiety and depression). Social determinants were present at an individual level (relating to demographics, socioeconomic status, housing, social/relational experiences, and health) and neighbourhood level (indexes of multiple deprivation and urbanicity).

Results

Social determinants explained a noticeable amount of variance in both anxiety and depressive symptoms (39% and 42% respectively). Network density was equivalent across both models (32% and 31% respectively), with mean absolute edge weights of 0.10. Both anxiety and depression were directly connected to nodes representing loneliness, benefit status, benevolent childhood experiences, and age. Across both networks, the nodes with the most influence represented housing tenure, employment status relationship status, income, and educational level.

Conclusions

Overall, the social determinants of mental health in England may explain a noticeable amount of variance in population level anxiety and depression. Individual factors appear to have a greater influence (directly and indirectly) than neighbourhood factors. Targeting relational/social factors is likely to directly reduce anxiety and depressive symptoms (both through prevention and attenuation of symptoms), whilst targeting socioeconomic factors is likely to indirectly reduce symptomology.

Practitioner Points

- Social determinants of health can explain a noticeable amount of variance in anxiety and depressive symptoms experienced at a population level. The most influential variables appear to relate to social/relational factors, like loneliness and positive childhood experiences, alongside an individual's socioeconomic status. Individuals in receipt of benefits are likely to be at risk of increased symptomology.
- Public health interventions, including government policy, which concurrently seek to increase the rate of positive childhood experiences and the socioeconomic status of the population are likely to reduce symptoms of anxiety and depression. Further research will be required to evaluate the effectiveness of such interventions.

Key words: 'social determinants', 'anxiety', 'depression', 'population health, 'network model'

Introduction

Social Determinants of Mental Health

Broadly speaking, social determinants of health can be understood as "the conditions in which people are born, grow, live, work and age, and people's access to power, money and resources" (WHO, 2024). Whilst the argument for addressing social determinants and mental health can be economical (e.g., Zechmeister at al., 2008, McDaid & A-la Park 2019), action in this area is also a matter of social justice (Kirkbride et al., 2024, Lund, 2024). Disparities exist in the outcome and prevalence of mental ill-health, which are not solely determined by intraindividual factors - social factors impact the mental health of individuals differently, according to different demographics (Ostler et al., 2001). For equitable outcomes to exist in mental health care, the relationship between social determinants must be understood (Defario et al., 2019). Moreover, public health approaches to prevention are necessary (Whiteford et al., 2013), but theories driving public health research often lack social perspectives (Erikkson et al., 2018), even though social perspectives can inform understanding of the aetiology of mental-ill health and subsequent public health approaches (Lund et al., 2014).

Models and Theories of Social Determinants of Mental Health

The impact of, and relationship between social determinants has been conceptualized in various ways. The following overview is non-exhaustive, identifying different theoretical and practical ways of modelling social determinants of mental health, which subsequently inform intervention strategies.

Researchers use the terms 'ecological' and 'social determinants' interchangeably (e.g., WHO, 2008; Gislason et al., 2021; Lund et al., 2018). Bronfenbrenner's Ecological Systems Theory is a prominent theory that has changed over time and been applied in multiple contexts (Erikkson et al., 2018). Earlier theory emphasized the effect of context on an

individual, where context refers to systems an individual is directly and indirectly in contact with (referred to as proximal and distal factors respectively). Later theory highlighted the importance of proximal over distal factors, noting also that systems interact between each other and with individuals over the life-course. Based on Bronfenbrenner, Lund et al. (2018) provide a conceptual model categorizing proximal and distal social determinants within (social and cultural, environmental, neighbourhood, economic, demographic). Lund et al. identify globally conducted research which suggests determinants do not act uniformly; varying according to gender, age, and local context. Their model links to the UN's sustainable development goals, to identify intervention targets.

In their seminal review, Kirkbride et al. (2024) argue for the integration of a social determinants lens within the biopsychosocial understanding of mental health. The review characterizes social determinants at the individual level (including, but not limited to, socioeconomic disadvantage, early life adversity, experiencing discrimination/stigma/ loneliness) and within the wider social environment (e.g., neighborhood deprivation/inequality, the built environment). The review reports a range of evidence indicative of causal pathways between social determinants like poverty and poor mental health outcomes. The review also proposes a preventative framework for population mental health, consistent with the WHO's three levels of prevention (primary/secondary/tertiary). The authors emphasize the importance of primary prevention (preventing onset rather than later attenuating symptoms/impact).

Public Health England also has a conceptual model of 'psychosocial pathways and health outcomes' which informs actions on health inequalities (Bell, 2017; Stansfield & Bell, 2019). Based on the WHO's definition of social determinants of health, the model considers the wider context of an individual (akin to distal factors in Bronfenbrenner's model), alongside an individual's position in society (e.g., relating to occupation/income/education

level), their exposure to social/economic/environmental stressors, the adverse/protective psychosocial factors available to them, and the impact this has upon how somebody acts and how their body reacts to these circumstances. PHE argues research is needed which 'examines the associations and causal relationships between various factors in the conceptual framework' and 'the contribution different factors have on mental wellbeing' (Bell, 2017; p57).

The Impact of Social Determinants in the UK

Determinants identified in these three models have been shown to impact mental health in the UK. On an individual level, adverse childhood experiences (ACEs) are typically associated with increased likelihood of poor mental health and social outcomes (e.g., unemployment; Bellis et al., 2014, Bellis et al., 2023). Contrastingly, research pertaining to 'benevolent childhood experiences' (BCEs), which include experiences like having positive relationships with a teacher/neighbor, suggests BCES can mitigate the effect of ACEs on mental health (Crandall et al., 2019). It is notable that young people in less advantaged areas/settings are less likely to experience BCES (Redican et al., 2023). The notion that positive relationships play a protective factor in mental health is reflected in literature relating to loneliness and social isolation, which form a key area of Kirkbride et al.'s (2024) review, amongst others. Specifically, loneliness increases the likelihood of experiencing poor mental health (e.g., Victor & Yang, 2011) and is a key target for intervention in the UK (Department for Culture, Media, and Sport, 2022).

Other individual factors, including components of socioeconomic status like employment and income, have also consistently been linked to mental health, whereby those who are unemployed, live in poverty, or have lower income are more likely to experience mental health difficulties (Ford et al., 2010, Wang et al., 2020, Kromydas et al., 2021, Thomson et al., 2022). Within this literature, there appears to be demographic differences, whereby men

and women experience the impact of unemployment and poverty differently (e.g., Wang et al., 2020., Kromyda et al., 2022). This is not unusual; research often identifies demographic differences in the prevalence/experience of poor mental health. For example, Proto & Quintana-Domeque (2021) observed ethnic-gender specific changes in mental health during the pandemic, even when controlling for other identity characteristics, including socioeconomic characteristics.

At a neighborhood level, research indicates that in the UK, those living in deprived areas are more likely to experience poor mental health or wellbeing in comparison to those living in more affluent areas (e.g., Mattheys et al., 2016). This relationship appears to remain even after accounting for individual characteristics (Fone et al., 2014), suggesting both neighborhood and individual level variables are important determinants of mental health.

Interactions Between Determinants

As highlighted, social determinants can be considered at proximal and distal levels and both individual/neighborhood factors appear to be important determinants of mental health. However, the extent to which these variables are differentially impactful and/or interact is of ongoing debate. Propper et al. (2005) suggest when a 'neighborhood' is comprised of smaller geographical areas, the effect of neighborhood characteristics, like deprivation (i.e., distal factors) are limited, with individual/household characteristics (i.e., proximal factors) have greater impact. However, research also suggests neighborhood deprivation is uniquely impactful and can be moderated by neighborhood cohesion (Fone et al., 2014). Other research finds wellbeing is positively associated with engagement in community cultural assets (e.g., attending art exhibitions), regardless of individual demographics, but the relationship is stronger in more deprived areas (Mak et al., 2021). These findings are suggestive of complex interactions between economic, neighborhood, cultural and social determinants of mental health and wellbeing.

Network Analysis

The complexity of the interacting impact of social determinants is reflected in the research discussed; however, empirical studies typically include limited numbers of variables, and a broader, empirical, England specific model of social determinants does not exist. Such a model could fit with PHE's suggestion that the association between social determinants could be better characterized, to identify how various factors contribute to mental health/wellbeing (Bell, 2017). Within a network model, social determinants and mental health are represented as 'nodes', whose strength of relationship is represented by connecting 'edges' (see figure 1 for a published example). The extent to which one determinant relates to others, i.e., how important it is to the network overall, can be evaluated via centrality indices.

A network analysis may provide a novel way of assessing relationships between social determinants of mental ill-health. Network analyses make it possible to see how different categories of variables are related (McElroy et al., 2021). Whilst psychopathological network models typically consider symptom interactions (Fried et al., 2017), the field is rapidly developing. Recently, network models have considered the impact of individual and neighbourhood/environmental characteristics on mental health and wellbeing (Bjørndal et al., 2024; McElroy et al., 2021); findings suggest network models can represent complex associations between social variables and psychological states. McElroy et al. (2021) found that overall, individual level variables appeared to have the greatest impact on well-being, with factors like financial security being directly connected to overall wellbeing, and factors like home ownership exerting significant impact within the overall network.

Figure 1

Published network model examining the relationship between social determinants and mental wellbeing (McElroy et al., 2021)

Rationale and Aims for the Present Study

Assessing Mental Ill-Health for The Purpose of This Study

Historically, mental-ill health has been defined by diagnoses comprised of distinct categories. However, this approach has been challenged on the basis that disorders are often comorbid and symptoms frequently transdiagnostic. Research suggests mental-ill health or 'psychopathology', might be better categorized by a three-factor model incorporating the following dimensions: internalizing (e.g., anxious and depressive symptoms), externalizing (e.g., substance disorders, antisocial disorders, hyperactive-impulsive symptoms) and thought disorders (e.g., psychotic symptoms). Though dissociable, these dimensions still correlate, and it has been demonstrated that internalizing, externalizing, and thought disorders may be underpinned by a General Psychopathology factor, 'p' (e.g., Caspi et al., 2014; Carragher et al., 2016). This study assessed whether the anxiety and depression measures used constitute distinct categories, or whether they reflect an underlying latent factor (i.e., internalising). In the original study, participants completed two measures of anxiety and depression, the PHQ-9 and GAD-7 and ICD-11 aligned measures of anxiety and depression. This study uses the PHQ-9 and GAD-7 data to enable comparison to similar research (e.g., Böhnke et al., 2014).

Exploring the Relationship Between Social Determinants of Health and Anxiety and Depression`

As interventions targeting singular social determinants are not effective in all areas (e.g., Candy et al., 2007; McGrath et al., 2021; Sainsbury, 2001), public health approaches could benefit from understanding the pathways by which social determinants interact and their relative contributions to mental health outcomes. This approach would be enabled by

network analysis and fits with recent NHS policies, for example, there is an interest in identifying/qualifying health inequalities and identifying preventative approaches (NHS Long Term Plan), and the NHS Community Mental Health framework is moving towards integrating psychological and social intervention (e.g., supporting with benefits and housing within mental health teams) (NHS, 2019). Concurrently, it is also recommended that research seeks to understand health inequalities relating to demographics, socioeconomic factors, and their intersects (Wykes et al., 2023). A network model could identify which determinants would benefit from being targeted together or prioritised, according to pathways between them. This approach fits with recommendations that research takes a 'complexity science approach' (which includes network analyses) to identify possible targets for treatments and policy (van der Wal, 2021).

Accordingly, the present study aims to first use confirmatory factor analysis to assess the structure of common mental health disorders at a population level in England, hypothesizing that the data will be best represented by a single dimension model. Secondly, the study aims to use network models to provide a preliminary model of social determinants of mental health in England. Specifically, a mixed graphical model will be created to account for the inclusion of continuous, categorical, and ordinal data. Network models are typically a-theoretical, accordingly, this study does not make hypotheses about how determinants included are likely to interact.

Methods

Design

This cross-sectional study comprised of a secondary analysis of the 6th wave of the COVID-19 Psychological Research Consortium (C19PRC) study (McBride et al., 2022). On

July 19, 2021, the UK Government lifted legal restrictions on social contact, live events, and reopened previously closed settings which had been implemented due to the COVID-19 pandemic. The new policy encouraged people to make informed decisions based on guidance rather than enforceable laws. Some businesses, like public transport and healthcare settings, continued to require face coverings, though this was not legally enforceable. The original study examined knowledge, attitudes, and behaviours related to COVID-19; the role of psychological factors and social/political attitudes in the public's response to the pandemic; and the occurrence of common mental health disorders.

This study was pre-registered with the Open Science Framework (https://osf.io/5gz83/). A STROBE checklist regarding transparent reporting is available in appendix A.

Sample

Quota sampling was used (according to age, sex, and household income) and the original sample (n = 2058) was UK representative according to economic activity, ethnicity, and household composition. The only inclusion criteria were that participants were aged 18+, able to read and write in English, and UK residents. This study uses a cross-section of the data, from wave 6 of the study, for which n = 2058 (McBride et al., 2021). Wave 6's retention rate was 51.8%, meaning 1643 participants from previous waves completed wave 6 measures; 1100 were recruited at baseline. Analyses showed attrition was highest amongst women, younger adults, those in employment, those born outside the UK, those living in cities, and those not living alone.

After assessing non-respondents' characteristics, the sample was topped up according to baseline sampling quotas for age, gender, and household income, and the sample was re-balanced according to these demographics, with 415 new participants. There were some

differences noted between participants entering the study at this wave and those retained from previous waves, for example new participants had higher levels of COVID-19 related post-traumatic stress disorder.

For this study, a subsection of the wave 6 sample was used. Specifically, participants living in England were retained (n = 1702). This was to enable accurate modelling of the Index of Multiple Deprivation (IMD) data, which cannot accurately be compared across UK countries. This approach is consistent with prior research (Gascoigne et al., 2023). Including IMD data was necessary to facilitate comparisons of neighbourhood versus individual variables. Additionally, given the purpose of this paper was to consider mental health at a population level, to potentially facilitate considerations about mental health and social determinants at a policy level, retaining data for England only seemed appropriate.

Data collection and management

Data collection and recruitment was managed via Qualtrics. Respondents received alerts sent out by Qualtrics, who recruit via 'traditional, actively managed, double-opt-in market research panels, that are used for corporate and academic market research only'. Incentives for participation varied according to survey characteristics, including cash, air miles, gift cards, charitable donations, redeemable points, sweepstakes entrance, or vouchers.

Measures

Where possible, standardised and validated measures were used, however some measures were adapted due to data collection occurring during the pandemic. A full description of each measure is available in table 1. The information below regarding the measures used by this study is from the supplementary measures material provided from the Wave 6 study (for full supplementary material see McBride et al., 2021). In line with

recommendations, ordinal variables with greater than 7 categories were treated as continuous (Rhemtulla et al., 2012). The mixed graphical model (MGM) does not discern between ordinal and categorical data, therefore ordinal data with less than 7 categories are considered categorical. Within some variables (ethnicity, gender, relationship status, sexual orientation, and employment status) there was extremely inequal distributions of scores and accordingly some response categories were collapsed. Full details concerning how variables were collapsed and dummy coded are available in Appendix B.

Table 1

Study Measures

Variable	Measure details
Mental Health	
Depression	*Patient Health Questionnaire-9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001).* The PHQ-9 is a nine-item measure, which asks how often, over the last two weeks, participants have been bothered by each of the depressive symptoms. Response options were "not at all", "several days", "more than half the days", and "nearly every day", scored as 0, 1, 2 and 3, respectively. PHQ-9 scores range from 0 to 27. Scores of ≥5, ≥10, ≥15, represent mild, moderate and severe levels of depression severity (Kroenke et al., 2001). Psychometric properties are reported in Kroenke, Spitzer, Williams, and Löwe (2010).
Anxiety	*Generalized Anxiety Disorder Scale (GAD-7) (Spitzer, Kroenke, Williams, & Löwe, 2006).* The GAD7 askes respondents to rate, on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day), how often over the last 2 weeks they were bothered by seven anxiety symptoms (e.g. trouble relaxing, becoming easily annoyed or irritable). The GAD-7 has good reliability and construct validity (Löwe et al., 2008).

Demographics

Age	Age was gathered both in categories (18-24 years; 25-34 years; 35-44 years; 45-54 years 55-64 years; 65 years and over), and continuous values. This study retained the continuous values.
Gender	Gender options included: male, female, transgender, other, prefer not to say.
Ethnicity	Ethnicity could be recorded as: White British/Irish; White non-British/Irish; Indian; Pakistani; Chinese; Afro-Caribbean; African; Arab; Bangladeshi; Other Asian; Other -specify. Sexual Orientation was considered as: straight/heterosexual, gay/lesbian/homosexual, bisexual, other, prefer not to say.
Relationship Status	Relationship Status was recorded as: legal marital or same-sex status (married); never married and never registered same-sex civil partnership (Single); cohabiting; separated, but still legally married; divorced; widowed; in a registered same-sex civil partnership; separated but still legally in a same-sex civil partnership; or formally in a same-sex civil partnership which is now legally dissolved; surviving partner from a same-sex civil partnership; in a relationship but not living together
Educational Level	Education Level was categorized as: no qualifications; O-level/GCSE or similar; A-level or similar; diploma; undergraduate degree; postgraduate degree; technical qualification; or Other.

Housing

Housing Tenure response options included:	Own outright; buying it with the help of a mortgage or loan; shared ownership; renting; living rent free; squatting; or other.
Household Crowding	This item was created by dividing the number of individuals living in a home by the number of bedrooms (originally two separate items).

Neighbourhood

Neighbourhood deprivation	Neighbourhood deprivation was assessed by obtaining Indexes of Multiple Deprivation

	(IMD), according to participant's postcodes. IMDs were developed to assess level of deprivation within concentrated local areas.
Urbanicity	Urbanicity was identified by whether participants reported living in a city, a suburb, a town, or somewhere rural.
Socioeconomic Status	
Income	Self-estimated gross annual household income for 2019 utilised the following categories: (1) £0-£15,490; (2) £15,491-£25,340; (3) £25,341-£38,740; (4) £38,741-£57,930; and (5) £57,931 or more.
Employment Status	Respondents were asked to indicate whether they were currently: employed full-time, employed part-time; self-employed (full-time), self-employed (part-time), been placed on the government 'furlough' scheme; unemployed, but looking for work; unemployed, looking after family or home; unemployed, long-term sick or disability; full-time student; or retired.
Future Financial Security	Participants were asked "*Looking forwards, do you expect your financial security to* (1) get worse, (2) stay about the same, or (3) get better?"
Benefit Status	A single item was utilised: "*Are you currently in receipt of any government benefits (not including child benefits and state pension)?*" (Yes/No response).
Subjective Social Status	MacArthur Scale of Subjective Social Status; Adler, Epel, Castellazzo, and Ickovics (2000). The MacArthur Scale of Subjective Social Status was used. The measure is presented in pictorial format, with a social ladder accompanied by the following statement: "*Think of a ladder representing where people stand in the United Kingdom. At the top of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the bottom are the people who are the worst off – those who have the least money, least education, and the least respected jobs or no job. The higher up you are on the ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom*". *Please click the number below to show where you think*

	you stand at this time in your life, relative to other people in the UK. 10-rungs.
Social	
Benevolent Childhood Experiences:	*Benevolent Childhood Experiences (BCE) scale.* (Narayan, Rivera, Bernstein, Harris & Lieberman, 2018). This scale is a 10-item self-report measure which quantifies positive experiences during the first 18 years of life. The scale measures aspects including internal perceived safety (e.g. 'Did you have beliefs that gave you comfort'), external perceived safety (e.g. 'Did you have at least one caregiver with whom you felt safe'), security and support (e.g. 'Was there an adult who could provide you with support or advice?') and positive and predictable qualities of life (e.g. 'Did you have a predictable home routine, like regular meals and a regular bedtime'). Responses were binary scored (Yes = 1, No = 0).
Loneliness	*Loneliness Scale* (Hughes, Waite, Hawkley, & Cacioppo, 2004). Social connectedness was measured using the three-item Loneliness Scale, which has been specifically designed for use withinin large-scaled population surveys. Respondents were asked how often they felt: (1) that they lacked companionship; (2) left out; and (3) isolated from others. Responses were scored on a 3-point scale (hardly ever, sometimes, or often).
Health	
General health	General Health (Contoyannis, Jones, & Rice, 2004) was measured using a single-item taken from the British Household Panel Survey, which asked participants "*Compared to someone your own age, would you say your health has on the whole been?,* with responses recorded on a 5-point Likert scale ranging from 1, poor to 5, excellent.

Ethics and Quality Control

Ethical approval was gained from the University of Sheffield (reference number 033759; appendix C). Informed consent was gained at every wave of the original study (wave 6 consent form available in appendix D). Some emotive questions were included (e.g., regarding suicide), thus participants were signposted to the NHS website for information on emotional support services.

The study data is deposited in the UK Data Service and the Open Science Framework – when this happens personal data is removed, and location data is replaced with relevant socioeconomic summary data (e.g. area-level deprivation). All data storage is compliant with General Data Protection Regulation.

During recruitment, Qualtric alerts included general information, not specifics, to avoid self-selection bias. Soft launches were used at each wave to check for any errors with the measures and ensure median survey time did not exceed 30 minutes. Wave 6 median response time was 22mins 51 seconds. During completion, a minimum survey completion time was set to ensure responses were trustworthy and were not duplicates.

Statistical analysis

Establishing a Variable to Represent Mental Ill Health

Confirmatory factor analysis (variance standardized method) assessed whether questionnaire data pertaining to symptoms of anxiety and depression best reflected a single or dual factor model. Given the ordinal nature of these questionnaires, the analysis utilised polychoric correlations. Analyses were completed in R, using the lavaan package (version 0.6-17). When handling ordinal data, Lavaan automatically uses a weighted least squares means and variance adjusted (WLSMV) estimator. This is suitable for use with polychoric

correlations derived from multivariate non-normal data and is considered more appropriate than other methods when response categories are limited (Beauducel & Herzberg, 2006), as they are in the GAD7 and PHQ9.

The fit of each model was estimated with the following indices: χ^2 value, the CFI and TLI, and the RMSEA, which have been shown to be effective measures of fit under the WLSMV approach (Beauducel & Herzberg, 2006). The CFI and TLI would indicate good fit at > .95 and the RMSEA at <.05, with acceptable fit at <.08 (Bollen & Curran, 2006).

Network Models

The results of the CFA guided the development of the network model: if results indicated mental health measures best represent a single underlying factor (i.e. 'internalising') as opposed to two (i.e., anxiety & depression) then a single model would be created, in which anxiety and depression measurements are combined to create a single outcome variable. However, if anxiety and depression appeared to be distinct constructs, two individual network models would be created.

A mixed graphical model (MMG; Haslbeck & Waldorp, 2015) was completed, owing to the inclusion of continuous, ordinal, and categorical data. Analyses were conducted in R (version 4.3.2) using the 'mgm' package. To reduce the likelihood of including false positives in the model, regularization was applied. Specifically, within the 'mgm' package, the least absolute shrinkage and selection operator is applied (Tibshirani, 1996), which is also known as 'L1-penalized regression'. For this study, the penalty parameter was set to 0.25, using the Extended Bayesian Information Criterion. This value is in keeping with research suggesting values of 0.25 significantly decreases the risk of false positives, without increasing the risk of false negatives too significantly (Foygel & Darton, 2010). Regularisation works by shrinking

edges and setting small edge weights to zero, which reduces the likelihood of type one errors and produces a sparser and therefore more interpretable graph.

Results were plotted using the 'qgraph' package, employing the 'SPRING' command. Specifically, this utilises the Fruchterman Reingold Algorithm to control node positions. Nodes are placed so that edges are generally of equal length with minimally crossing edges (to aid interpretability). Strongly associated nodes are plotted together and nodes with weak/little connection within the network are plotted on the outer edges of the network. Within the graph, green edges represent positive conditional dependence between continuous variables, red edges represent negative conditional dependence between continuous variables, and grey edges represent a relationship between two categorical variables (or categorical-continuous variables).

In addition to the graphical model, there are several statistical means of understanding the relationship between nodes and the overall structure of the model. Edge weights are understood as a representation of the strength of relationship between two nodes (variables). Edges are present when the relationship between two variables cannot be explained by the impact of other variables within the model. Node predictability can also be calculated, which for continuous variables is akin to R^2, describing how well a node is predicted by other nodes (Haslbeck & Fried, 2017). Centrality describes how influential a given node is within the network, this was calculated in two ways: strength centrality, which assesses the strength of an individual node across the network, and expected influence, which looks at the influence a node has on the nodes it is directly connected to.

There are four key assumptions to network models (Burger et al., 2022): cases are independent, continuous relationships are linear, missing data are missing (completely) at

random, and the distributional assumptions of the network variables are met. These were assessed prior to analyses taking place.

Power Analyses

CFA

Samples of > 500 are considered adequate even when faced with the 'worst conditions' (i.e., low communalities and many weakly determined factors (Macallum et al., 1999). Accordingly, the present sample size (n = 1702) was appropriate for the proposed analyses. Indeed, this sample size is congruent with seemingly all 'rules of thumb' identified for factor analyses sample sizes (Kyriazos, 2018).

MGM

A power analysis was completed using the approach described by Constantin et al. (2021), using the R package 'powerly'. Whilst this method was originally described in relation to gaussian graphical models, the authors note that the computations can be extended to other network models (e.g., mixed graphical models). Results indicated that for a network of 19 nodes (density set to 0.4, sensitivity to 0.7, and probability 0.8), a sample size of 1761 was recommended. Our sample was slightly smaller (n = 1702, or 1698 following participant exclusion, which constitutes 96.42% of the recommended sample), this was likely to have minimal impact upon the sensitivity and probability values.

Results

Sample Demographics and Descriptive Statistics

A summary of the sample characteristics and the descriptive statistics concerning outcome measures are available in table 2. A summary of correlation coefficients pertaining to the continuous variables are available in table 3.

Table 2

Sample Characteristics and Descriptive Statistics for all Variables

Variable	Mean (SD) or Percentage	Range (continuous variables)
Mental Health		
Depression	6.03 (6.72)	0 – 27
Anxiety	4.90 (5.82)	0 – 21
Demographics		
Age	45.52 (15.76)	18 - 89
Gender	47.6% Male	
Ethnicity	89.7% White	
Sexual Orientation	90.6% Straight	
Relationship Status	Married/civil partnership: 46.5% Single: 28% Cohabiting: 13.6% Separate/divorced (including civil partnerships): 7.2% Widowed: 1.8% In a relationship, not cohabiting: 3.0%	
Educational Level	No qualification: 3.1% O Level/GCSE/Equivalent: 20.3% A Level/equivalent: 19.2%	

	Technical Qualification: 10.1% Undergraduate degree: 26.7% Diploma: 3.7% Post-graduate Degree: 15.8% Other qualifications: 1.1%	
Housing		
Housing Tenure	Own house outright: 38.6% Buying with mortgage: 26.1% Part rent part mortgage: 1% Rental: 26.3% Living rent free (e.g., with family/friends): 6.9% Squatting: 0.9%	
Household Crowding	.96 (.49)	.20 – 5.00
Neighbourhood		
IMD (Neighbourhood Deprivation)	5.57 (2.70)	1 - 10
Urbanicity	City:21.8% Suburb: 34.0% Town:27.7% Rural:16.4%	
Socioeconomic Status		
Income (annual)	£0 - £15490: 19.5% £15491 – £25340: 18.8% £25341 - £38740: 20.3% £38741 – £57930: 20.3% £57931 or more: 21.1%	
Employment status	Employed full-time: 45.6% Employed part-time: 14.0% Self-employed full time: 2.8% Self-employed part-time: 2.8% Unemployed, looking for work: 3.9% Unemployed, caring for other: 6.2% Unemployed, long-term sick/disabled: 5.8% Retired: 16.0% Full time student: 2.7%	
Future Financial Security	Get worse:14% Stay same:68% Get better:18%	

Benefit Status	In receipt of benefits: 24.5% Not in receipt of benefits: 75.5%	
Subjective Social Status	5.76 (1.96)	1 – 10
Social		
Benevolent Childhood experiences:	7.38 (2.60)	0 - 10
Loneliness	4.94 (1.93)	3 - 9
Health		
General health	Very poor: 2.7% Poor: 12.0% Fair: 28.4% Good:44.2% Excellent:12.7%	

Table 3

Correlation coefficients of continuous variables (n = 1702)

	Crowding	BCES	Depression	Loneliness	SSS	IMD	Age	Anxiety
Crowding		-0.43	.104**	.051*	-.088**	-.035	-.347**	.110**
BCES	-0.43		-.294**	-.264**	.214**	-0.27	.143**	-.282**
Depression	.104**	-.294**		.584**	-.174**	-.026	-.309**	.895**
Loneliness	.051*	-.264**	.584**			-0.16	-.266**	.562**
SSS	-.088*	.214**	-.174**	-.187**		0.11	.067**	-.175**
IMD	-.035	-0.27	-0.26	-0.16	.011		0.44	-.023
Age	-.347**	.143**	-.309**	-.266**	.067**	.0444		-.323**
Anxiety	.110*	-.282**	.895**	.562**	-.175**	-.023	-.323**	

** significant a p <.001
* significant at p < .05
Crowding = household crowding
BCES = benevolent childhood experiences
SSS = subjective social status
IMD = indexes of multiple deprivation

Confirmatory Factor Analysis

In the full sample, there were no missing data (n = 1702) for any item responses, in either questionnaire. Descriptive statistics are available in table 4 and factor loadings in table 5. Each questionnaire, and their combination were found to be highly reliable (see Cronbach's alphas in table 4).

Table 4

Descriptive Statistics for the GAD7 and PHQ9 (n = 1702)

	Mean	SD	Range	Cronbach's Alpha
PHQ9	6.04	6.73	0 – 27	.94
GAD7	4.92	5.82	0 - 21	.96
Combination				.97

Neither the single nor dual factor model (figures 2 and 3 respectively) showed good fit according to the fit indices (see table 6), with the dual factor model showing marginally better fit than the single factor model. Accordingly, the network models are completed for anxiety and depression independently.

Figure 2

Single Factor Model

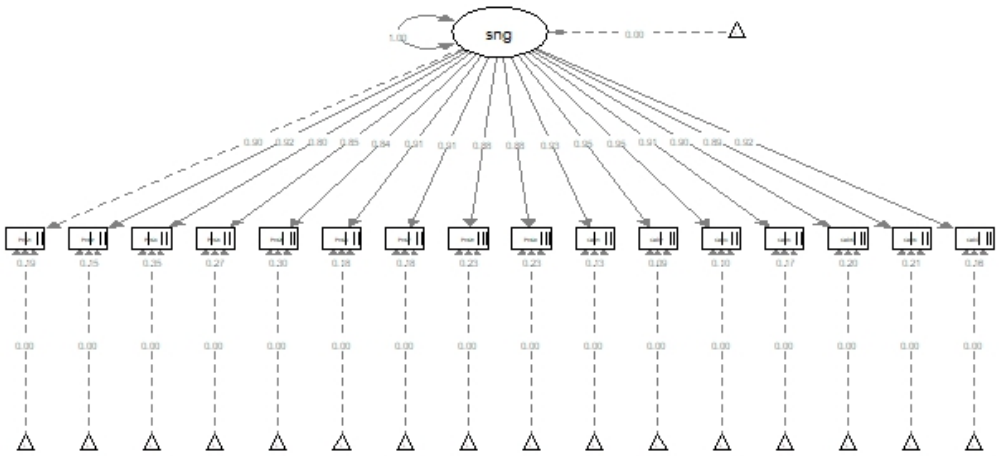


Figure 3

Dual Factor Model

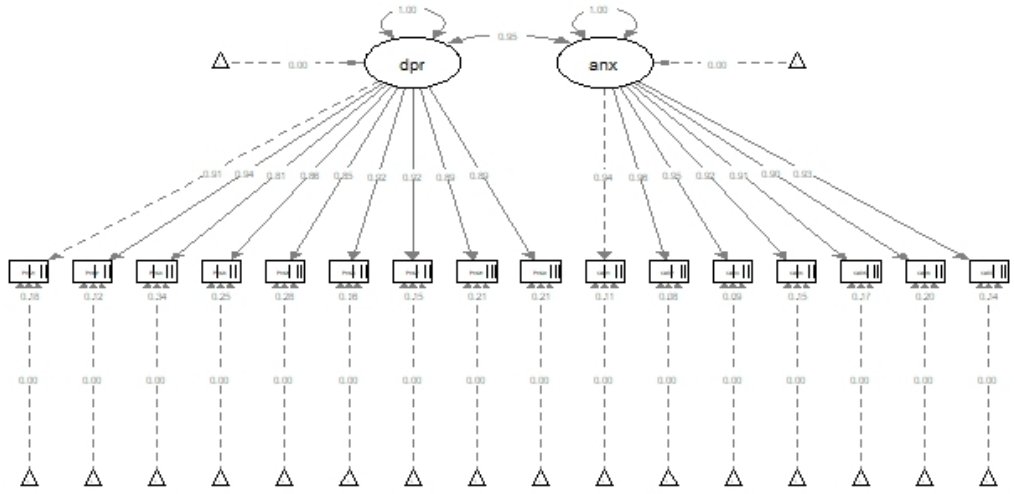


Table 5

Factor Loadings

	Single Factor Model	Double Factor Model
PHQ1	0.90	0.91
PHQ2	0.92	0.94
PHQ3	0.80	0.81
PHQ4	0.85	0.86
PHQ5	0.84	0.85
PHQ6	0.91	0.92
PHQ7	0.91	0.92
PHQ8	0.88	0.89
PHQ9	0.88	0.89
GAD1	0.99	0.94
GAD2	0.95	0.96
GAD3	0.94	0.95
GAD4	0.92	0.92
GAD5	0.90	0.91
GAD6	0.88	0.89
GAD7	0.91	0.92

Table 6

Fit Indices for the Single and Dual Factor Models of Mental Health Symptoms

	Single Factor Model	Double Factor Model
χ^2	2246.18	1695.50
CFI	0.91	0.93
TLI	0.89	0.92
RMSEA	0.15	0.12

Note
CFI = Comparative Fit Index
TLI = Tucker Lewis Index
RMSEA =.Root Mean Squared Error of Approximation

Mixed Graphical Models

Data Preprocessing

Regarding the model assumption that cases are met, the dataset meets the requirement as each observation in the dataset represents an independent case (i.e., participant). Regarding the continuous variables, it is possible to assess both homoscedasticity and linearity using residuals (Tabachnik & Fidell, 2019). Residuals were plotted with depression and anxiety separately as dependent variables. Results indicated there was no heteroscedacity and the assumption of linearity was met. Regarding normality, Tabachnik & Fidel (2019) note that in large samples, it is the values of skew and kurtosis which matter most. Kline (2011) suggests that values greater than 3 and 10, for skewness and kurtosis respectively, are indicative of deviations from normality. None of the variables exceeded these cut offs, indicating the variables were normally distributed. This was supported by visual inspection of Q-plots, which appeared normal. Multicollinearity was assessed according to the Variance Inflation Factors, with no multicollinearity evident (VIFs ranged from 1.0 – 1.20; Obrien, 2007).

Whilst there were outliers present in the data, these represented the minimum and maximum values for a given measure (e.g., 0 and 27 within the PHQ9). Given the sample was drawn from the general population, it is reasonable to assume that these outliers are in fact part of the distribution. Regarding categorical variables, all categorical variables were measured at an ordinal or nominal level, and the groups within each category were independent (i.e., they did not overlap).

Only one variable, 'IMD', had data missing (24 missing cases). This was handled with the R package MissForest, which is understood to be one of the most effective packages for data imputation, that can also handle mixed datatypes (Waljee et al., 2013). The NRMSE value indicated that imputation was completed to good effect (0.06). Only four participants were transgender, to enable to the network model to be calculated, these participants had to be excluded (as there were too few cases in comparison to the other categories 'male' and 'female'). Accordingly, the final sample for the network model comprised of n = 1698 individuals.

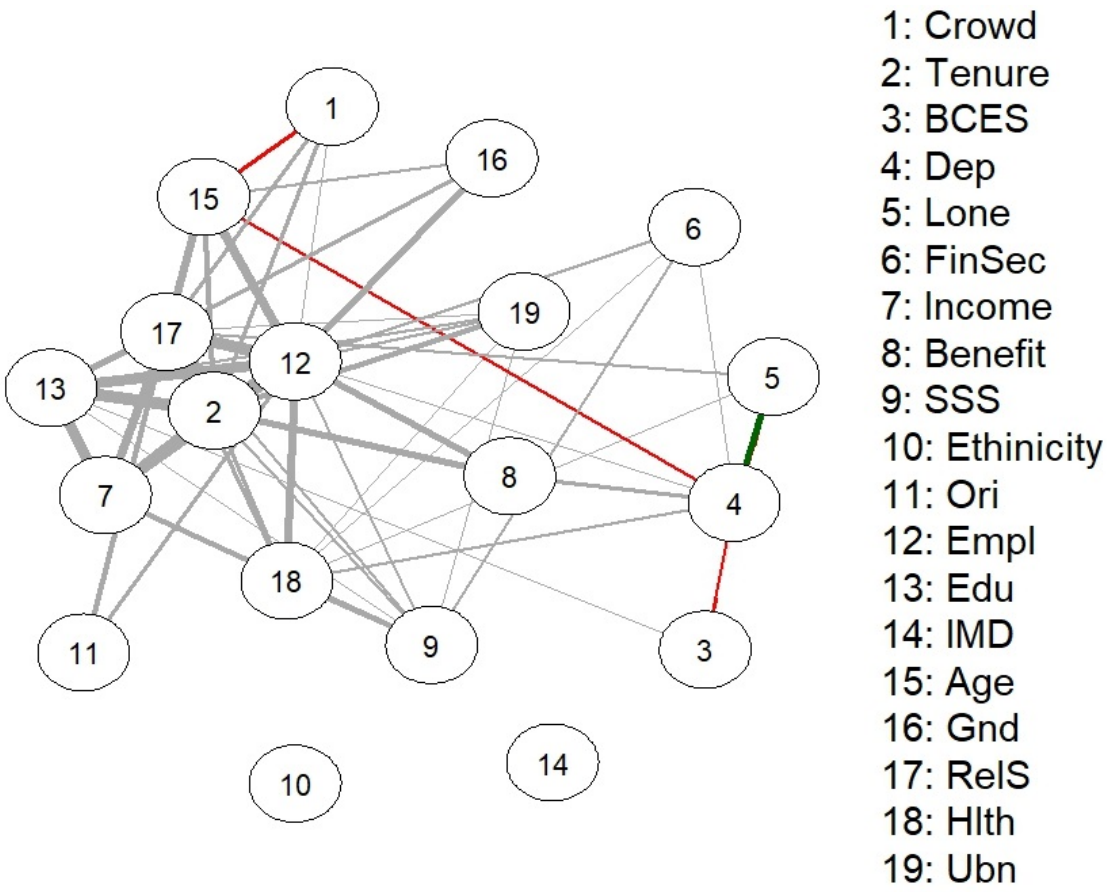
Depression Model

Regarding network density, the total possible number of non-zero edges was 342, with the model returning 106 of these (31%). Absolute edge weights demonstrate the strength of association between nodes. Within the network, the mean absolute edge weight was 0.10. Regarding the depression node specifically, associations were present between the nodes representing loneliness (0.47), benefit status (0.27), benevolent childhood experiences (0.12), age (.10), health (.08), financial Security (0.07), and employment (.02). Not all of these are represented in the graphical model (figure 4), as the model automatically sets small edges to zero. Of the associations represented, the relationship between depression and benefit status

was continuous-categorical, interaction analyses indicated that for individuals in receipt of benefits, depressive symptoms increased.

Figure 4

Graphical Representation of the Depression MGM



Variable abbreviations:

1. Crowd = household crowding
2. Tenure = home tenure
3. BCES = benevolent childhood experiences
4. Dep = depression
5. Lone = loneliness
6. FinSec = financial security
7. Income = income
8. Benefit = benefit status
9. SSS = subjective social status
10. Ethnicity = ethnicity

11. Ori = sexual orientation
12. Empl = employment status
13. Edu = educational level
14. IMD = index of multiple deprivation
15. Age = age
16. Gnd = gender
17. RelS = relationship status
18. Hlth = health
19. Ubn = urbanicity

Centrality Indices

Strength values were calculated, which indicate how influential each node is within the network. In figure 5, strength values are presented as standardised Z-scores, whereby higher values signal these nodes are of greater importance within the network. The nodes with the most influence represented home tenure, employment status, relationship status, income, and educational level. These nodes were highly correlated within the network.

The expected influence was also calculated (table 7). This metric determines the nodes with the highest influence across the network. Expected influence can be calculated at multiple levels, for this study, expected influence was calculated at one-step and two-step intervals. Expected influence refers to the direct influence that a node has on the nodes it is connected to (one-step expected influence), and the influence it has to the nodes it is indirectly connected to (two steps away). In keeping with the strength values, the nodes with greatest influence were tenure, relationship status, employment status, educational level, and income.

Predictability

Predictability refers to the proportion of a node's variance that is explained by other nodes within the network. For continuous variables, the result is akin to R^2. Regarding the depression node, predictability was estimated at .42, or 42%.

Figure 5

Standardised Z-Scores Pertaining to The Strength Value of Each Variable (Depression Model)

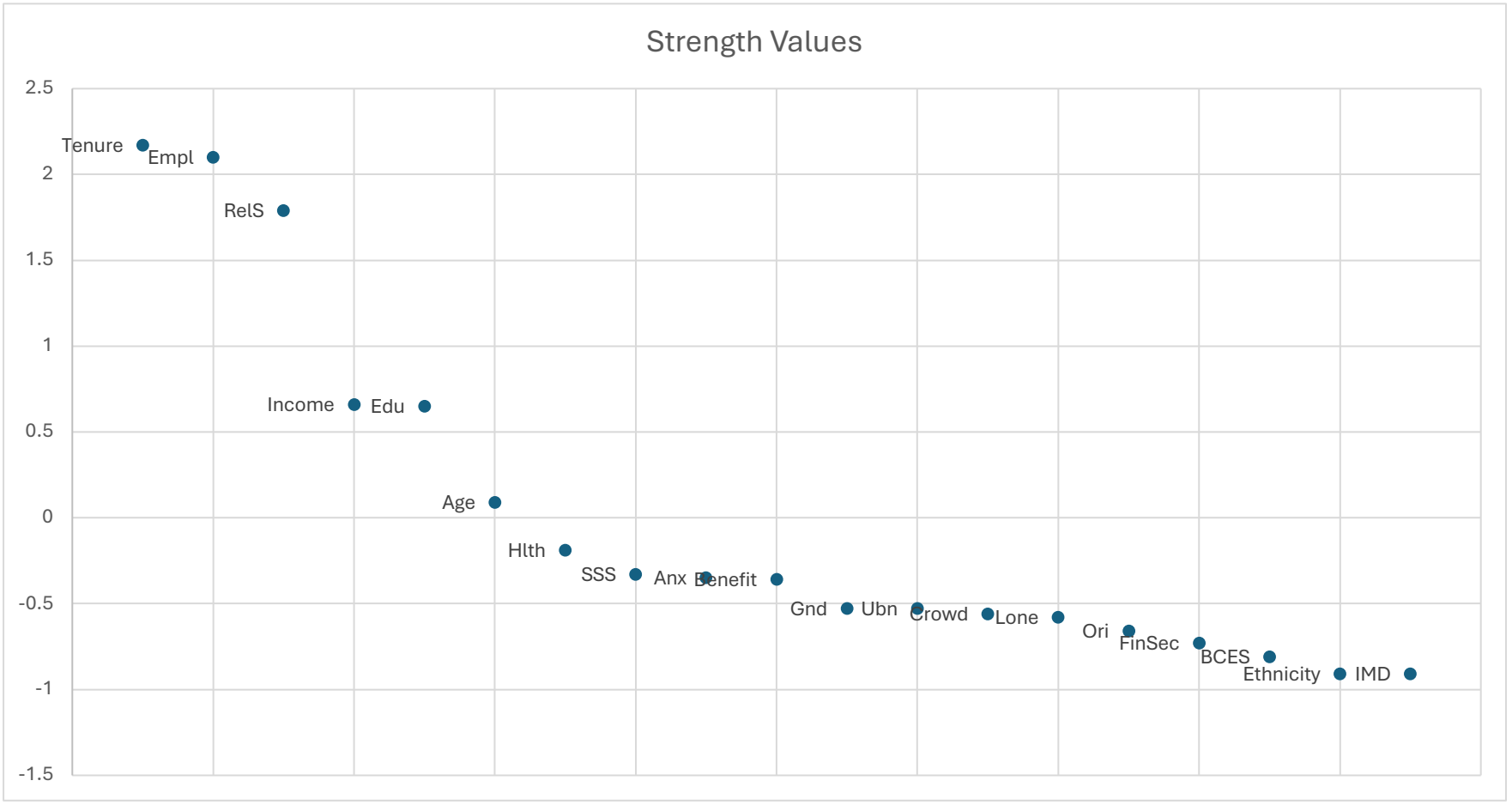


Table 7

Expected Influence of Individual Nodes (Depression Model)

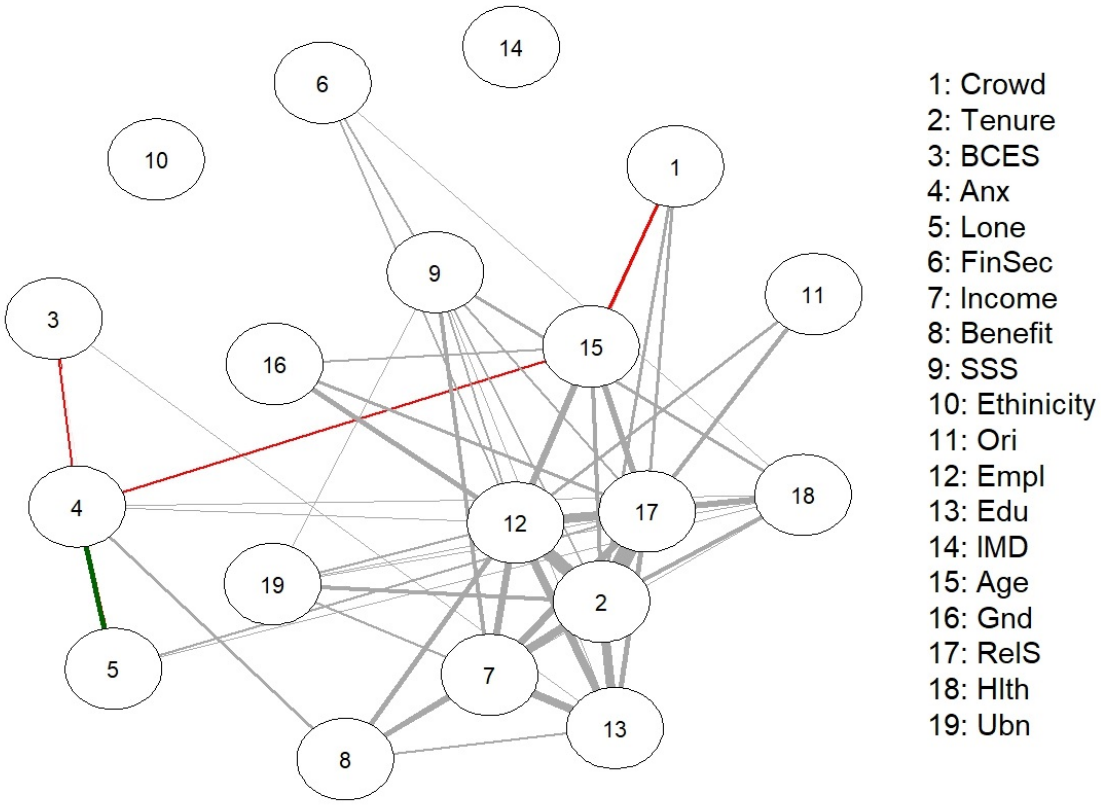
Variable	One-step influence	Two-step influence
Overcrowding	0.69	3.92
Tenure	6.10	28.90
BCES	0.20	0.46
Depression	1.12	2.22
Loneliness	0.66	1.82
Financial security	0.35	1.35
Income	3.11	17.54
Benefit status	1.10	6.40
Subjective social status	1.14	5.01
Ethniicty	0.00	0.00
Sexual orientation	0.49	3.23
Employment status	5.98	25.03
Educational level	3.10	17.85
IMD	0.00	0.00
Age	1.10	11.16
Gender	0.76	4.47
Relationship Status	5.36	25.78
Health	1.43	8.00
Urbanicity	0.75	4.60

Anxiety Model

The total of possible non-zero edges was 342, with the model returning 110 of these (32% density; figure 6). Within the network, the mean absolute edge weight was 0.10. Regarding the anxiety node specifically, associations were present between the nodes representing loneliness (.44), benefit status (.23), age (.11), benevolent childhood experiences (.10), health (.05) and employment (.03). Of the associations represented, the relationship between depression and benefit status was continuous-categorical, interaction analyses indicated that for individuals in receipt of benefits, anxiety symptoms increased.

Figure 6

Graphical Representation of the Anxiety MGM



Note: variable abbreviations:

1. Crowd = household crowding
2. Tenure = home tenure
3. BCES = benevolent childhood experiences
4. Anx = anxiety
5. Lone = loneliness
6. FinSec = financial security
7. Income = income
8. Benefit = benefit status
9. SSS = subjective social status
10. Ethnicity = ethnicity
11. Ori = sexual orientation
12. Empl = employment status
13. Edu = educational level
14. IMD = index of multiple deprivation
15. Age = age
16. Gnd = gender
17. RelS = relationship status
18. Hlth = health
19. Ubn = urbanicity

Centrality Indices

Strength values are represented in figure 7. As with the depression model, the nodes with the most influence represented home tenure, employment status, relationship status, income, and educational level. Again, these nodes were highly correlated within the network.

The expected influence of each node, at both one and two-steps are available in table 8. As with the depression model, the nodes with the greatest expected influence reflected the nodes with the greatest strength: tenure, income, employment, education level, relationship status.

Predictability

Regarding the anxiety node, predictability was estimated at .39, or 39%.

Figure 7

Standardized Z-Scores for the Strength Values of Each Variable (Anxiety Model)

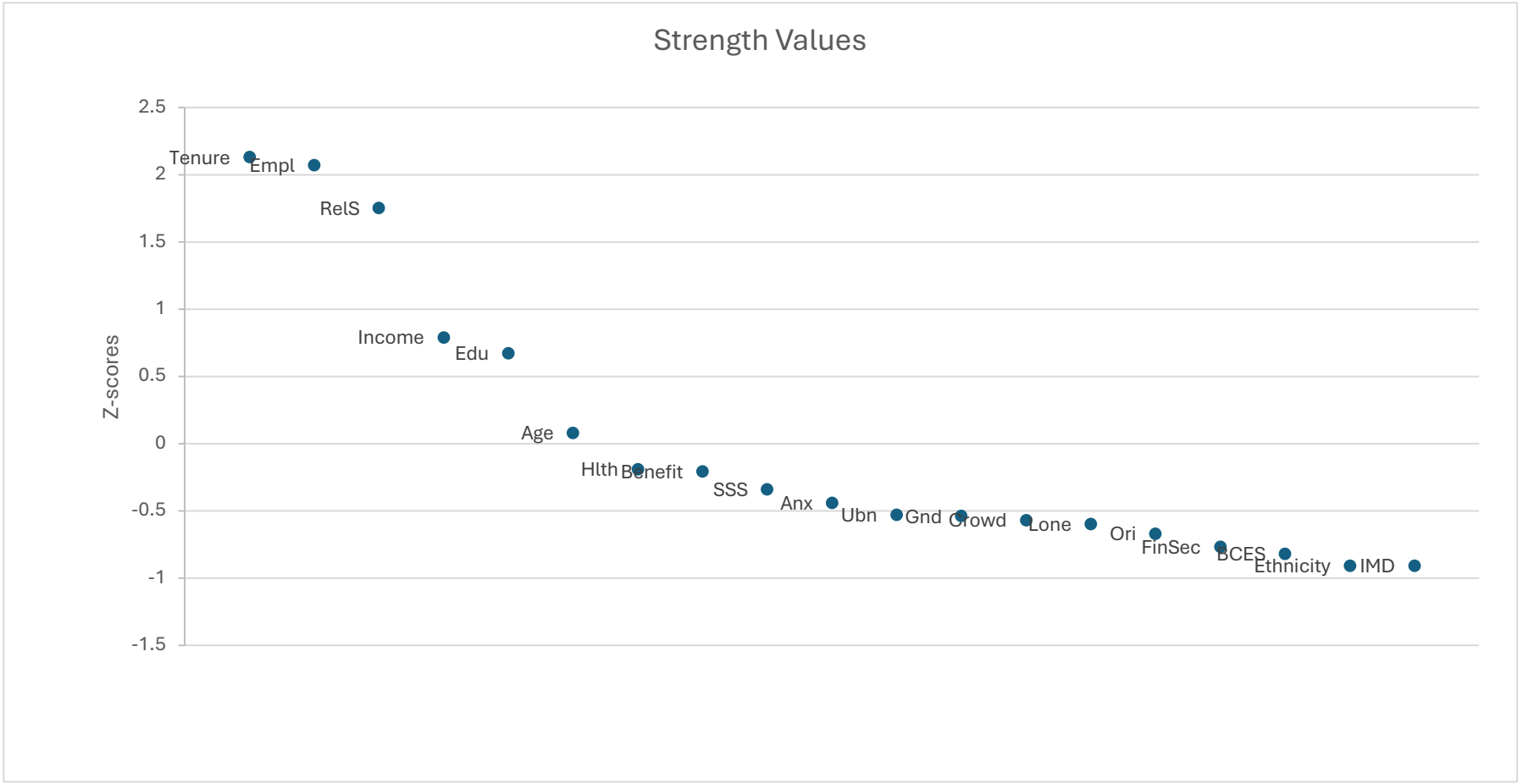


Table 8

Expected Influence of Individual Nodes (Anxiety Model)

Variable	One-step influence	Two-step influence
Overcrowding	0.69	3.89
Tenure	6.14	29.63
Benevolent Childhood Experiences	0.20	0.43
Anxiety	0.95	2.03
Loneliness	0.63	1.65
Financial security	0.28	1.20
Income	3.44	18.72
Benefit status	1.42	7.88
Subjective social status	1.16	5.19
Ethnicity	0.00	0.00
Sexual orientation	0.48	3.19
Employment status	6.01	25.59
Educational level	3.20	18.42
Index of Multiple Deprivation	0.00	0.00
Age	2.00	11.18
Gender	0.76	4.50
Relationship Status	5.37	26.11
Health	1.47	8.27
Urbanicity	0.76	4.71

Discussion

This study utilised a network model approach to understand the relationship between various social determinants of health with anxiety and depression. A confirmatory factor analysis (CFA) found anxiety and depression were best represented as two separate constructs. Accordingly, two mixed graphical models were completed, one for each mental health outcome. For both anxiety and depression, the variance explained by social determinants was noticeable and equivalent, at 42% and 39% respectively, suggesting the experience of these mental health difficulties is likely to be underscored, at least in part, by an individual's social circumstances. Network density was practically identical across models. The most central nodes were housing tenure, employment status, relationships status, income, and educational level, which also had the largest expected influence (at one and two-steps), indicating these nodes had substantial influence across the wider network, and the nodes they were more immediately connected to. Similarly, the nodes connected to depression (loneliness, benefit status, benevolent childhood experiences (BCES), age), were also connected to anxiety.

Factor structure of mental health

While the two-factor model in this study demonstrated marginally better fit, the fit indices and factor loadings were roughly equivalent. Therefore, the results do not strongly contradict the possibility of an internalizing factor. However, other research has also found that single-factor models may not provide the best fit for anxiety and depression symptoms. Böhnke et al. (2014) compared five different factor analyses/structural equation models using routine outcome data (GAD-7, PHQ-9, and Work and Social Adjustment Scale (Mundt et al., 2002)) from primary care mental health patients. They found the best fitting model was a bifactor model, which assumed all items load onto a general dimension, but associations between

domain-specific items remained possible. This model was not tested in this paper, as the primary purpose of the CFA was to determine whether to combine the two outcome measures. However, this model may have provided a better fit at a population level as well. Interestingly, the overall fit of both models in the current paper were better than the equivalent single and dual factor models reported by Böhnke et al. These differences may be in part due to methodological variation in relation to sample differences (clinical vs general population) and outcome measures. Specifically, their models included three variables, and their third measure contributed to some domain specific variance.

Contextualising Results Within the Existing Evidence-Base: Individual Nodes

Loneliness is highly prevalent worldwide (Surkalim et al., 2022) and considered a public health concern (Lee et al., 2021). Research indicates loneliness has a statistically significant, moderate impact upon depression (Erzen et al., 2018) and if loneliness was eradicated, 11-18% of depression cases might be reduced for older adults in England (Lee et al., 2021). The results of the present network model were consistent with such research. finding greater loneliness was associated with increased depressive symptoms. There is comparatively less research concerning the relationship between loneliness and anxiety (Kirkbride et al., 2024). Our results contribute to this evidence base, suggesting loneliness has an approximately equal impact on anxiety as depression, at a population level.

The UK government has expressed interest in understanding how loneliness is linked to mental health, particularly within marginalised groups (Department for Culture, Media, and Sport, 2022). Loneliness was not specifically linked to any of the demographics represented in this network model, however, this may reflect methodological challenges in a) collapsing variables like ethnicity into ‘White’ and ‘Non-White’ and b) difficulties identifying

curvilinear relationships that may exist, for example in relation to age and loneliness (Victor & Yang, 2011).

It is widely accepted that BCES play a protective role in the development of mental health difficulties (Han et al., 2023). BCES are more likely to be experienced by children living with less social deprivation (Redican et al., 2023), however, when present for children experiencing poverty and adversity, BCES may serve a protective function and lead to improved health in adulthood (Crandall et al., 2021). In the network models, BCES were directly connected to anxiety and depression, indicating increased BCES reduce the severity of anxiety/depressive symptoms, independently of an individual's current objective socioeconomic status. Like the loneliness node, z-values and edge-weights were similar across models. Based on these results, future research may wish to consider whether increasing BCES at a population level decreases the prevalence/severity of anxiety and depression in adults in England.

Being in receipt of benefits was directly associated with increased symptoms of anxiety and depression, a finding consistent with wider research (e.g., Shahidi et al., 2019). When variables are indirectly connected within a network model (e.g., A – B – C), it can indicate that the relationship between C and A is mediated by B (Epskamp & Fried, 2018). This could suggest that the effect of other socioeconomic variables, which were indirectly connected to depression/anxiety were mediated benefits status. Another possibility is that the relationship between benefit status and depression/anxiety was also influenced variable(s) which are not included in the model but are captured by benefit status. For example, stigma and shame are often associated with receiving benefits (e.g., Sutton et al., 2013; Baumberg, 2015) and shame negatively impacts mental health (e.g., Cândea & Szentagotai-Tătar, 2018). Future research may wish to consider how social determinants operate differently for individuals in receipt of benefits compared to those not-in-receipt of benefits.

As the UK has an ageing population (Centre for Ageing Better, 2023), it is crucial to consider the etiology of mental health disorders within this demographic. Research summarised by Lund et al. (2018) indicates a higher prevalence of depression but lower prevalence of anxiety among older adults. Our results partially align with this, as increasing age was negatively correlated with symptoms of both disorders. The unique connection between age and mental health within the network models implies that targeted interventions based on older-age-specific risk factors (e.g., biological risk factors like visual impairment; Vink et al. 2008; Curran et al., 2020) could be beneficial. This could be an important way of ensuring equitable outcomes, as preventative interventions in early childhood are often emphasised in research and policy (e.g., Kirkbride et al., 2024).

There were some unexpected results within the network. The Index of Multiple Deprivation (IMD) had no effect on the network. Whilst this contrasts research finding higher IMD scores are associated with poorer mental health, even after controlling for individual factors (Skapinakis et al., 2005). The results are not entirely inconsistent with other literature (e.g., Mohan & Barlow, 2023). Indeed, researchers have suggested that when considering area level deprivation, benefits data may offer a better indication than more general measures of deprivation (Fone et al., 2007). As neighbourhood-level variables are generally less predictive in models with neighbourhood and individual factors (e.g., McElroy et al., 2021), and this study included multiple individual proxies of deprivation (e.g., benefits status, income), this may explain why there was no conditional dependency between IMD and mental health.

Ethnicity also had no impact. For this study, it was necessary to collapse the ethnicity variable into ‘White and Non-White’. Some granularity in the relationship between ethnicity and mental health was likely lost through this. Indeed, research highlights that “intersections related to experiences of racism, migration, religion, and complex trauma might be more

relevant than crude ethnic group classifications" (Bansel et al., 2022). This may have been compounded by the presence of multiple social variables, as prior research has observed that when other health and social variables are modelled, the strength of the relationship between race and mental wellbeing reduces (Chang et al., 2014). Notably, the data may have also been susceptible to sampling biases. For example, whilst the average income within the sample was reflective of data gathered by the Office for National Statistics in 2019 (Office for National Statistics, 2019), education level is likely to be higher within the sample as compared to the general population (Office for National Statistics, 2021).

In the present study, subjective social status (SSS) was not associated with mental health. Whilst this contrasts the results of the meta-analysis described in this author's literature review, some studies included in the systematic review reported that that SSS was no longer significantly predictive when objective measures of socioeconomic status (OSES) were included. The network model approach may not have identified a conditionally dependent effect of SSS, due to the inclusion of multiple measures of OSES. Additionally, most of the research included in the meta-analysis was conducted in the US. Whilst study-country did not moderate results, this may have been due to heterogeneity within the subgroup categories. Therefore, an additional possibility is that SSS is less impactful (at a population level) in England than in the United States, after accounting for OSES.

Contextualising Results According to Previous Network Models

There is growing interest in using network model approaches to understand the relationship between psychological states (e.g., mental health and wellbeing) and non-psychological variables. McElroy et al.'s (2021) network model mapped the relationship between wellbeing, individual, and neighbourhood characteristics, finding individual characteristics, like subjective financial difficulty and physical health were more strongly associated with wellbeing than neighbourhood characteristics; a result which is generally

consistent with this network model. Notably, within their network, housing tenure exerted the strongest overall impact on the model, which is also consistent with current results. Similarly, their model found housing tenure was related to variables like financial, marital, and employment status; these nodes were also some of the most strongly connected nodes within the network. A notable difference between the models is that in McElroy's model, financial and marital status were directly connected to wellbeing, whereas these nodes were not directly connected to anxiety or depression.

There are several ways of contextualising these findings. Firstly, McElroy's sample was comprised of participants living in an economically disadvantaged area in England, which may lead to sampling biases if attempting to generalise. Secondly, McElroy's model operationalised some variables differently (e.g., representing financial status as 'doing well/getting by' or 'struggling'), included more neighbourhood level variables, and used demographic variables as covariates. One interpretation is that McElroy's findings provide context-specific understanding of factors influencing mental wellbeing, whilst this study identifies a broader perspective on these relationships, which may be more relevant to population-level public health interventions. Regardless, both models support the notion that targeting individual level social determinants is likely to improve mental health/wellbeing.

Bjørndal et al. (2024) used network models to characterise the relationship between environmental factors, anxiety, depression, and mental wellbeing at a population level in Norway. Within their models, supportive and rewarding social relationships were associated with better wellbeing and lower levels of anxiety and depression. The presence of supportive/rewarding relationships could be understood as a construct which overlaps with loneliness; accordingly, our finding that loneliness was negatively associated with mental health within both models is consistent with their results. Bjørndal et al. also reported that the same nodes exerted similar levels of strength across all three models, indicating that these

variables were similarly impactful across anxiety, depression, and wellbeing. This is consistent with the results of the models within this paper and between this paper and McElroy et al.'s model. A notable difference between this paper and Bjørndal et al.'s is the level of predictability: their overall models accounted for 21.8% and 27.1% of the variance in anxiety and depressive symptoms respectively. Within the present models, predictability was almost double that. One explanation for this discrepancy is the variation in proximal versus distal factors: the present models contained a greater number of individual (i.e. proximal) variables, which may have a greater influence on mental health and wellbeing than neighbourhood level variables (e.g., McElroy et al., 2021), and accordingly may account for more variance in outcomes. The different results could also reflect measurement sensitivity or the varying impact of social determinants between countries. This latter possibility highlights the importance of conducting research that is relevant at a population level in individual countries.

Public Health Implications

Current interventions for social determinants typically focus on singular domains (e.g., employment or housing). However, research considering whether interventions targeting multiple social determinants may be beneficial to individuals with mental health difficulties is necessary (Alegria et al., 2018). The present study's network models offer insight into which determinants are likely to have a direct impact on anxiety/depression, how these are related to other variables, and which determinants may be indirectly influencing mental health. These results can be considered within the wider literature, to help characterise which social determinants might warrant concurrent interventions.

The models indicated that loneliness had the strongest association with mental health but was not directly connected to any of the demographic variables. Whilst this could suggest that interventions targeting loneliness could be beneficial across demographic groups,

research finds interventions addressing loneliness are of limited efficacy (Kirkbride et al., 2024). Loneliness was also connected to BCES, which was also uniquely associated with depression and anxiety. There is perhaps a logically consistent pathway between BCES and loneliness: The BCES scale includes questions about whether/how the individual was cared for during childhood and it is reasonable to assume that those experiencing fewer BCES they may experience less secure attachments (e.g., Almeida et a., 2023). Additionally, those with insecure attachments may be more likely to experience loneliness (e.g., Akdogan, 2017). Accordingly, interventions which support parenting may have a direct impact on BCES and consequently an indirect impact on loneliness. Indeed, parenting interventions are already generally considered to be effective in reducing mental health difficulties for both parents and children (Kirkbride et al., 2024). However, poverty is a significant barrier to parenting (Russel et al., 2008), therefore improving the socioeconomic resources of families may be a necessary concurrent policy target.

Another way of incorporating BCES into public policy could be in raising awareness about their protective role. Public Health England recommends the REACH tool to raise awareness about the impact of childhood adversity and trauma (i.e., the impact of ACES; Stansfield & Bell, 2019). The tool could incorporate the known positive impact that BCES have, by highlighting the protective role of positive relationships with neighbours and teachers. Overall, BCES may constitute a useful candidate for primary prevention of mental ill-health, fitting with the general understanding that earlier intervention is preferable (Kirkbride et al., 2024).

The direct and indirect connections between various socioeconomic nodes (tenure, income, employment status, benefit status) and mental health, alongside the centrality values of individual nodes (tenure, employment status, income) indicate that improvements in socioeconomic status are likely to improve population level mental health. Within the

literature it is emphasised that social determinants of health should be understood as outcomes of structural inequalities in institutions, not individual failures, and responsibility for addressing these adverse conditions lies with government policies and resource allocation, rather than individuals (Kirkbride et al., 2024). Indeed, research indicates that UK socioeconomic policies have the potential to impact mental health positively and negatively. Increasing minimum wages decreased mental health difficulties in low-income workers (Reeves et al., 2017), whilst psychological distress increased when Universal Credit replaced existing benefit schemes (Wickham et al., 2020) and when housing benefit was reduced (Reeves et al., 2016). The National Living Wage has the capacity to improve mental health, however this effect is not observed when individuals are concurrently impacted by policy relating to benefit freezes (Akanni et al., 2024). More broadly, research finds that when countries attempt to reduce access to benefits or minimise the funds available, this is typically associated with worse health outcomes (Shahidi et al., 2019) and income changes tend to provide the most benefit to mental health when they move individuals out of poverty (Thomson et al., 2022).

When considering the present findings in the context of extant literature discussed here, it suggests that broadly speaking, improving socioeconomic status through policy has the potential to improve population level mental health (although the effects are likely to be most notable for the individuals who are most disadvantaged). However, careful consideration is needed regarding the potential harm caused by policies, particularly in relation to benefit status. This fits with recommendations that newly proposed policies are evaluated in relation to the potential harm they cause to mental health (Stansfield & Bell, 2019; Wickham et al., 2020).

Limitations

Several limitations bear consideration. The cross-sectional design limits conclusions about causality, although network model pathways can suggest causal relationships (Epskamp & Fried, 2018). Additionally, data were gathered during the COVID-19 pandemic; while the specific wave was after 'Freedom Day' and population mental health had returned approximately to baseline (Shevlin et al., 2020), the contribution of some variables may differ in another context. These limitations highlight the importance of gathering longitudinal data, which could still be analysed using mixed graphical models.

An additional limitation is the exclusion of certain important determinants of mental health, such as food security (Alon et al., 2024), which were not available in the dataset. Including such variables could alter the network. Moreover, certain demographics, including individuals with learning disabilities and transgender individuals, were not represented, limiting generalizability to these groups. The network models might be slightly underpowered for a sensitivity value of .7, however this risk in minimal and the application of regularization mitigates the likelihood of type 1 errors. Stability analyses would have been preferable (Burger et al., 2022) but were not feasible due to computational limitations. Future research could consider longitudinal designs with more representative samples and include additional variables like food security, and influential neighbourhood variables identified by McElroy et al (2021).

Limitations regarding the network approach itself should be highlighted (e.g., Borsboom et al., 2021). For example, whilst centrality metrices are often used to consider optimum targets for intervention (Borsboom et al., 2021), there is a lack of evidence that centrality indices have prospective predictive value (Bringman et al., 2019). Moreover, researchers have highlighted that there is a lack of evidence which indicates network models

demonstrate consistent replicability, raising concerns about the generalisability of models using this approach (e.g., Forbes et al., 2021).

Summary

This study provides novel evidence to suggest social determinants of mental health in England explain a noticeable amount of variance in population level anxiety and depression. Consistent with Bronfenbrenner's ecological systems theory, analyses indicated that proximal, rather than distal factors likely exert more significant impact within the network. In line with prior research, it seems likely that those who have the most privilege in relation to education, employment, income, and receiving care and nurture in childhood are more likely to experience better mental health in adulthood. The centrality indices and edge weights suggested that interventions targeting relational factors like loneliness and benevolent childhood experiences are likely to have a direct impact on population level mental health, whilst policies which seek to improve the objective socioeconomic status of the population may have an indirect impact upon mental health. However, as highlighted by Kirkbride et al. (2024) the possible benefits of any population-based approach need to be tempered by the unequal distribution of modifiable risk factors.

Appendix A

STROBE Transparent Reporting Tool

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Pages 87 - 89
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 88
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pages 90 – 97
Objectives	3	State specific objectives, including any prespecified hypotheses	Pages 96 - 97
Methods			
Study design	4	Present key elements of study design early in the paper	Pages 97 - 107
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 97
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 98
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pages 99 – 104
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*NA*
Bias	9	Describe any efforts to address potential sources of bias	Page 104
Study size	10	Explain how the study size was arrived at	Page 107

Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 99 + appendices
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Pages 104 – 107
		(*b*) Describe any methods used to examine subgroups and interactions	Page 106
		(*c*) Explain how missing data were addressed	Page 115
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	NA
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pages 108 - 110
		(b) Indicate number of participants with missing data for each variable of interest	Page 115
Outcome data	15*	Report numbers of outcome events or summary measures	Pages 108 - 110
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA – network model reported
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Pages 116 - 123
Discussion			

Key results	18	Summarise key results with reference to study objectives	Pages 123 – 124
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pages 132 – 133
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pages 125 – 130
Generalisability	21	Discuss the generalisability (external validity) of the study results	Mentioned in limitations
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	NA

Appendix B

Variable dummy coding

Variable	Treated as continuous or categorical	Coding (for categorical variables)
PHQ9	Continuous	NA
GAD7	Continuous	NA
Age	Continuous	NA
Gender	Categorical	Male = 1 Female = 0
Ethnicity	Categorical	White = 0 Other = 1
Sexual Orientation	Categorical	Straight = 1 Other = 0
Relationship Status	Categorical	Married/civil partnership = 1 Single = 2 Cohabiting = 3 Separated/divorced (including civil partnerships) = 4 Widowed = 6 In relationship but not cohabiting = 7
Education Level	Categorical	No qualification = 1 Olevel/GCSE/Equivilent = 2 A Level/equivalent = 3 Technical qualification = 4 Undergraduate degree = 5 Diploma = 6 Postgraduate degree = 7 Other qualifications = 8
Housing Tenure	Categorical	Own outright = 1 Buying with mortgage = 2 Part rented, part mortgage = 3 Rented = 4 Living rent free at friend/family = 5 Squatting = 6 Other = 7
Household Crowding	Continuous	NA
IMD	Continuous	NA

Urbanicity	Categorical	City = 1 Suburb = 2 Town = 3 Rural = 4
General Health	Categorical	Very poor = 1 Poor = 2 Fair = 3 Good = 4 Excellent = 5
Employment Status	Categorical	Employed full time = 1 Employed part time = 2 Self-employed full time = 3 Self-employed part time = 4 Unemployed, looking for work = 5 Unemployed, caring = 6 Unemployed, long term sick/disability = 7 Retired = 8 Full time student = 9
Income	Categorical	£0 – 1290 p/month = 1 £1291 - £2110 p/month = 2 £2111 - £3230 p/month = 3 £3231 - £ 4830 p/month = 4 £4831 or more p/month = 5
Financial Security	Categorical	Get worse = 1 Stay about the same = 2 Get better = 3
Benefit Status	Categorical	Not receiving benefits = 0 Receiving benefits (excluding child benefit/state pension) = 1
Subjective Social Status	Continuous	NA
Benevolent Childhood Experiences	Continuous	NA
Loneliness	Continuous	NA

Appendix C

Ethical Approval for the Study

The University Of Sheffield.

Downloaded: 25/05/2024
Approved: 23/01/2023

Rosa Sinclair Emerson
Registration number: 210154984
Psychology
Programme: Doctorate of Clinical Psychology

Dear Rosa

PROJECT TITLE: Ecological Determinants of Mental Ill-Health: A Network Model Approach
APPLICATION: Reference Number 051332

This letter confirms that you have signed a University Research Ethics Committee-approved self-declaration to confirm that your research will involve only existing research, clinical or other data that has been robustly anonymised. You have judged it to be unlikely that this project would cause offence to those who originally provided the data, should they become aware of it.

As such, on behalf of the University Research Ethics Committee, I can confirm that your project can go ahead on the basis of this self-declaration.

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since full ethical review may be required.

Yours sincerely

Department Of Psychology Research Ethics Committee
Departmental Ethics Administrator

Appendix D

Informed Consent Gained from Participants in Wave 6 of the C19PRC Study

DEPARTMENT OF PSYCHOLOGY

Participant Information Sheet

Project Title:

The COVID-19 pandemic in the UK (Top Ups)

Thank you for your interest in this study. Before you decide whether you would like to take part, please read the following information to ensure that you understand what it involves.

What is the purpose of the study and what does it involve?

The aim of this survey is to examine the possible psychological and social effects of the coronavirus COVID-19 pandemic. It is part of a wider study to understand how the pandemic is affecting the lives of ordinary people over time. We hope that the findings from this survey will be used to make recommendations about how to best manage this and future pandemics and similar crises. We are therefore asking you to complete a series of questionnaires online, which you will be taken to after this invitation.

We will ask you about your experiences of the pandemic (e.g. whether you have been infected with coronavirus), your knowledge and attitudes towards the coronavirus pandemic (e.g. what are your thoughts about a vaccine for the coronavirus); your health and well-being (e.g., physical health, mood, worries), your home life during the pandemic, as well as your social attitudes (e.g., political beliefs). The survey will take you approximately 30 minutes to complete. We may contact you again in the future to further understand how your life is affected as the months pass, but you will be free to refuse to participate at that stage if you then decide that you no longer want to be involved in this study.

Do I have to take part?

Participation is on a voluntary basis. If you do decide to take part, you can withdraw at any time. You will not be asked to provide a reason for withdrawing.

What are the possible disadvantages and risks of taking part?

We anticipate no risk of harm from taking part in this study, although some of the questions may be quite personal. If for any reason you experience any discomfort and feel that you can no longer continue, you may withdraw from the study by just shutting down the browser. If

Appendix D

Informed Consent Gained from Participants in Wave 6 of the C19PRC Study

The survey will take you approximately 30 minutes to complete. We may contact you again in the future to further understand how your life is affected as the months pass, but you will be free to refuse to participate at that stage if you then decide that you no longer want to be involved in this study.

Do I have to take part?

Participation is on a voluntary basis. If you do decide to take part, you can withdraw at any time. You will not be asked to provide a reason for withdrawing.

What are the possible disadvantages and risks of taking part?

We anticipate no risk of harm from taking part in this study, although some of the questions may be quite personal. If for any reason you experience any discomfort and feel that you can no longer continue, you may withdraw from the study by just shutting down the browser. If you are worried about COVID-19, you might find it helpful to visit the UK Government's COVID-19 website https://www.gov.uk/coronavirus. If you are concerned or distressed by any of the topics covered in the survey, you might find it helpful to seek support from your GP.

Will my participation in this project be kept confidential?

Your data will be treated as anonymous, and you will not be identifiable by the information that you provide to us. However, we will record your computer's IP address. We will use the IP address (and the first part of your postcode which you may have provided during a previous survey) to locate the neighbourhood in which you live and to find out what kind of area it is; for example, how many people live in your area and how many people from your area become ill due to COVID-19 in the future. Once we have this information, we will erase your postcode information and IP address from the database. Hence, there will be no possibility of linking the information you provide directly back to you.

We will share the data with other scientists who may want to use it. However, we will require them to observe the highest ethical standards when using it.

What is the legal basis for processing my personal data?

According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further

Appendix D

Informed Consent Gained from Participants in Wave 6 of the C19PRC Study

information can be found in the University's Privacy Notice https://www.sheffield.ac.uk/govern/data-protection/privacy/general

Who is organising and funding the research?

Researchers at the University of Sheffield, Ulster University, University of Liverpool, and University College London are conducting this study. It is funded by the UK Research and Innovation's Economic and Social Research Council.

Who is the Data Controller?

The University of Sheffield is the Data Controller for this study. This means that University of Sheffield is responsible for looking after your information and using it properly.

What will happen to the data collected, and the results of the research project?

When the results of the study are published in a scientific journal, you will not be identifiable. Your data will be stored anonymously, with all personal information removed.

Who has ethically reviewed the project?

Ethical approval was obtained from the University of Sheffield, Department of Psychology Ethics Committee.

What if something goes wrong and I wish to complain about the research?

If you have any concerns or complaints about the study, you may contact Dr Sarah Butter (s.butter@sheffield.ac.uk) directly.

Also, you can contact the chief investigator: Professor Richard Bentall (r.bentall@sheffield.ac.uk)

Alternatively, if your complaint has not been handled to your satisfaction you may contact Professor Elizabeth Milne (Head of the Psychology Department; psy-hod@sheffield.ac.uk).

Contact for further information

If you have any questions regarding this study, please feel free to contact Sarah Butter or the chief investigator Richard Bentall (details provided above).

Thank you for taking part in this study.

Appendix D

Informed Consent Gained from Participants in Wave 6 of the C19PRC Study

DEPARTMENT OF PSYCHOLOGY

CONSENT TO TAKING PART

Please read and tick the statements below to indicate your consent to take part in the research.
You must agree to all of these statements in order to participate

Please tick the appropriate boxes

Taking Part in the Project

Consent1 I have read and understood the project information page. (If 'No' survey terminated.)

Yes (1) No (2)

Consent2 I understand that my taking part is voluntary and that I can withdraw from the study at any time while I am completing the survey; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw. (If 'No' survey terminated.)

Yes (1) No (2)

Consent3 I understand that my geolocation data is going to be collected as part of demographic information and that this data will be treated as strictly confidential. (If 'No' survey terminated.)

Yes (1) No (2)

How my information will be used during and after the project

Consent4 I understand and agree that other authorised researchers will have access to the data from this survey only if they agree to preserve the confidentiality of the information as requested in this form. (If 'No' survey terminated.)

Yes (1) No (2)

Consent5 I understand that no information that identifies me will be revealed in any reports or publications that arise from this survey. (If 'No' survey terminated.)

Yes (1) No (2)

Project contact details for further information:

Prof. Richard Bentall (Primary Researcher; email: r.bentall@sheffield.ac.uk)

Dr Sarah Butter (Researcher; email: s.butter@sheffield.ac.uk)

Prof. Elizabeth Milne (Head of Psychology Department; psy-hod@sheffield.ac.uk)

Address: Cathedral Court, 1 Vicar Lane, S1 2LT

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