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Introduction

The mental health and wellbeing of university students has become an important public health concern (Brown, 2016). In a large international survey of 14,000 students across 19 universities in 8 countries, 35% of students met the diagnostic criteria for at least one common mental health condition (Auerbach et al., 2016). University students report higher levels of depression than the 12.9% reported in the general population (Eisenberg et al., 2007; Ibrahim et al., 2013; Lim et al., 2018) and age matched peers (Cvetkovski et al., 2012). Whilst suicide rates are lower for students than for the general population (Mortier et al., 2018), rates are increasing, from three per 100,000 in 2000/01 to 4.7 per 100,000 and with a 15% increase since 2009/10 in the UK (Gunnell et al., 2020). Undergraduates are thought to be particularly at risk during to the transition to university (Montgomery and Côté, 2003) and face the developmental challenge of transitioning to adulthood, with the peak onset for mental health problems occurring before the age of 24 years (Kessler et al., 2007).

Experiencing mental health issues is associated with poor academic achievements (Hysenbegasi et al., 2005) and increased study drop-out rates (Megivern et al., 2003), with a 210% increase in the number of students discontinuing their studies due to poor mental health in the last four years (Hubble and Bolton, 2020). Considering these costly repercussions for both students and universities, addressing student mental health is an urgent research priority. There is increasing pressure on universities to improve psychological support services offered to students. However, the absence of quality evidence on modifiable risk factors prevents services from accessing resources and address growing demand (Broglia et al., 2018).

Aims

Published research recommends that the NHS, universities and healthcare services should address student mental health as a research priority. There are however, a number of important knowledge gaps which hinder the development of effective interventions and preventative strategies. At present, there is no published systematic review providing an overview of the prevalence and risk factors for student mental health problems at undergraduate level and on an international scale. Appropriate determination of needs (O'Cathain et al., 2019) and systematic reviews of prognostic factor research (Hemingway et al., 2013) are essential precursors to the development of targeted approaches to prevention and care, which will reduce the humanistic and economic burden of poor student mental health. The aims of this systematic review were to: (1) narratively synthesise existing data to identify a set of risk factors as potential intervention targets and, (2) estimate the pooled prevalence of student mental health problems and quantify the effects of associated risk factors.

Materials and Methods

The protocol was registered prospectively on PROSPERO (CRD42019144927) and was conducted in line with the preferred reporting items for systematic review (PRISMA checklist, Moher et al., 2015; Supplementary Material 1).

Data sources and search strategies

The following databases were searched: MEDLINE (Ovid) 1946 to February 2020, PsycINFO, EMBASE (Ovid) 1974 to February 2020 and the Cochrane Central Register of Controlled Trials. Search terms included "exp Mental Health/", "Exp Students/ and exp

Universities/, “undergraduate* or freshman* or college)ti.ab., “Exp Risk/”, predict*ti.ab.. Full details are provided in Supplementary material 2. Publicly available registers were also searched, such as PROSPERO and White Rose Online, a repository that gives free access to theses awarded by the Universities of Leeds, Sheffield and York. Reference lists were hand-searched and grey literature, including Google Scholar, theses and dissertations and government reports and briefing papers, were taken into consideration where accessible.

Inclusion criteria

Articles meeting the following inclusion criteria were considered eligible: (1) the article was available in English; (2) all study participants were studying at undergraduate level, either full-time or part-time; (3) the study design was longitudinal observational cohort or a case-control; and (4) data collection included an end-point mental health outcome and/or psychological distress, both at clinical and subclinical levels. Outcome measures included the diagnosis of a mental health problem as found in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), self-report measures such as the Beck Depression Inventory (BDI; Beck et al., 1961) or risk assessment tools such as Colombia-Suicide Severity Rating Scale (C-SSRS; Posner et al., 2008).

Exclusion criteria

The review excluded articles where participants were studying at postgraduate level, including doctoral researchers, and university staff members. We excluded cross-sectional design studies and qualitative papers as causal relationships between the risk factor and outcome cannot be determined.

Study selection

Articles were input into Rayyan (Ouzzani et al., 2016), an online tool for study selection in systematic reviews. Initial screening of titles and abstracts was conducted independently by three reviewers (E.S., T.M., and N.C.) and checked in duplicate. Discrepancies were resolved by discussion and analysis of the full text. Duplicates were removed. Potentially eligible full texts were reviewed and the process repeated with reasons for rejection recorded. Reference lists and grey literature were searched and discussed by three reviewers (E.S., M.W., and K.S.).

Data extraction

Data was extracted and coded for the following criteria; (1) study characteristics, including basic study information and descriptive statistics, (2) quantitative outcome and statistical data (e.g., tests of significance (p values), odds ratios, confidence intervals and correlations); and (3) a list of key risk factors according to mental health outcomes. The data extraction tables were piloted by five reviewers (E.S., T.M., N.C., M.W., and K.S.), with all records reviewed for accuracy by a sixth reviewer (H.G.).

Quality assessment

The Quality of Prognostic Studies (QUIPS) tool (Hayden et al., 2013) was used to assess risk of bias and determine the methodological quality of included studies. The tool assigns a classification of low, moderate, high or unclear to indicate the risk of bias in the following domains: study participation; study attrition; prognostic factor measurement; outcome measurement; study confounding; and statistical analysis/reporting, as well as giving an overall grade. Five reviewers (E.S., T.M., N.C., M.W., and K.S.) independently assessed the quality of the articles. A final sixth reviewer (H.G) reviewed the complete risk assessment and resolved any disagreements with E.S.

Data synthesis

Narrative synthesis

Overall findings were reported in a narrative synthesis. To aid interpretation due to the heterogeneity in risk factors investigated across studies, key risk factors were grouped according to Furber et al.'s (2017) risk categorisation protocol which provides a detailed taxonomy of predictors for mental illness. Consistent findings in at least two high quality studies were defined as strong evidence and positive findings in one high quality study was defined as limited evidence. Poor quality articles with inconsistent findings or high risk of bias are presented in Table 2, but are not discussed in the narrative synthesis.

Quantitative synthesis

Studies that reported the required statistical data were quantitatively synthesised in post-hoc meta-analyses. To estimate prevalence, effect sizes were extracted as the proportion of the study sample with mental health problems. To assess risk factors, effect sizes were extracted or calculated for each risk factor assessed within an eligible study. As studies often assessed more than one risk factor, studies were able to contribute more than one effect size. For studies that reported odds ratios (ORs) for the association between risk factors and mental health outcomes, this was extracted as the effect size for inclusion in the meta-analysis. Studies that did not report ORs, but provided sufficient information (e.g., 2x2 frequency table), the OR effects size was calculated manually. Although multiple studies reported regression analyses including several predictors, we chose not to use standardised regression coefficients as a standalone effect size as there is evidence to suggest this leads to inflated estimates of effects (Peterson and Brown, 2005). Findings that did not enable an OR to be calculated were therefore excluded on the basis of the required data being unavailable. If outcomes were assessed at multiple time points, the final outcome was selected. If studies

measured multiple mental health outcomes then effect sizes were calculated for each outcome as long as they represented different mental health problems/disorders (e.g., depression, anxiety, suicide-related event).

A minimum of two effect sizes assessing a risk factor were required to perform a meta-analysis. Due to the heterogeneity in both the type of risk factors and mental health outcome assessed across studies, a step-wise categorisation process was applied to every effect size calculated for individual risk factors to determine whether there were sufficient studies to be meta-analysed. First, each effect size was categorised according to the type of mental health outcome (i.e., depression, anxiety, suicide-related event). Effect sizes within each outcome were then further categorised according to the risk factor classifications identified by Furber et al. (2017). Meta-analyses were performed on the final subgroups with at least two effect sizes assessing the same risk factors: depression and suicide-related outcomes (i.e., suicidal ideation, both one-time and persistent, suicidal thoughts and behaviours, completed suicides).

We conducted random-effects meta-analyses using the Dersimonian and Laird (1986) estimation method (Berkey et al., 1995) with 95% confidence intervals (95% CI) to calculate (1) the pooled prevalence of depression and suicide-related outcomes at university (weighted using inverse of the variance after performing double-arcsine transformation), and (2) the pooled odds ratios of identified risk factors associated with depression and suicide-related outcomes (weighted using the inverse of the variance). Both Cochran's Q statistic and I^2 statistics were used to assess heterogeneity between the studies. I^2 values greater than 50% were considered to show substantial heterogeneity (Higgins and Thompson, 2002). Publication bias was assessed by visual inspection of the symmetry in a funnel plot (Liu,

2011). Post-hoc subgroup analyses were conducted to explore the impact of the type of suicide related outcome. All statistical analyses were performed using MetaXL version 5.3.

Results

After removing duplicates, 3614 records were identified for initial title and abstract screening. Of these, 3539 were excluded as not meeting the eligibility criteria leaving 75 articles for secondary full-text examination. Further screening excluded nine studies where the population (k = 5) or outcome (k = 4) was not relevant. The selection process yielded a final number of 66 articles to be included in the review (Figure. 1).

[INSERT FIGURE 1 HERE]

Characteristics of the included studies

Table 1 summarises the study characteristics of the included articles. All studies followed a longitudinal cohort design, except three with a case control design (Karbeyaz et al., 2016; Meilman et al., 1994; Niemi and Lonnqvist, 1993). Thirty of the study cohorts comprised first year students; the remaining studies recruited undergraduates from all years of study. Eleven articles focused exclusively on medical students, and two on veterinary students (Hafen et al., 2008; Reisbig et al., 2012). The length of follow-up ranged from two weeks to five years. Some articles (Carr et al., 2013; Kulsoom and Afsar, 2015) were timed to encompass the period before and after an examination. The articles were published between 1986 and 2020. All studies were based in one country besides Velten et al. (2018) who recruited participants from both Germany and China. Sample sizes ranged from 60 to 15,396 participants (median: 363). The average quality score of included studies was moderate (Supplementary material 3). The risk of bias for outcome measurement was uniformly low due to the use of validated psychological inventories with clearly defined thresholds for a

mental health problem or psychological distress. Studies consistently showed a high risk of bias for study attrition during the follow-up period.

[INSERT TABLE 1 HERE]

Narrative synthesis

We identified risk factors associated with mental health problems and distress presented by university undergraduates, drawing from 66 studies. Using Furber et al.'s (2017) risk categorisation scheme, factors were grouped into primary and secondary level categories: *Physiological and health* (Physical illness or disability, Physiological vulnerabilities and strengths)*; Psychological* (Psychological vulnerabilities and strengths; Mental health history)*; Predictors of response to trauma* (Negative life events; Additional life stress; Childhood adversity)*; Relational* (Parental physical or mental health; Parent/caregiver-child relationships; Social and peer support; Community environment)*; Sociodemographic* (Modifiable and Non-modifiable sociographic factors)*; Lifestyle* (Physical activity; Risk behaviours; Diet) and *Factors related to Higher Education* (Academic environment; Sexual Harassment). We renamed the "Occupation" risk category taken from the taxonomy to "Factors related to Higher Education" making it relevant to a university context. See Table 2 for details of the categorised risk factors.

Factors related to Physiology and Health

Physical illness or disability. Having an injury or physical illness (Andrews and Wilding, 2004), problems with health (Jessop et al., 2020; Silva et al., 2017), or a disability at baseline (Richardson et al., 2017) significantly predicted depression or anxiety at follow-up. Students who developed a chronic health problem during the 12-month follow-up were at an increased risk of first-onset suicide ideation (Blasco et al., 2019).

Physiological vulnerabilities and strengths. Sleep disturbance was a risk factor for poor mental health across three articles. Hossain et al. (2019) reported that long sleep duration was predictive of depression symptoms, whereas short sleep durations significantly predicted anxiety problems at follow-up. Dissatisfaction with daily sleep (Hossain et al., 2019) general sleep problems (Semplonius and Willoughby, 2019) and sleep disturbances (Wong et al., 2013) were also associated with depression outcomes.

Psychological Factors

Psychosocial vulnerabilities and strengths. Five risk factors were identified: (1) self - esteem; (2) emotion regulation; (3) self-perceived health; (4) stress; and (5) cognitive functioning. Low self-esteem consistently predicted depression (Carr et al., 2013; Orth et al., 2009; Sargent et al., 2006; Zheng et al., 2014). Anger suppression (categorised as emotion regulation) predicted medical student distress (Vitaliano et al., 1989); however, Rosal et al. (1997) reported this finding as significant in female medical students only. Self-perceived health predicted depression (Borst et al., 2015; Hafen et al., 2008) and medical student distress (Vitaliano et al., 1989). Stress was an identified risk factor in five studies for depression and anxiety (Barker et al., 2018; Borst et al., 2015; Hossain et al., 2019; Morrison and O'Connor, 2005; Reisbig et al., 2012). More specifically, Reisbig et al. (2012) reported transitional stress as predictive of depression and anxiety in both the first and second semesters. Cognitive vulnerability factors also predicted depression outcomes. These included: response style (negative rumination; Ito et al., 2006; Morrison and O'Connor, 2005; negative coping (Heffer and Willoughby, 2017); perceived burdensomeness and thwarted belongingness (Carrera, 2016); vulnerability to harm as an early maladaptive schema (Cámara and Calvete, 2012); problem solving avoidance (Brunwasser, 2013); deficits in set

shifting, extreme and pessimistic attributions, higher levels of brooding and higher inhibition costs (Stange, 2017).

Mental health history. A consistent finding was that poor mental wellbeing and distress either prior to or at the start of university (baseline) is an important risk factor for student mental health problems (Cámara and Calvete, 2012; Carr et al., 2013; Hiramura et al., 2008; Hossain et al., 2019; Morris and Tiggemann, 1999; Morrison and O'Connor, 2005). More specifically, risk factors for the onset of major depressive disorder (MDD) included baseline suicidal ideation, suicide attempts and plans, non-suicidal self-injury (NSSI) and any mental disorder diagnosis (Blasco et al., 2019; Ebert et al., 2019; Karatekin, 2018). One article reported a significant gender difference whereby depressed feelings in daily life significantly predicted depression at follow-up for females (Brose et al., 2017). Findings further suggested that psychiatric history prior to university predicts future mental health problems. For example, Zocolillo et al. (1986) found that a history of depression before medical school predicted depression scores at one year follow-up, whereas Wilcox et al. (2012) found that a depression diagnosis prior to college increased the risk of NSSI. Psychological distress was similarly predicted by baseline scores in the first year of studying (Guthrie et al., 1998; Karademas and Kalantzi-Azizi, 2004; Nerdrum et al., 2009).

Predictors of response to trauma

We identified three risk factors in this category: negative life events, additional life stress and childhood adversity. Negative life events that predicted major depression included experiences of sexual victimisation prior to college (Rosenthal et al., 2018) and any traumatic experience (Ebert et al., 2019). Bodell et al. (2011) found that students who experience a high number of negative life events and low social support had increased bulimic symptoms at follow-up, suggesting an interaction effect. Additional life stress was described as a risk

factor in terms of daily life stressors (Schonfeld et al., 2019) and the perceived intensity of daily life stress (Brose et al., 2017). Experiencing stress (Hossain et al., 2019) and the occurrence of stressful events (Ebert et al., 2019; Orth et al., 2009) were also identified as independent predictors of depression and anxiety. Childhood adversity was investigated in-depth across multiple longitudinal studies. Exposure to domestic abuse and sexual maltreatment showed a consistent direction of effect, with 100% of results being positively associated with increased risk (Blasco et al., 2019; Ebert et al., 2019; Igarashi et al., 2010). Poor parental support displayed the same trend across the psychiatric outcomes of depression, anxiety and suicidal behaviour (Macalli et al., 2020), whereas parental divorce and death produced inconsistent findings across different outcomes. While parental divorce was a significant risk factor for increased anxiety, parental death predicted suicidal ideation. Neither factor was associated with risk of depression, including high quality studies (Ebert et al., 2019; Igarashi et al., 2010). Cámara and Calvete (2012) identified childhood abandonment, dependence and emotional deprivation as risk factors for depression and anxiety with noted gender differences. Females displayed the typical diathesis-stress effect, with those students high in abandonment scores experiencing more depressive symptoms when under conditions of high stress, evidencing an interaction effect. By contrast, males with high abandonment scores showed similar levels of depressive symptoms independently of the number of stressors.

Relational

Parental physical or mental health. Maternal depression predicted both one-time and persistent suicide ideation (Wilcox et al., 2010), however findings for paternal depression were non-significant. Maternal depression also predicted past-year NSSI, whereas paternal depression predicted life-time NSSI (Wilcox et al., 2012). Internalising disorders were

predicted by parent negative mood (Meng et al., 2011), while major depression was predicted more generally by parental psychopathology (Ebert et al., 2019). Family history of depression predicted depression in medical students (Zoccolillo et al., 1986), however this article was assessed as high risk in statistical bias.

Parent/caregiver-child relationship. One high quality study (Meng et al., 2011) identified having an unfulfilling relationship with the mother and increased behavioural restrictions by the father as socio-environmental risk factors for internalising disorders in a sample of Chinese undergraduates.

Social and peer support. Social isolation is a key risk factor for a range of mental health outcomes. Greater loneliness (Carr et al., 2013; Duarte and Pinto-Gouveia, 2015; Richardson et al., 2017), homesickness (Hafen et al., 2008) and low social connectedness (Hill et al., 2015; Rosenthal et al., 2018) predicted depression, stress, anxiety and general mental health problems. Liu et al. (2020) and Vitaliano et al. (1989) reported social isolation and loneliness as predictors of depression in females only, suggesting a gender difference. Importantly, low social support predicted one-time and persistent suicide ideation (Wilcox et al., 2010), with no perceived parental support predicting suicidal behaviours, any mental health problem, MDD, and severe generalised anxiety disorder (Macalli et al., 2020). Difficulties with peers, roommates or romantic partners were linked to increased mental health problems more generally (Duarte and Pinto-Gouveia, 2015; Ebert et al., 2019; Meilman et al., 1994; Reisbig et al., 2012; Rosenthal et al., 2018; Silva et al., 2017; Stewart et al., 1997; Velten et al., 2018). One article reported “romantic problems in males” as a risk factor based on the case notes of student suicides (Karbeyaz et al., 2016), however this study was assessed as high risk of bias. Nonetheless, social and peer support are important predictors of undergraduate mental health problems.

Community violence. Blasco et al. (2019) found that bully victimisation predicted first-onset of suicide ideation but was non-significant for persistent ideation. Poly-victimisation (Holt et al., 2017), vicarious racism and interpersonal discrimination (Jochman et al., 2019) have been linked with anxiety and depression; however, results were inconsistent. For example, Holt et al. (2017) reported peer victimisation and minimal victimisation as non-significant risk factors, with no gender differences reported across the three reporting articles.

Sociodemographic factors

Non-modifiable sociodemographic factors. Identifying as female was consistently found to increase risk of mental health problems, which supports existing evidence that a greater proportion of females report mental health difficulties than males (Tedstone Doherty and Kartalova-O'Doherty, 2010). Predicted outcomes included depression and anxiety (Cámara and Calvete, 2012; Hossain et al., 2019 Kulsoom and Afsar, 2015; Reisbig et al., 2012; Richardson et al., 2017; Vitaliano et al., 1989), stress (Velten et al., 2018), suicidal ideation and lifetime NSSI (Wilcox et al., 2012, 2010). A non-heterosexual orientation was associated with past-year and life-time NSSI (Wilcox et al., 2010) as well as one-time suicide ideation (but not persistent ideation; Wilcox et al., 2012). Younger age predicted depression, anxiety and stress in one high quality article (Velten et al., 2018).

Modifiable sociodemographic factors. Undergraduates with financial difficulties, subjective stress about debt and those who consider abandoning studies due to financial reasons have an increased risk of depression, anxiety, psychosis, alcohol dependence and global mental health problems (Andrews and Wilding, 2004; Richardson et al., 2018, 2017). Anxiety and alcohol dependence also predicted worsening financial situations in the student

sample, suggesting a bidirectional relationship. Cooke et al. (2004) showed that not only do students become increasingly concerned about their finances as they progress through university, but debt concern and financial stress also predict worsening mental health. However, one article reported only partial effects of tuition fee level on mental health and that an increase in fees did not have a long-lasting impact (Richardson et al., 2015). In this risk category, one high quality study (Silva et al., 2017) identified "not living in a household" as a sociodemographic risk factor for student depression.

Lifestyle Factors

Physical activity. Two articles reported low weekly physical activity (Hossain et al., 2019) and insufficient physical activity (Xie et al., 2019) as predictors of depression. The latter article was also assessed as high risk of bias, suggesting that the evidence is limited.

Smoking, alcohol consumption and drug use. Smoking predicted depression, anxiety and stress in two articles (Kulsoom and Afsar, 2015; Velten et al., 2018). Marijuana use and experiencing alcohol consequences predicted depression (Rosenthal et al., 2018), however quantity of alcohol consumption was non-significant. Hossain et al. (2019) conversely reported alcohol consumption levels as significant predictors of both depression and anxiety, suggesting that the evidence-base for this risk factor is inconsistent. Substance and alcohol abuse were risk factors for student suicides (Karbeyaz et al., 2016; Niemi and Lonnqvist, 1993), however both articles received high risk of bias ratings and provide poor quality evidence.

Diet quality. One high quality article found that both low and high daily meal intake frequency were significant predictors of depression and anxiety (Hossain et al., 2019).

Problematic mobile phone use. Two articles identified excessive recreational screen time (Hossain et al., 2019) and problematic mobile phone use (Xie et al., 2019) as predictors of depression.

Factors related to Higher Education

Academic environment. Most articles found risk factors related to the university environment as predictive of depression. These include: students of a social science faculty, experiencing dissatisfaction with the student culture and future career (Hossain et al., 2019); a lack of motivation by vocational interest to study medicine (Silva et al., 2017) and concern about the curriculum (Stewart et al., 1997). Academic stressors also predicted depression, including increased academic demand (Barker et al., 2018); concerns about academic performance (Hafen et al., 2008; Morris and Tiggemann, 1999); high academic stress (Reisbig et al., 2012); academic ineffectiveness (Silva et al., 2017) and concern about personal competence and endurance (Stewart et al., 1997). A lack of clarity in educational structure and study workload were associated with psychological distress (Nerdrum et al., 2009). Taken together, the evidence suggests that both the university environment and the academic pressures associated with studying in higher education can be risk factors for depression.

Sexual harassment. Three studies (Carey et al., 2018; McGinley et al., 2016; Wolff et al., 2017) reported that experiences sexual harassment or assault whilst at university increased the risk of developing anxiety and depression.

[INSERT TABLE 2 HERE]

Quantitative synthesis

Prevalence of depression and suicide related outcomes

The prevalence of depression (k = 8) ranged from 10% to 58%. The pooled depression prevalence was 25% (95% CI 17%, 35%). The prevalence of suicide-related outcomes (k = 4) ranged from 0% to 40%. The pooled prevalence was 14% (95% CI 0%, 44%). A forest plot is provided in Supplementary Material 4. We found significant study heterogeneity (Q = 8547.2, p<0.001 and I^2 = 99%). See Supplementary Material 5 for the sensitivity analysis results with High/Moderate quality studies only.

Risk factors associated with depression and suicide related outcomes

Thirty-eight individual effect sizes contributed to meta-analytic comparisons of 13 separate risk factors across depression (12 risk factors) and suicide-related outcomes (5 risk factors; 4 risk factors were assessed for both outcomes; Table 3). For depression outcomes, risk factors significantly associated with depression were: response style (negative rumination trait), parental depression; parent separation; having a current mental health problem (at baseline); and sexual harassment. For suicide-related outcomes, financial difficulties, having a current mental health problem and childhood adversity were identified as significant predictors. Post-hoc subgroup analyses based on the type of suicide related outcome found that presenting a current mental health problem at baseline was a significant risk factor for persistent suicidal ideation, but not for one-time ideation. Heterogeneity was high for all comparisons with I2 values ranging from 0 to 99.6. Funnel plot asymmetry was evident in the majority of comparisons indicating potential influence of reporting biases (Liu, 2011).

Supplementary Materials 6 and 7 summarise the study characteristics of the included articles for both meta-analyses.

[INSERT TABLE 3 HERE]

Discussion

This is the first systematic review that determined the prevalence and risk factors of mental health problems among university undergraduates on an international scale. Our findings indicate that, whilst studying at university, 25% of students experience depression and 14% of students experience suicide-related outcomes. These rates are comparable to those reported by the World Health Organisation (WHO) survey which found that, of the 1,572 college students surveyed, one-fifth (20.3%) had a DSM disorder (Auerbach et al., 2016). The findings also suggest that the prevalence rate for depression is higher in student populations compared to the general population prevalence of 12.9% (Lim et al., 2018). Whilst there is some support for our reported prevalence rates, comparisons to the general population are inconclusive due to the heterogeneity in the broader literature. A systematic review by Ibrahim et al. (2013) found that rates of student depression were substantially higher than those found in the general US population, whereas Blanco et al. (2018) found no significant difference in the prevalence of depression between US college students and their matched non-college attendants. It is therefore difficult to make robust comparisons between the prevalence rates reported in this review with those reported for the general population.

Both the narrative synthesis and risk factor meta-analysis highlight several key determinants of mental health problems among undergraduates which can emerge at an individual, interpersonal and systemic level.

Individual risk factors

The narrative summary reported female undergraduates as a particularly high-risk group. It was not possible to confirm this in a meta-analysis due to the small number of studies that met the eligibility criteria for statistical synthesis. This is consistent with the

existing literature reporting a greater proportion of females with common mental health difficulties (Tedstone Doherty and Kartalova-O'Doherty, 2010) but may reflect different levels of self-disclosure, help-seeking behaviour or utilisation of health services (Mackenzie et al., 2006). The quantitative findings reported gender as non-significant for suicide-related outcomes, which is supported by research data showing that males tend to have a higher suicide rate and are less likely to self-disclose (Chang et al., 2019). Given that gender did not predict suicide-related outcomes, our findings support the wider literature which suggests that female students may be more likely to disclose mental health conditions than males. These findings support recent initiatives not only to ensure services are appropriate for those seeking help, but also to develop preventative outreach strategies to encourage students who are less likely to engage (Sagar-Ouriaghli et al., 2020).

Adverse childhood experiences significantly predicted suicide-related outcomes, but were non-significant for depression. This reflects the inconsistencies reported in the narrative synthesis. Whilst sexual abuse, exposure to domestic abuse, emotion deprivation and poor parental support were well-established predictors of depression, parental divorce and death produced varied results. Nonetheless, childhood adversity represents a non-modifiable risk factor that could enable university and healthcare services to assess and target students in need of psychological support.

Presenting with a mental health problem at baseline was significant for both depression and persistent suicidal ideation, with a range of mental health diagnoses reported in the narrative synthesis. Cognitive vulnerability factors (negative rumination, perceived burdensomeness and thwarted belongingness) were significant predictors of depression, highlighting the importance of psychological processes for increased risk. In line with the diathesis-stress model, these indicators recognise that individual vulnerabilities confer

elevated risk for developing or exacerbating mental health problems when triggered by the presence of stressors (O'Connor and Kirtley, 2018), such as starting university and/or experiencing debt. Indicators for suicide-related outcomes may also govern the transition from ideation to action (Klonsky and May, 2015; O'Connor, 2011), with severity and capabilities increasing over the course of the university experience. Early recognition of modifiable, individual risk factors is therefore critical to prevent further deterioration of mental health and possible suicidal behaviour, as well as considering how psychological interventions can be adapted to suit university populations with their own unique and evolving pressures.

Interpersonal factors

Two key interpersonal risk factors were identified in the narrative synthesis: parental depression and poor social support. The latter was further categorised into: social isolation (including loneliness and social disconnection) and difficulties with peers. The meta-analysis results found parental depression as a significant predictor of depression, whilst poor social support was non-significant; however, this finding arises from only three papers. The relationship between social isolation and poor mental wellbeing is well-established in the literature (Leigh-Hunt et al., 2017), and the effects of increased social support on reducing distress have been strongly evidenced (Michie and Williams, 2003). Reducing loneliness and improving levels of social support offered to students may therefore be effective interventional targets as modifiable risk factors. Considering parental depression as a non-modifiable risk factor, these findings can inform approaches to identify higher-risk students, such as those with a family history of depression.

Systemic factors

From a broader perspective, undergraduate mental health problems may be a bi-product of systemic issues in higher education. The narrative synthesis found that academic pressures, financial stress and experiences of sexual harassment whilst at university may trigger or exacerbate a range of mental health difficulties, suggesting that student life in itself can be a causal factor. A recent meta-synthesis also found that the mental wellbeing of doctoral researchers can be impacted by the university environment (Hazell et al., 2020), indicating that this is a widespread problem across different levels of study. This suggests that the nature of these systemic risk factors may therefore be relevant to postgraduate students, and may not be specific to undergraduate populations. Whilst the research area is heterogeneous, and may vary according to each institution, our findings indicate that there is a need to consider systemic issues, such as how far universities are able to engage in organisational culture change to meet good practice guidelines (see Universities UK, 2020). There is also a need to engage in the broader political landscape within which universities are shaped and funded (Universities UK, 2018).

Limitations and strengths

Whilst our review yielded a respectable number of articles, the field of student mental health is largely heterogeneous. The varied risk of bias, length of follow-up and reporting of statistical findings limited the extent to which we were able to statistically synthesise the datasets. Crucially, definitions used to describe risk factors and their associated outcomes were inconsistent. Student mental health was captured by a wide range of terms including (but not exclusive to): mental illness, mental health problems, psychological wellbeing and distress. This use of generic terminology suggests a differentiated focus across the articles and presents difficulties for combining longitudinal datasets. Outcome measures also varied, particularly with patient-reported outcome measures (BDI, PHQ-9 etc.). Articles often used

psychological inventories which have been designed and validated using clinical populations and may therefore not reflect or be generalisable to the mental health experiences of university students. Poor coordination of data collection and differences in how mental health is defined therefore limited the number of articles eligible for risk factor meta-analysis.

For the narrative synthesis we used a validated risk categorisation scheme, developed by Furber et al. (2017), which provided a detailed taxonomy of predictors for mental illness. Whilst covering a diverse range of risk factors, the framework was not developed for student populations and was therefore adapted for the purposes of this review. Categories such as "work environment" do not adequately reflect the academic pressures associated with studying in higher education and may therefore be inappropriate.

Both meta-analyses examined studies assessing depression and suicide-related outcomes (including one-time and persistent suicidal ideation, suicide behaviours and completed suicide). Subgroup analyses revealed, however, that some risk factors produce differential effects; for example, presenting a mental health problem at baseline significantly predicted persistent suicidal ideation, but not one-time ideation. This brings into question the appropriateness of combining suicide-related outcomes, especially when considering the significant between-study heterogeneity. Due to the small number of eligible studies it was not possible to determine whether this heterogeneity also reflected differences in study design (length of follow-up, outcome measures) or study characteristics (sample size, country of origin, etc.).

This review nonetheless has a number of strengths. To our knowledge, this is the first systematic review identifying risk factors for student mental health and distress in undergraduates and on an international scale. A meta-analysis following similar review procedures was conducted by Dachew et al. (2019), however the sample was exclusive to

Ethiopian universities. We used a standardised quality assessment tool which was undertaken in duplicate to minimise bias. Eligibility, study selection and data extraction were also completed by five independent reviewers, with a final reviewer to ensure reliability and validity of the findings. Given the number of longitudinal articles screened during study selection, the review has wide-reaching coverage of relevant research. Excluding low quality cross-sectional designs also allowed for definitive cause and effect relationships to be determined.

Implications for practice and research

This research can help schools, universities, health systems and policy makers to identify groups of undergraduates at risk of poor mental health, which is an essential condition to prioritising resource allocation and targeting effective preventive care. Preventing the emergence of crises prior to or during the developmental transition to university (Barkham et al., 2019; Reavley and Jorm, 2010), based on a set of discrete and modifiable risk factors, may therefore be an effective approach. In line with MRC guidance (Steyerberg et al., 2013), the risk factors identified in this review provide the necessary, evidence-based groundwork to developing and validating a statistical model for predicting individual risk and prognostic endpoints. This would require a prospective cohort study, the size of which would be determined by the baseline prevalence rate of a given mental health problem in the chosen population and the candidate risk factors associated with the presenting problem. The proposed model would allow practitioners to screen at-risk student populations, and tailor preventive strategies to meet individual needs and address priority areas (Hingorani et al., 2013). This stepwise approach to predicting risk may also inform treatment decisions and enable stratification for risk severity in university healthcare settings.

Further longitudinal research is however, warranted to robustly test the findings of small-scale studies, such as those exploring risk factors related to low emotional resilience and negative coping. This could also feed into the development of more coherent and appropriate study design and outcome measurement approaches to better identify and support students at risk (Barkham et al., 2019), and allow for comparisons to age-matched peers in the population. More generally, we advocate for a core minimum dataset to be developed for use in student populations, including recommended outcome measurement scales and screening tools, based on the methodological problems, between-study heterogeneity and inconsistent terminology highlighted in this review.

Conclusion

This review evidences the importance of a range of risk factors for poor undergraduate mental health. By understanding risk factors that underpin student mental health, interventions can be targeted and modified to meet students' needs based on their presenting problem and level of risk. Critically, early recognition of at-risk students presents an opportunity to prevent the emergence of mental health crises by intervention prior to or early in the university experience. Further longitudinal research is however, needed to overcome the shortcomings of the current evidence base before robust conclusions can be made.

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Conflict of interest

None of the authors has a conflict of interest to disclose.

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Table 1. Characteristics of studies included in the systematic review (n=66)

	Number of Articles (k)	**Percentage (%)**
Total Number of Studies	**66**	**100**

Participant Characteristics		
Gender Mix, Study Population		
Approx. 40-60% Females	**17**	**25.8**
More than 60 % Females	**35**	**53.0**
Less than 40 % Females	**5**	**7.6**
Not Reported	**9**	**13.6**
Region (Countries)		
USA and Canada	**27**	**40.9**
Europe (UK, Scotland, Spain, France, Belgium, Greece, Norway, Germany, Netherlands, Turkey)	**22**	**33.3**
East Asia (China, Japan, Hong-Kong)	**12**	**18.2**
South Asia (India, Bangladesh) and Saudi Arabia	**3**	**4.5**
Australia	**2**	**3.0**
Predicting Factors Characteristics		
Inventory / Psychiatric Measure		
CES-D	**14**	**21.2**
DASS-21	**6**	**9.1**
PHQ-9	**3**	**4.5**
BDI and BDI-II	**2**	**3.0**

Not Applicable	**3**	**4.5**
Other	**11**	**16.7**
Multiple Inventory	**27**	**40.9**
Outcome (Psychiatric Diagnosis)		
Depression	**14**	**21.1**
Psychological Distress	**5**	**7.6**
Suicidal Ideation	**5**	**7.6**
Other	**5**	**7.6**
Multiple Outcome	**37**	**37.0**
Study Characteristics		
Length of Follow-Up		
≤3 Months	**6**	**9.0**
4-6 Months	**12**	**18.2**
7 -12 Months	**31**	**47.0**
13-15 Months	**4**	**6.1**
> 15 Months	**11**	**16.7**
Not reported	**2**	**3.0**
Study Size (Participants)		

≤ 100	4	6.1
≥ 101 - 500	40	60.6
≥ 501 - 1000	11	16.7
≥ 1001	11	16.7
Study Overall Risk of Bias		
Low	21	31.8
Medium	36	54.5
High	9	12.1

Notes. CES-D: Center for Epidemiological Studies-Depression Scale (Radloff, 1977); DASS-21: Depression Anxiety Stress Scale-21 (Lovibond and Lovibond, 1995); PHQ-9: Patient Health Questionnaire (Spitzer et al., 2000); BDI: Beck Depression Inventory (Beck et al., 1961); BDI-II (Beck et al., 1996)

Table 2. *Summary of risk factors in the narrative synthesis*

Reported potential risks (QUIPs Score)*	**Significant risk factors**
Physiological and health	

Physical illness and disability (*L*)	Personal illness/injury; Problems with health; Chronic health problems (at baseline and at 12 months; Disability at baseline; Baseline health outcomes
Sleep disturbance (*L*)	Dissatisfaction with daily sleep and long sleep duration (for depression) and short sleep duration (for anxiety); Sleep problems; Sleep disturbances and daytime dysfunction
Psychological	
Stress (*M*)	High perceived stress; Increased perceived stress; Transitional stress; Stress High levels of stress; Interaction between social avoidance and perceived stress
Self-perceived health (*M*)	Worries about own health; Perceived poor physical health; Perceived physical illness
Self-esteem and self-beliefs (*M*)	Perception of competence; self-esteem; External contingencies of self-worth; Low self-esteem; Self-image goals; Vulnerability to harm
Personality (*L*)	Personalities with weak capacity to adjust; High openness; High agreeableness; Cynicism, trait anxiety; Type A personality
Cognitive functioning and response styles (*L*)	Negative rumination trait and uncontrollability of negative rumination; Rumination; Negative coping; Problem solving avoidance; Perceived burdensomeness and thwarted belongingness; Negative cognitive styles, Extreme, pessimistic attributions, Higher levels of brooding, Higher inhibition costs; Depressogenic cognitive style; Cognitive appraisal variables
Emotion regulation (*L*)	Suppressed anger in females; Emotion dysregulation; Anger suppressed; Unwillingness to express emotion; Emotional exhaustion

Trait resilience (*M*)	Low emotional resilience; Low bounce-back resilience
Current mental illness (*M*)	Depressive symptoms; Depression, anxiety; Baseline depression Extreme baseline depression; Any mental disorder; Generalised anxiety disorder; Non-suicidal self-injury; Suicidal ideation; Suicide attempts and plans; 1-3 mental health disorders; Depressed mood; Rating of suicidal ideation at baseline; Depressed mood during 12 month follow-up; Definite/Possible psychiatric illness in males; Repeated suicide attempts in females; Depression by Year 3 of studying; Depression diagnosis during college; Baseline Psychological distress
Psychiatric history (*M*)	History of depression before medical school; Depression diagnosis prior to college
Predictors of response to trauma	
Negative life events (*L*)	Negative life events; Sexual victimisation prior to college; Any traumatic experience; 2 and 3+ traumatic experiences
Childhood adversity (*L*)	Emotional deprivation; Punishment and scolding; emotional abuse, Emotional abuse and neglect; Exposure to domestic abuse; Sexual abuse
Additional life stress (*M*)	The perceived intensity of daily stressors (for females); Depressed reactions to daily stressors (in females); Stressful events; Daily life stressors; Any stressful event experienced within 12 months, 2 and 3+ stressful events experienced within 12 months
Relational	

Parental depression (*L*)	Positive family history of depression; Possible/definite maternal depression; Parental psychopathology; Maternal depression and paternal depression; Father negative mood; Mother negative mood; Family history of suicide
Attachment to parents (*L*)	Having a negative relationship with the mother
Parenting (*L*)	Increased activity; Behaviour restrictions by the father
Social isolation (*L*)	Loneliness; Homesickness; Social disconnection; Isolation and loneliness in females; Frequency of social contacts outside work/school at baseline (in females); Low social connectedness
Social relationships (*L*)	Institutional integration with peers; Interpersonal conflicts; Difficult fitting in with peers; Not getting along with roommate; Difficulties with relationships, Not satisfied with social network or social activities; Concern about recreational social life; Serious betrayal from someone other than partner; Serious ongoing arguments or breakup with friend or family; Breakup with romantic partner; Romantic partner cheated; Relationship stress; Romantic problems in males; Relationship difficulties; Social pressure in females; Irregular social rhythm; Quality of relationships
Social support (*L*)	No perceived parental support; Low social support
Perceived discrimination/ Racism (*M*)	Interpersonal discrimination and vicarious racism; Poly-victimisation; Bully victimisation
Community violence (*L*)	Gender harassment; dating violence
Sociodemographic	

Debt and/or worsening SES (*M*)	Financial difficulties; Index financial scores; Debt worry and financial concerns; Tuition fee amount x time interaction; Greater subjective stress about debt; Considering abandoning studies due to financial reasons; Students who see loan as an extra tax
Poor living arrangements (*L*)	Not living in a household
Gender (*L*)	Identifying as female
Sexual minorities (*L*)	Sexual orientation (bisexual and homosexual); Non-heterosexual orientation
Age (*L*)	Younger age
Factors related to Higher Education	
Academic environment (*L*)	Increased academic demand; Concerns about academic performance; Students of a social science faculty; Dissatisfaction with current education and future career; Poor subjective examination performance; High academic stress; Academic ineffectiveness; Work/school failure; Not motivated by vocational interest or professional security to study medicine; Difficulties with learning; Concern about the curriculum; Advancing years in a programme; Study workload, clarity of educational structure
Sexual harassment (*L*)	Previous sexual assault; Chronic sexual harassment; Sexual coercion; Unwanted sexual attention
Lifestyle	
Physical activity (*M*)	Weekly physical inactivity; Insufficient physical activity

Alcohol consumption (*L*)	Alcohol consumption and alcohol consequences; Alcohol use; Alcohol problems; Alcohol consumption
Drug use (*H*)	Substance abuse; Other drug problems; Ongoing substance misuse
Smoking (*L*)	Regular smoking; Smoking
Diet quality (*M*)	Low and high daily meal intake frequency
Mobile phone use (*M*)	Low and excessive recreational screen time and Problematic mobile phone use

**L* low risk of bias, *M* moderate risk of bias, *H* high risk of bias

Table 3. *Factors associated with depression and suicide-related outcomes among university undergraduate students (Pooled OR with 95% CI)*

Risk factors	Number of Included Studies (k)	Combined Sample Size (n)	Pooled OR (95% CI)
Depression			
Current mental health problem	3	1,309	2.78 (2.15-3.59)*
Parental mental illness (depression)	3	2,515	2.30 (1.64-3.20)*
Alcohol consumption	3	3,162	1.25 (0.48-3.23)
Adverse childhood experiences	3	2,450	1.71 (0.94-3.12)
Poor social/peer support	3	1,481	2.51 (0.97-6.54)
Sexual assault/harassment	2	1,441	2.44 (1.17-5.07)*
Parent separation	2	5,421	1.33 (1.22-1.44)*
Response styles (negative rumination)	2	338	1.11 (1.06-1.16)*
Financial difficulties	2	4,814	1.83 (0.71-4.69)
Drug use and smoking	2	2,211	1.18 (0.46-3.01)
Perception of health	2	1,029	0.61 (0.06-6.14)

Academic stressors	2	1,029	2.99 (0.70-12.25)
Suicidal ideation			
Financial difficulties	3	5,955	1.16 (1.30-1.31)*
Adverse childhood experiences	2	2,501	4.31 (2.03-9.16)*
Current mental health problem	2	2,501	3.59 (1.01-12.75)*
Identifying as female	2	1,326	0.84 (0.51-1.40)
Parental separation	2	5,711	1.06 (0.68-1.65)

*Significant effect of risk factor on presence of mental health problems $p<.05$