

Interventions Addressing Loneliness Among University Students: A Systematic Review

Olivia Betty Ellard

University of Warwick Warwick Medical School

Christina Dennison

University of Warwick Warwick Medical School

Helena Tuomainen (✉ Helena.Tuomainen@warwick.ac.uk)

University of Warwick Warwick Medical School <https://orcid.org/0000-0003-1636-8187>

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Abstract

Background

Loneliness is detrimental to mental health, with university students at higher risk than other population groups. However, little research has explored interventions to reduce loneliness among students. This systematic review identifies the characteristics and effectiveness of interventions targeting students at university or college.

Methods

PsycINFO, PubMed, ASSIA and Web of Knowledge were searched from inception using keywords linked to 'loneliness', 'intervention' and 'students'. Relevant peer and non-peer reviewed English-language articles on studies implementing an intervention with loneliness as an outcome and investigating undergraduate or postgraduate students at a higher education institute were included for quality analysis and narrative review. Risk of bias was assessed at both study level and at outcome level using the revised Cochrane risk of bias tool for randomized trials (ROB2) and the risk of bias in non-randomized studies of interventions (ROBINS-I).

Results

22 articles were included, comprising 18 quantitative and four qualitative studies covering 29 interventions. The large majority of studies were conducted in the United States. Interventions were based on psychoeducation, social support groups, increasing social interaction, or reflective exercises. For quantitative studies, 80% of each of the interventions based on either social support, increasing social interaction or reflective exercises, and 30% of psychoeducation interventions reduced loneliness scores significantly. 21 out of 25 interventions measured quantitatively were delivered in a group setting, of which 62% significantly reduced loneliness scores, regardless of intervention.

Conclusions

Universities have a choice of interventions to help reduce loneliness among students either on campus or virtually. Ones promoting social connectedness appear to be more successful. More high-quality studies in a larger number of countries are needed, taking vulnerable student groups into consideration.

Background

University students have been found to suffer with depression, stress and anxiety (1-4). This is being addressed globally by improvements to university mental health services (5-7). Despite this, college students in the United States (U.S.) reporting mental health concerns increased from 19% to 34% between 2007 and 2017. In the United Kingdom (UK), this number increased almost five-fold (from 0.4% in 2006 to 2% in 2016) in first year students, prompting a significant rise in the demand for student support services

(1). Meeting this increasing demand is a challenge for universities (1, 8, 9). New approaches are needed to improve student wellbeing. A preventative strategy is to focus on student loneliness.

Loneliness is a subjective, negative experience associated with the sense of having fewer social contacts than desired and/or a lack of anticipated level of intimacy in relationships (10). Loneliness predicts greater anxiety, stress and depression in students (11, 12) and has been associated with maladaptive coping styles, lower life satisfaction and suicidal ideation (13). In 2014-15, 32.4% of students in Germany felt moderately lonely and 3.2% severely lonely (12). In 2018, young people aged 18–22 were identified as the loneliest generation of Americans (14). The same year, 9.8% of young people in the UK aged 16 to 24 years “often” felt lonely. A follow-on survey found that over 15% of students reported feeling lonely on a day-to-day basis, with figures worse for Black, Asian and Minority Ethnic (BAME), disabled and international students, and those living at home (15).

Students tend to form friendships with other students who share interests and hobbies (16). In 2020, students across the globe were affected by the global Covid-19 pandemic. This caused the closure of campuses, the restriction of face-to-face teaching, and the cancelling of sports and society events. Students were confined to their accommodation, or at home with parents. Opportunities to develop friendships were reduced. During the first lockdown, young people and students in the UK and U.S. experienced loneliness and suffered from psychological distress more intensely than the general population (17, 18). In the UK, 18 to 24 year olds were nearly three times more likely than 65 to 74 year olds to have experienced loneliness “more often than normal” (19).

The evidence suggests a greater need for interventions to reduce loneliness in students, both in response to restrictions related to the Covid-19 pandemic but also outside of such restrictions. While charities and health services offer help for those feeling lonely at university (17), targeted interventions have been developed to attempt to relieve loneliness. Discussion groups allow students to talk with others about the stresses of university, relationships and self-identity (20). Social skills training enable students to overcome loneliness by learning new skills (21). Online chat rooms and forums allow students to connect with other students from home (22). Although universities currently offer various relevant interventions that address student loneliness, these have not been evaluated thoroughly. There is a need for a solid research base (23).

A systematic review by Masi et al. (24) grouped loneliness interventions aimed at adults into four categories: improving social skills, enhancing social support, increasing opportunities for social contact and addressing maladaptive social cognition. The latter was found to be the most effective intervention; however, students were not identified as a vulnerable subgroup. In another systematic review, Bessaha et al. (25) discovered that interventions involving technology and support groups significantly reduced loneliness in various adult groups. Again, students were not identified as a subgroup. It is therefore unclear which interventions are suitable and effective for university students. Due to the scarcity of studies targeting students, in this systematic review our aim was to identify, describe and analyse the

effectiveness of all intervention studies addressing loneliness in university students, including those with loneliness as a secondary outcome.

Methods

Protocol and registration

The protocol for this review was registered with the PROSPERO database (CRD42020180867) (Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020180867.) This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (26).

Search strategy

Searches were conducted on four electronic databases: PsycINFO, Medline, Web of Knowledge and Applied Social Science Index and Abstracts on 22nd April 2020. The search strategy combined keywords and index terms for the concepts of loneliness, interventions and students. A full search strategy can be found in Additional file1 [see Additional file 1].

Reference lists of full text articles were screened for additional relevant studies. Duplicates and non-English titles were removed using a reference management software to provide an initial list of articles. Titles and abstracts were screened independently by two reviewers (OE and CD). Discrepancies were discussed between reviewers, and a third opinion (HT) was sought in the event a discrepancy could not be resolved.

Eligibility criteria and study selection

Journal articles and doctoral dissertations were included only if they met the inclusion criteria specified in Additional file 2 [see Additional file 2]. Studies implementing an intervention with loneliness as an outcome and investigating undergraduate or postgraduate students aged 16 years or above at a higher education institute were included. Following the review of titles and abstracts, articles were assessed by reviewing the full text. Conflicts were resolved by discussion among the research team.

Quality assessment

Risk of bias was assessed at both study level and at outcome level. The revised Cochrane risk of bias tool for randomized trials (ROB2) (27) was used to assess randomised experimental studies. The Risk of Bias In Non-Randomized Studies of Interventions (ROBINS-I) (28) was used to assess non-randomised experimental studies. Studies deemed to have “critical” risk of bias were excluded from data synthesis.

Two reviewers (CD and OE) assessed all studies independently then collaborated to identify discrepancies. If disagreements remained, a third opinion was sought (HT).

Data extraction and synthesis

Data extracted from each study included: author, journal, year of publication, location, study type, subgroup, intervention, control, measurement tool, number of participants consented (% male), % drop-outs pre-intervention, group sizes at pre-test (% male), groups sizes at post-test (% male), group sizes at follow up (% male), % drop out from pre-test to follow up, mean age (range) at follow up, and measurement points. A pilot extraction was performed on a small sample.

Attempts were made to contact authors in the event of missing data, e.g. on planned analysis, but these were unsuccessful. All data was extracted by two reviewers (OE and CD) independently, then results were compared for discrepancies. A third opinion (HT) was sought in the event of a disagreement. Given the use of two reviewers, blinding was not performed. An Excel spreadsheet was used to extract data; no other data management tools were used.

A meta-analysis was not possible due to the heterogeneity of studies. Instead, a narrative synthesis of findings was performed.

Results

Study selection

Following removal of non-English language and duplicate articles, 2852 articles remained for screening by title and abstract (Figure 1). 138 articles underwent full-text screening during which 118 were excluded, leaving 20 articles. Three additional articles were included after searching reference lists of full-text articles. 19 quantitative and four qualitative studies were included in the quality assessment.

Findings from quantitative research

Study quality

Quality assessment of quantitative studies is presented in Figure A1 (randomised control trials, n= 11) and Figure A2 (non-randomised designs, n=8) in Additional file 3 [see Additional file 3]. The study by Mohamed et al. (29) was found to have an overall critical risk of bias arising mostly from missing data; this article was removed from further review.

Of the remaining 18 studies, eight were judged as having overall high or serious risk of bias and ten were judged as having overall moderate risk or some concerns. Of the studies judged to have a high or serious

risk of bias, most (n=6) were due to a lack of blinding of participants. As all measurements of loneliness were self-reported, knowledge of the intervention may have influenced participants' responses. Therefore, findings of studies judged as having high or serious risk of bias were interpreted cautiously.

All studies other than Mascaro et al. (30), in which all analyses were conducted using blinding, were judged as either moderate risk or some concerns for risk of reporting bias. No further articles were removed due to concerns of risk of bias.

Study characteristics

Of 18 studies using quantitative measurements of loneliness, 11 were randomised control trials (RCT), three were controlled pre-test, post-test designs and four were pre-test, post-test designs without a control group. 11 of the 18 studies were published within the past ten years, the remainder being conducted between 1985 and 2010.

The characteristics of each study are presented in Table 1. The majority of the studies were conducted in the U.S. (n= 14); one additional study was conducted in each of the following countries: UK (31), Turkey (32), Canada (21) and China (13). All participants were university students, however, some articles specified subgroups, including students with autistic spectrum disorder (33), graduate students (34), medical students (20, 30), elementary education students (32), psychology students (35, 36), first year students (37, 38), students displaying elevated levels of loneliness at baseline (13, 21, 31, 39) or students self-identifying as stressed, anxious, or depressed, or with a pre-existing mental health condition (31). The sample sizes in the included studies ranged from 2 (40) to 112 (36).

Outcome measures

Tools used to measure reductions in feelings of loneliness were relatively consistent across the research, with most (n=12) using the Revised UCLA Loneliness Scale or UCLA3. The UCLA3 consists of 20 items assessing subjective feelings of loneliness and feelings of social isolation, using questions such as "How often do you feel close to people?". Participants rate each item on a scale of 1 (Never) to 4 (Often) (41). Other tools used to measure feelings of loneliness included one item of the PERMA profiler (36), a three-item loneliness Likert scale (35), The University of the Philippines Loneliness Assessment Scale (UPLAS) (42) and the Chinese College Student Loneliness Scale (13).

Measurement points varied. A pre- and post-test measurements only were taken in five studies. An additional mid-test measurement was implemented in six studies (including Barber (22) in which multiple mid-test measurements were taken). A further follow-up measure was taken in six studies. The length of time between post-test measurements and follow-up measurements varied from two weeks (43) to around six months (20, 37, 44).

Intervention characteristics

13 studies explored the effectiveness of a single intervention whereas five studies compared the effectiveness of multiple interventions. In total, 18 studies covered 25 interventions. While the aim of three studies was solely to reduce levels of loneliness (13, 35, 39), most used loneliness as one measure of intervention effectiveness among others, such as happiness (32, 36), anxiety (31, 32, 42), adjustment to college (37), academic achievement (38), self-esteem (21, 22, 33, 40), confidence (44), overall wellness (20, 34), empathy (20), depression (21, 31, 40, 43) and compassion (30).

The nature of the interventions followed common themes: some provided psychoeducation (21, 35, 36, 39, 43), some implemented social support groups in which students could discuss problems (20, 33, 37, 38, 44), some provided an opportunity for social interaction with other students outside of a support group, with or without a specific activity or topic of discussion (22, 31, 32, 40, 42) and others implemented reflective exercises such as mindfulness (13, 22, 30, 34, 35).

The majority (n= 21) of interventions were implemented in a group setting, whereas a smaller number (n= 4) were implemented on an individual. Two group interventions were delivered online (22, 40) as was one individual intervention (22). Of the group interventions, group sizes varied from two participants (40) to 112 participants (36).

Time commitments required from students to partake in each intervention varied. The longest duration of any intervention session was 180 minutes (32), with others lasting between 30 minutes and 120 minutes (Table 1). Overall, support group interventions appeared to require longer sessions whereas individual interventions were found to use shorter sessions.

Of the studies that included a control condition (n=14), most (n=8) did not implement an intervention for this group. Instead, measurements coincided with those taken from the intervention group. Six studies, however, created an alternative intervention to act as a control condition. These included the provision of general information (35, 37, 38), an educational course not aimed at reducing loneliness (32, 36) and a self-help discussion (39).

Study findings

Of 25 interventions, 15 interventions found a statistically significant effect in decreasing loneliness scores (Table 2). These included three psychoeducation interventions (21, 36), four reflective exercises (13, 22, 30, 34), four social support interventions (33, 37, 38, 44) and four social interaction interventions (22, 32, 40, 42). Seven interventions showed a reduction in loneliness score, however this was not deemed to be statistically significant (20, 31, 35, 43).

Two out of four individual interventions (performed with or without the use of the internet) showed statistical significance (22, 34), the two not showing statistical significance were psychoeducation type (43). Of 21 group interventions, 13 showed statistical significance (13, 21, 22, 32, 33, 36, 38, 40, 42, 44).

Of the interventions performed online, all three were effective in reducing loneliness scores regardless of whether they were performed in an online group or individually (22, 40). Two of these interventions involved chatting to another online (22, 40), and the other involved typing journal entries (22).

Three of ten psychoeducation interventions showed statistical significance (21, 36), as did four of five social support interventions (33, 36-38, 44), and four of five reflective interventions (13, 22, 30, 34). Three reflective exercises utilised meditation and mindfulness (13, 30, 34) and one utilised writing in a journal (22). Four of five social interaction interventions demonstrated a statistically significant reduction in loneliness scores (22, 32, 40, 42), one of which utilised non-human interaction with a dog and facilitator (42).

The largest proportion of interventions failing to show a statistically significant reduction in loneliness score were in the psychoeducation category, of which, five of seven were published in 1996 or earlier (39, 43).

Studies involving students with pre-existing mental health problems or feelings of loneliness (diagnosed or self-declared) included a range of interventions including social interaction (31), reflective (13), and psychoeducation interventions (21, 39, 43). However, only three interventions out of nine targeting these students demonstrated a statistically significant reduction in loneliness score (13, 21).

Although no study compared the effect of a single intervention across subgroups, reductions in feelings of loneliness appeared consistent across groups. For example, reductions in loneliness were seen across students of all educational disciplines, in those with autism spectrum disorder (ASD) (33) and in students from varied geographic locations. Similarly, reductions in feelings of loneliness were reported in studies sampling mostly female students (21) and in studies sampling mostly male students (33).

Findings from qualitative research

Study quality

Quality assessment of qualitative studies is presented in Figure A3 (n=4) in Additional file 4 [see Additional file 4]. Three studies (45-47) had an overall moderate risk of bias. Horgan et al. (48) was found to have a serious risk of bias due to missing data. The primary objective was to assess a decrease in depressive symptoms, however, only a small number of participants (7 out of 118) provided forum posts at follow up, some of which related to the reduction of feelings of loneliness.

All qualitative studies were judged as having moderate risk of bias due to confounding factors. This arose from a lack of randomisation in the allocation process.

Study characteristics

All interventions explored through qualitative research (n=4) were delivered as part of a group, with one (48) delivered in an online format (Table 3). Two studies recruited medical students (45, 46), one recruited black, male students (47) and one recruited students scoring highly on the C-DES scale of depressive symptoms (48). Three studies were conducted in the USA (45-47) and one in Ireland (48).

Clark et. al. (47) collected data through semi-structured, open ended interviews as opposed to questionnaires or forums (45, 46, 48). Horgan et al. (48) and Brodtkin et al. (45) primarily used quantitative methods to measure outcomes other than loneliness, for example, reductions in depressive symptoms. These were included as reductions in loneliness were commented on qualitatively.

Data were collected at different points across the research: Brodtkin et al. (45) adopted pre-test and post-test measurements, as did Horgan et al (48). Clark et al (47) and Goetzel et al. (46) collected data post-test only. Although this design prevents a comparison to baseline levels of loneliness, participants were asked to give their opinions of the intervention, not their levels of loneliness.

Intervention characteristics

The types of interventions implemented included support groups and increasing social interaction (Table 3). Support groups included the “Human Dimension Group” which adopted a face-to-face discussion around student difficulties with support from a facilitator (46). An online forum allowed students to support each other virtually with access to online resources (48). The “Black Male Scholars Programme” improved social interaction by encouraging students to play sports together and by enlisting speakers on a number of topics (47). A parenting and professionalism course also improved social interaction in which students learned about parenting (45).

Study findings

Table 4 summarises the findings of interventions using qualitative data collection. The results of a study sampling students of black African or Caribbean descent showed that bringing students together who have a shared cultural experience can reduce the feelings of loneliness (47). Feedback for the Black Males Scholar Programme was generally positive across participants and focussed on reducing alienation of ethnic minorities in universities.

Horgan et al. (48) reported that, although primarily aimed at reducing depressive symptoms, the online forum resulted in participants feeling less lonely due to being able to talk to others in a similar situation to theirs. Being able to tell someone about their problems improved feelings of loneliness: “It’s about empathy and the realization that you’re not alone. Being able to tell someone/people, even if it is just anonymously putting it out there into the virtual domain, is supposed to be cathartic in some way. And it kinda’ is.” (48)

Studies investigating medical students showed that support groups were beneficial, although Brodtkin et al. (45) specified that the intervention group reported no increase in loneliness as opposed to a decrease. Feedback for both interventions was generally positive across participants.

Discussion

This systematic review has investigated the characteristics and effectiveness of interventions addressing loneliness in university students. Loneliness is an indicator of wellbeing and may lead to the development of mental disorders if left untended (49). From inception to date, 29 interventions addressing loneliness among university students were discovered, as part of 22 studies. Only seven interventions targeted loneliness as a primary outcome (13, 35, 39), others had a broader wellbeing remit. Interventions providing social connectedness via social support groups or social interaction, and those based on reflective exercises, were more effective in reducing loneliness than psychoeducation. Nearly two thirds of interventions conducted in a group setting and measured quantitatively showed a significant reduction in loneliness scores. Qualitative studies highlighted that the sharing of experiences with students of similar background or with similar experiences helped reduce feelings of loneliness. However, none of the studies followed up participants longitudinally. It is therefore unclear whether the interventions had lasting impact. As blinding to the intervention was not possible, all studies scored with at least “some concerns” or “moderate risk of bias” during quality assessment.

The current review represents an unexplored avenue in loneliness research: 13 of 22 studies focusing on university students were published within the past ten years, the remainder being conducted earlier, over a period spanning 25 years. The majority of the research has been carried out in the U.S., including two of the studies with a narrow focus on loneliness, despite increased numbers of students all over the world suffering from loneliness, especially owing to Covid-19 pandemic.

The four major intervention strategies that were identified (psychoeducation, increased social support, reflective exercises and increased social interaction) closely mirror those identified by Masi et al. (24), with ‘psychoeducation’ being broader but encompassing the ‘addressing maladaptive social cognition’ strategy. In the current review, 80% of interventions evaluated quantitatively utilising either social support, reflective exercises, or increasing social interaction as a strategy demonstrated significant reductions in loneliness. Psychoeducation type interventions failed to show similar efficacy; only 30% of interventions showed significant reduction in loneliness. This contrasts findings of Masi et al. (24) who found addressing maladaptive cognition was the most effective technique.

In support of psychoeducational techniques, Jones et al. (50) have concluded that loneliness results from a lack of teachable social skills. Cognitive behavioural therapy targeting maladaptive cognitions has also been found to reduce loneliness in an elderly population (51). Psychoeducation interventions identified in this review included cognitive restructuring exercises and developing (social) skills with which to tackle loneliness, for example, through roleplaying. Two effective interventions out of eight targeted at students with elevated loneliness were based on psychoeducation. However, some other interventions were not

solely focused on loneliness but had a broader wellbeing remit (21, 36, 43). This may account for some of the variance between the current findings and those reported by Masi et al. (24), whose review included only interventions targeting loneliness.

Social support groups allowed students to discuss worries, manage stressors of university and seek advice and support. Bessaha et al. (25) found that support groups are one of the most effective interventions for reducing loneliness in non-elderly adults. Having others listen to one's problems can increase a sense of self-esteem and a sense of perceived support, both of which mediate loneliness (52). There might also be a link between feeling part of a community and reduced loneliness (53).

Interventions increasing social interaction encouraged students to spend more time with others outside of a support group, for example through playing sports or partaking in creative exercises. It appears that the act of coming together with other students helps reduce loneliness. Nyqvist et al. (54) found that young people who simply have more contact with others experience reduced levels of loneliness. A sense of social connectedness has also been identified as a protective mechanism against developing mental disorders (55). The promotion of friendships between adolescents has been shown to halve the risk of developing depression over 6 to 12 months (56).

Virtual communication interventions allow social connections to develop from home via use of technology. Our results showed significant reductions in loneliness associated with online interventions such as chat rooms. (22) (40). The association of social connectedness (regardless of physical or virtual meeting), with mental wellbeing is clear. However, existing literature regarding the effect of technology on loneliness is mixed (57-59).

Reflective interventions, such as meditation or journal writing, encouraged students to reflect on their own feelings without interference or instruction, differentiating them from cognitive restructuring. Negative thought processes associated with loneliness can be addressed by techniques such as increasing awareness of self and surroundings (60). Other documented benefits of mindfulness include reduction of anxiety, depression and mood disorders (61). In addition, reflective interventions can be performed alone, therefore may be more useful when group meetings are not possible.

Strength And Limitations

p>To our knowledge, this is the first systematic review to explore interventions addressing loneliness in university students.

Our search strategy incorporated a range of search terms, multiple databases and was not limited by the date of publication. Two independent reviewers completed both screening and quality assessment of all research ensuring reliability.

Whilst previous systematic reviews have focused on interventions with loneliness as the primary outcome, our review included studies with loneliness as either primary or secondary outcome, thus

capturing all relevant research in this area and drawing attention to interventions which may serve multiple purposes.

The reasons why some interventions were not effective may be because they were not developed specifically to reduce loneliness and because the studies were not powered to detect differences in secondary outcomes.

Our review may suffer from positive publication bias, inflating the perceived effects of an intervention (62). Although some non-published doctoral dissertations were identified, the majority were journal publications, leaving our results vulnerable.

We were unable to perform a meta-analysis due to the heterogeneity of studies. A percentage reduction in loneliness was somewhat comparable between studies using identical measurement tools (e.g. 20 item UCLA3) but was not possible between studies using different tools. This was due to variations in the number of and weighing of items in each scale.

Further to this, the UCLA3, the UPLAS Loneliness Scale, Chinese college student loneliness scale and 3 item Likert scale for loneliness were found to have coefficient alphas for reliability of .89 to .94 (63), .93 (64), .86 (13) and .89 (35) respectively, making any objective comparison more difficult.

Interventions were classified under broad groupings, between which will be some overlap as most appeared to include components of multiple categories. Interventions were, therefore, categorised based on their most prominent theme introducing an element of subjectivity.

Implications For Future Research

The majority of research identified was deemed at an increased risk of bias due to quasi-experimental study designs. Further studies adopting a randomised controlled trial design are needed to address this, especially among students with elevated loneliness or mental health problems. Further research is also needed to compare the effect of a given intervention across multiple subgroups, and to evaluate the effectiveness of an intervention longitudinally.

Due to the lack of research in BAME students and those with autism or disability, further experimental studies should be conducted in these subgroups. Evidence demonstrates these groups are particularly vulnerable to feelings of loneliness (65, 66).

Research is shifting focus from traditional methods of targeting loneliness, to the inclusion of digital interventions (67). They might combine aspects from different interventions, such as facilitating support groups via mobile applications. Virtual communication may remove potential barriers associated with the uptake of interventions, such as physical distance, time/space/facilitator availability and student confidence in meeting strangers.

Lastly, one of the intervention studies designed specifically to lower loneliness (39) differentiated between social loneliness, a lack of a supportive network, and intimate or emotional loneliness, a lack of an intimate relationship, in line with a growing body of research (68, 69). Although tailoring interventions to subtypes of loneliness was not effective in this student sample, future studies should take into account the different dimensions of loneliness (60).

Conclusions

Loneliness has detrimental effects to mental health and is prevalent in the student population. University campuses are ideally placed to tackle loneliness among students as a preventative or targeted strategy and a solution to stem the sharp rise in the demand for mental health/support services. The current review shows that universities can choose from a variety of strategies, ranging from social support groups to reflective exercises, and that most successful interventions among students promote social connectedness and are conducted in a group setting. Virtual platforms are a promising medium for delivering interventions when social gatherings are restricted. Further intervention studies should be conducted with loneliness as the primary endpoint in a broader range of countries and cultures, covering students with elevated loneliness, of different ethnic backgrounds and those with autism or a disability.

Abbreviations

G: Group

OG: Online Group

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

RCT: Randomized controlled trial

ROB2: The revised Cochrane risk of bias tool for randomized trials

ROBINS-I: The Risk of Bias In Non-Randomized Studies of Interventions

Declarations

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

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Authors' contributions

HT was responsible for the conception and design of the work, and critical revision of the article. OE and CD conducted all activities related to the review, including data collection, data analysis and interpretation, drafting the first manuscript, and critical revision of the article, under HTs supervision. All authors approved the final version of the article.

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Figures

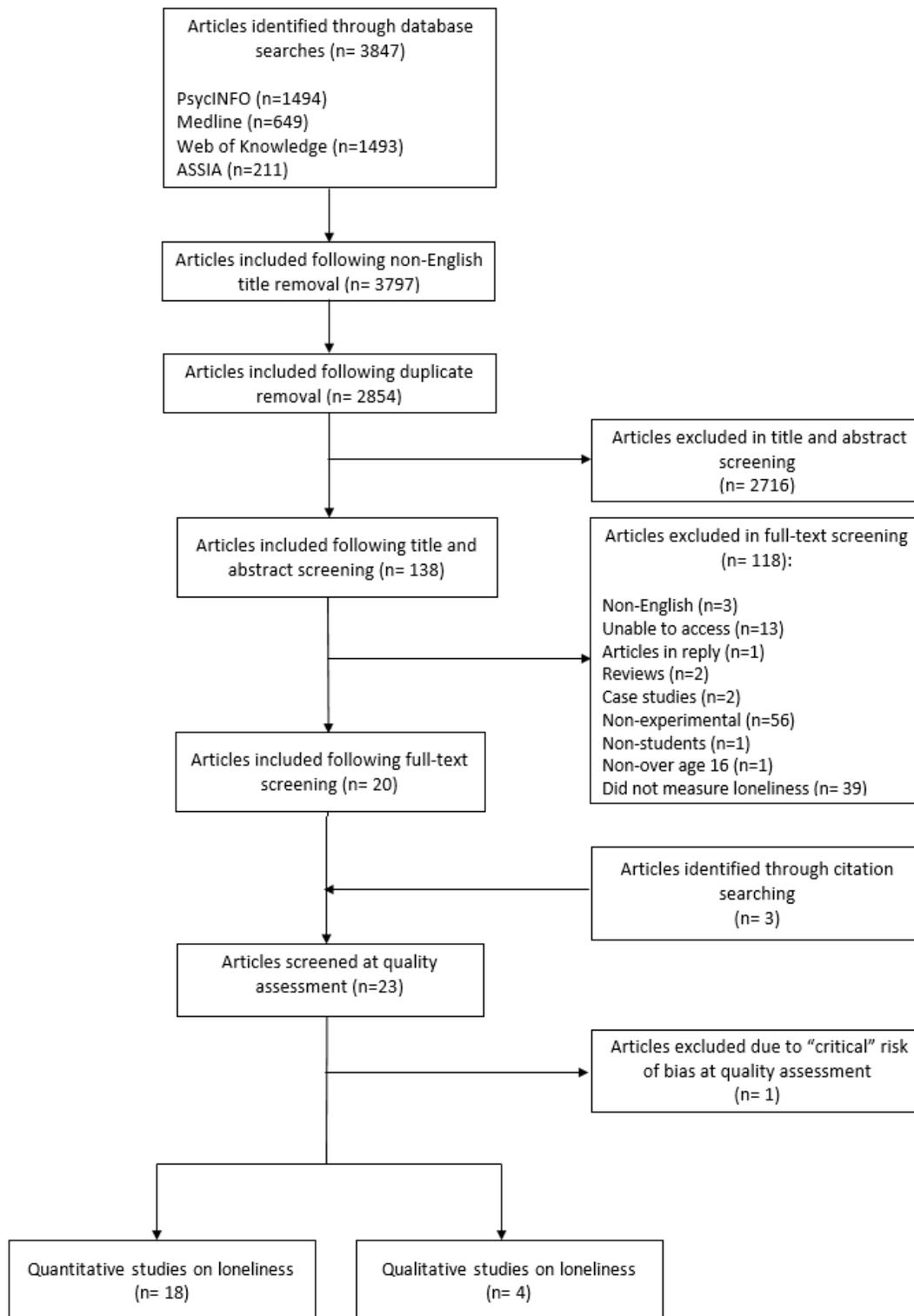


Figure 1

A summary of systematic literature search and study selection

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