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Review Article

Resilience and its association with mental health among forcibly displaced populations: A systematic review and meta-analyses

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ABSTRACT

Background: Forcibly displaced populations are growing exponentially and are at increased risk of experiencing mental health difficulties. However, it remains unclear if, and how, their resilience and mental health are associated. This systematic review and meta-analyses investigated the relationship between resilience and mental health outcomes among forcibly displaced groups.

Methods: MEDLINE Ultimate, APA PsycInfo and SCOPUS were searched up until January 2024. Peer-reviewed studies measuring a statistical association between resilience and mental health among forced migrants were eligible for inclusion. Random-effects meta-analyses for each identified mental health category were conducted. Study quality was evaluated using the National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.

Results: Thirty-one studies were included in the review ($n = 6656$). Meta-analyses revealed a significant negative association between resilience and symptoms of post-traumatic stress ($k = 13$, $n = 2446$, $r = -0.15$, 95 % CI [−0.23; −0.06]), depression ($k = 14$; $n = 2952$, $r = -0.34$, 95 % CI [−0.41; −0.26]), anxiety ($k = 7$, $n = 1516$, $r = -0.19$, 95 % CI [−0.27; −0.11]), and psychological distress ($k = 10$; $n = 2712$, $r = -0.29$, 95 % CI [−0.36; −0.23]).

Limitations: Effect sizes were highly heterogenous, most studies recruited small samples using non-random sampling strategies, and data was collected cross-sectionally.

Conclusions: Our findings point to an association between resilience and mental health difficulties in forcibly displaced groups. Directions for future research are discussed.

Systematic review registration: PROSPERO (CRD42023395925).

1. Introduction

The number of refugees and asylum seekers worldwide reached a record high of 110 million people forcibly displaced in 2023 (UNHCR, 2023b), more than double the number reported in 2013 (UNHCR, 2023a). The experience of forced migration, which includes pre-migration trauma and post-migration resettlement adjustment challenges, has been suggested to have long-term negative effects on mental health (Bogic et al., 2015; Jannesari et al., 2020; Porter and Haslam, 2005). Indeed, studies have reported that asylum seekers and refugees have greater mental health needs than the general population, particularly post-traumatic stress disorder, anxiety and depression (Blackmore et al., 2020; Henkelmann et al., 2020; Lindert et al., 2009; Patanè et al., 2022). However, alongside these findings, refugee populations are often described as showing resilience in the face of trauma and adversity (Hodes and Vostanis, 2019; Hutchinson and Dorsett, 2012; Rodriguez and Dobler, 2021; Yaylaci, 2018).

Resilience is defined as a multidimensional and dynamic construct, representing one's capacity to anticipate, adapt, and adjust under conditions of adversity in a way which promotes and sustains physical and mental wellbeing (Connor and Davidson, 2003; Ungar, 2018). However, the fast-expanding evidence surrounding resilience can be complicated to interpret due to widespread use of the word and varying interpretations and measurements of the construct (Liu et al., 2020). Two conceptualisations of resilience are common in the literature. In the general population literature, resilience is most frequently formulated as

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an amalgamation of individual traits or skills assisting coping with adversity (i.e. single system or individual resilience; Connor and Davidson, 2003; Richardson et al., 1990). Less frequently but increasingly, resilience is conceptualised as cumulative relational and contextual factors and resources (e.g. social, financial, political) which aid coping with adversity (Rodriguez and Dobler, 2021), some of which are global and some of which are culturally specific (i.e. systemic resilience; Ungar, 2018). These conceptualisations both have psychometric measures of resilience which align with their definitions. The body of research is further muddied due to the use of proxy measures of resilience. For example, resilience as a construct is at times applied as the absence of psychological distress or disorder following trauma (e.g., Popham et al., 2023). Furthermore, refugee research on resilience often focuses on identifying protective factors and developing understanding of the construct, not using specific measures of resilience (Marley and Mauki, 2019; Rodriguez and Dobler, 2021; Tol et al., 2013).

Research sampling non-refugee groups has found high resilience to correlate moderately or strongly with fewer mental health difficulties, marking the promotion of resilience as an important target for mental health interventions (Färber and Rosendahl, 2018, 2020; Hu et al., 2015; Mortazavi and Yarolahi, 2015). A systematic review examining resilience and mental health difficulties among conflict-driven adult forced migrants found resilience to generally be associated with better mental health outcomes (Siriwardhana et al., 2014). However, evidence of statistical associations between resilience and mental health outcomes were not synthesised. Importantly, Siriwardhana et al.'s review highlights that evidence for the direct association between resilience and mental health among forced migrants remains limited (Siriwardhana et al., 2014). Furthermore, differential relationships between resilience and different mental health symptoms among forcibly displaced groups have not been considered to date, representing a key gap in knowledge.

Resilience interventions are being rolled out for forcibly displaced individuals suffering with mental health difficulties, including Post-traumatic Stress Disorder (PTSD), anxiety and depression (Ciaramella et al., 2022; Lancaster and Gaede, 2020), without a clear consensus of the association between resilience and mental health. A quantitative synthesis of the association between different conceptualisations of resilience and different mental health outcomes therefore has important clinical implications. Firstly, it remains unknown if and how useful resilience building interventions may apply to forcibly displaced populations. Secondly, whether resilience interventions are appropriate for some mental health difficulties has not been explored. Further understanding of the strength of associations, resilience conceptualisations and associations with different mental health difficulties are needed to determine the goals, relevance and impact of the resilience building interventions. The many resilience building interventions being developed and implemented among general population and forcibly displaced groups alike require synthesised evidence supporting their application to different samples and presentations.

Forcibly displaced groups are growing exponentially and are known to be at increased risk of mental health difficulties. Resilience has been posited to represent a key component for epidemiological and interventional research to examine, with the aim to improve mental health outcomes among forcibly displaced groups (Siriwardhana et al., 2014). The literature investigating resilience among this population is challenging to interpret due to broad definitions and delineations of resilience and varied methodologies used. It remains unclear how different conceptualisations of resilience are associated with psychological well-being. It is also not known whether the trends observed in the literature apply to different mental health challenges. No meta-analysis has been conducted to examine the association between resilience and mental health among refugee populations to date. The current review aimed to fill these gaps by evaluating and synthesising existing evidence of association between individual and systemic resilience and different mental health difficulties among forced migrants as measured by higher quality measures. This review also provides a snapshot of the existing resilience and mental health literature among forced migrants regarding resilience conceptualisation, measures used and study characteristics and design. The review is guided by the following research questions:

1. What is the association between resilience and different mental health outcomes?
2. Does the strength of association differ depending on the mental health symptoms measured?
3. Does the conceptualisation of resilience affect the strength of association?

2. Methods

Findings were reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Page et al., 2021), using the PRISMA checklist. The review was registered prospectively in PROSPERO (CRD42023395925).

2.1. Search strategy

The strategy sought relevant articles in MEDLINE Ultimate, APA PsycInfo and SCOPUS bibliographic databases. Titles, abstracts and keywords were searched using search terms for forced migrants, resilience and mental health difficulties (see Supplementary Table 1). A search filter was used to include studies published up until 1st January 2024. Citation lists of identified papers and of relevant reviews were searched (Marley and Mauki, 2019; Pieloch et al., 2016; Rodriguez and Dobler, 2021; Siriwardhana et al., 2014; Tol et al., 2013).

2.2. Selection criteria

Quantitative studies measuring a statistical association between resilience and mental health among forced migrants were eligible for inclusion. "Forced migrant" refers to any individual forced, obliged or coerced to relocate from their home as a result of persecution, conflict, violence, human rights violations and events seriously disturbing public order, such as natural or man-made disasters, and/or development projects (UNHCR, 2023a). These include refugees, asylum seekers and internally displaced persons, among others, and exclude returned refugees and stateless people (UNHCR, 2024).

This review included resilience measures identified in a systematic review of resilience measures by Windle et al. (2011) as having the most optimal psychometric properties: the Connor-Davidson Resilience Scale (CD-RISC; Connor and Davidson, 2003), Brief Resilience Scale (Smith et al., 2008) and Resilience Scale for Adults (Friborg et al., 2003). In addition, the Resilience Scale (Wagnild and Young, 1993) was included as it was found to be the most widely used (Windle et al., 2011). The Child and Youth Resilience Measure (CYRM; Ungar and Liebenberg, 2011) was included as it is also widely used and is highlighted as one of the most appropriate measures of resilience for cross-cultural use alongside the CD-RISC (Terrana and Al-Delaimy, 2023). Studies that used validated psychometric questionnaires or diagnostic interviews capturing a mental health condition were included. A further category of 'psychological distress' was defined to encompass measures of other indicators of mental health difficulties, e.g., measures of general psychosocial functioning.

Measures or subscales capturing aspects of a mental health disorder, for example dissociation or somatic symptoms, were excluded. Studies not available in English or with sample sizes of fewer than 30 participants were excluded, as were books, book chapters, conference presentation papers, dissertations, editorials, commentaries, or any unpublished, non-peer-reviewed articles. Reviews, meta-analyses, clinical trials, qualitative studies, case studies or series, non-empirical studies were also excluded. If data from a single sample were used across multiple publications, the study with the largest sample was included.

Selection of studies for inclusion was steered by our pre-specified eligibility criteria (see Fig. 1 for PRISMA flowchart). In the initial screening phase, titles and abstracts of all articles identified in the search were screened individually by the first author (RL). The third author (FE) additionally screened 10 % of title and abstracts. Full text articles were retrieved for all those identified as potentially eligible in the initial screening phase and assessed for inclusion independently by two authors (RL, FE).

The quality of each included study was evaluated independently by two authors (RL, FE) using the National Institute of Health (NIH) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (NIH, 2023), providing a rating of "Good", "Fair", or "Poor". Disagreements between the reviewers at each stage of the screening or quality appraisal process were discussed to reach a consensus.

Corresponding authors were contacted for studies identified in the full-text review stage where measures of association were not reported but the data may be available, for example if moderator analysis was conducted. Additional data were received for five of the 20 studies where authors had been contacted (Altinay et al., 2023; Fino et al., 2020; Norton et al., 2023; O'Connor and Seager, 2021; Uysal et al., 2022).

2.3. Data extraction

For every eligible study, the lead author (RL) extracted the authors' names, year of publication, the study sample size and country, the measures used, as well as data relating to the participants' nationality and/or ethnic background, age and sex. Additional data related to the resilience and mental health measures, such as mean scores, and associations between resilience and mental health measures, such as correlation coefficients or odds ratios, were also extracted. Mental health outcome categories were generated based on the measures used: PTSD, depression, anxiety and psychological distress. Resilience measure categories were developed depending on whether measures captured individual resilience vs. systemic resilience. Studies were divided into categories based on age of participants: children (up to 18), adults (over 18), and mixed child and adult samples. Categories were also generated based on the Gross National Income (GNI) of the country where the study was conducted and where participants were recruited using the World Bank classifications for 2022 (World Bank, 2023).

Where multiple associations were reported within the same study for the same outcome (e.g., in longitudinal studies or where multiple measures are used), association data were extracted for the largest sample (e.g., first time point) or the most commonly used measure. Where data were only available relating to subscales, data were extracted for the largest or most relevant subscale, if appropriate. Where only standardised beta coefficients and odds ratios were available, these were converted to Pearson's correlation coefficient (Borenstein et al., 2021; Peterson and Brown, 2005). Positive correlation coefficients associated with mental health measures that are positively worded were converted to negative correlation coefficients by multiplying them by −1 to ensure consistency in directionality.

2.4. Data analysis

Random-effects meta-analyses for each mental health category were conducted using the "metafor" (version 4.4–0) package (Viechtbauer, 2010) and "dmetar" package (Harrer et al., 2019) in R. Pooled correlational coefficients and the 95 % confidence interval (CI) was reported, alongside forest plots. As recommended by IntHout et al. (2016), 95 % prediction intervals (PIs) were also reported to provide estimates of effect sizes with considerations of study heterogeneity. Heterogeneity between studies was assessed using the Q statistic (where variation between studies is implied if Q is significant, $p < .05$; Huedo-Medina et al., 2006) and the I^2 statistic (where I^2 values of 25 %, 50 %, and 75 % represent small, moderate and large degree of heterogeneity respectively; Higgins et al., 2003). Funnel plots and the Egger's test were performed to assess publication bias when >10 studies were available in a single meta-analysis (Egger et al., 1997; Sterne and Egger, 2001). Meta-analyses were re-run if any outliers were detected. Outliers were defined as studies where effects differed significantly from the pooled

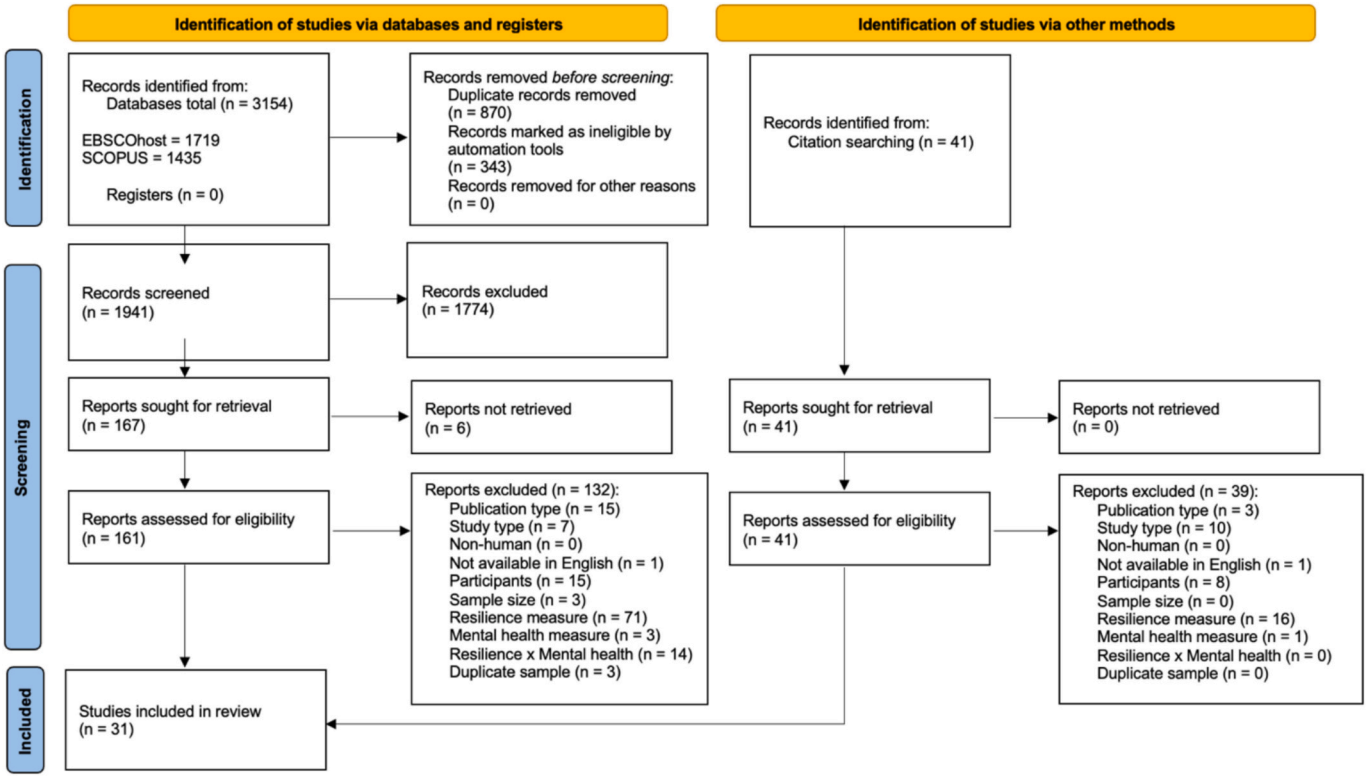

Fig. 1. PRISMA flowchart.

effect, i.e., 95 % confidence intervals of the individual studies did not overlap with the 95 % confidence interval of the pooled effect (Harrer et al., 2021).

Sources of heterogeneity between studies were investigated by moderator analyses when reported data allowed, i.e., if at least ten studies were included in the meta-analysis and subgroups had at least four observations (Fu et al., 2011; Schwarzer et al., 2015). Meta-regressions were performed for continuous moderators (publication year). Subgroup analyses were performed for categorical moderators (individual vs. systemic resilience, participant age category, study country GNI, study quality).

3. Results

3.1. Search outcomes

The search strategy identified 3154 references. After removing duplicates, 1941 records were screened based on titles and abstracts. The screening process resulted in the exclusion of 1774 records that were deemed irrelevant. Full-text screening was then conducted with the remaining 161 studies, with 29 studies identified as eligible for inclusion. Citation searching yielded 41 potential studies, two of which were eligible for inclusion. Thirty-one published papers met the inclusion criteria for this systematic review, see Fig. 1 for PRISMA flowchart.

3.2. Study characteristics

The 31 studies included in the systematic review were published between 2012 and 2023, reporting on a combined sample of 6656 participants (3050 males and 3601 females). The key characteristics of included studies are summarised in Table 1.

Most studies were conducted in high-income countries ($k = 18$) and used cross-sectional research designs ($k = 29$). Two cohort studies were included (Seong and Park, 2021; Wright et al., 2017); although longitudinal in design, data extracted for this review were collected at the same time point. Sample sizes varied from 36 to 556 participants, though few studies included sample size calculations. Most studies recruited adults only ($k = 16$), whilst others recruited both children and adults ($k = 7$) or children only ($k = 9$). Most studies measuring individual resilience used the CD-RISC (Connor and Davidson, 2003), whilst studies measuring systemic resilience most often used the CYRM (Ungar and Liebenberg, 2011). The most common mental health disorders studied alongside resilience were PTSD, depression, and anxiety. There was significant variance in the measures used within each mental health category. See Table 2 for individual study characteristics.

Table 1
Summary of included studies.

Variable	Category	Studies (n)
Design	Cross-sectional	29
	Prospective cohort	2
Study country GNI	High-income	18
	Low-and-middle-income***	13
Sample ages*	Child and adult	7
	Child	9
	Adult	16
Sample size*	<100	8
	101–300	15
	>301	9
Resilience measure	Individual	20
	Systemic	11
Mental health outcome**	PTSD	16
	Anxiety	7*
	Depression	17*
	Psychological distress	12
Quality appraisal score	Poor-or-Fair****	14
	Good	17

* One study recruited two samples of refugees (Rasheed et al., 2022).
** Seventeen studies captured multiple mental health outcomes, therefore these are not mutually exclusive.
*** Two studies were from a low-income country, therefore low- and middle-income countries were grouped for analysis purposes.
**** One study scored 'Poor' during the quality appraisal process, therefore 'Poor' and 'Fair' were grouped for analysis purposes.

3.3. Meta-analyses: associations between resilience and mental health outcomes

3.3.1. PTSD

Across the 16 studies included in the PTSD domain ($n = 2761$), the random-effects pooled correlation between resilience and PTSD was $r = -0.18$ (95 % CI [−0.30; −0.06]), see Supplementary Fig. 1. The 95 % prediction interval ranged from −0.62 to 0.34. There was substantial heterogeneity between studies ($Q = 105.40$, $df = 15$, $p < .0001$, $I^2 = 85.8$ % (95 % CI [78.4 %; 90.6 %])). Egger's test did not indicate the presence of funnel plot asymmetry (intercept = −2.56, $p = .18$).

Three outliers were detected (Civan Kahve et al., 2021; Fino et al., 2020; Park et al., 2017). The random-effects pooled correlation of the remaining studies ($k = 13$; $n = 2446$) was $r = -0.15$ (95 % CI [−0.23; −0.06]) and the 95 % prediction interval was −0.41 to 0.14, see Fig. 2. Heterogeneity reduced, but remained moderate ($Q = 26.24$, $df = 12$, $p < .01$, $I^2 = 54.3$ % (95 % CI [14.4 %; 75.6 %])). Egger's test indicated the presence of funnel plot asymmetry (intercept = −2.27, $p = .04$).

Subgroup analysis by study country GNI was significant ($Q = 4.32$, $df = 1$, $p = .04$), with high-income country studies showing stronger negative correlations between resilience and PTSD ($r = -0.19$, 95 % CI [−0.30; −0.08]) compared with low- and middle-income countries ($r = -0.06$, 95 % CI [−0.12; −0.01]). No other significant moderating effects were observed, see Table 3.

3.3.2. Depression

Sixteen studies (17 samples) examined the association between resilience and depression ($n = 3583$). The random-effects pooled correlation between resilience and depression was $r = -0.34$ (95 % CI [−0.43; −0.24]). The 95 % prediction interval was −0.67 to 0.11. High heterogeneity between studies was observed ($Q = 107.99$, $df = 16$, $p < .0001$, $I^2 = 85.2$ % (95 % CI [77.7 %; 90.2 %])). A forest plot of all effect sizes and confidence intervals from each individual study is shown in Supplementary Fig. 2. Egger's test did not indicate the presence of funnel plot asymmetry (intercept = −2.45, $p = .25$).

Three outliers were detected (Badri et al., 2020; O'Connor and Seager, 2021; Poudel-Tandukar et al., 2019). The random-effects pooled correlation of the remaining studies ($k = 14$; $n = 2952$) was $r = -0.34$ (95 % CI [−0.41; −0.26]) and the 95 % prediction interval was −0.59 to −0.03, see Fig. 3. Heterogeneity remained significant ($Q = 58.07$, $df = 13$, $p < .0001$, $I^2 = 77.6$ % [62.8 %; 86.5 %]). Egger's test did not indicate the presence of funnel plot asymmetry (intercept = −0.45, $p = .83$).

Subgroup analysis showed a significant difference in the pooled effect by sample age category ($Q = 3.86$, $df = 1$, $p = .0496$), with studies sampling children only showing stronger negative correlations between resilience and depression ($r = -0.37$, 95 % CI [−0. 42; −0.32]) compared to studies sampling adults only ($r = -0.27$, 95 % CI [−0.36; −0.17]). No other moderating effects of were observed for the association between resilience and depression by subgroup, see Table 4.

3.3.3. Anxiety

Across the six studies (seven samples) reporting associations between resilience and anxiety ($n = 1516$), the pooled correlation between resilience and anxiety was $r = -0.19$ (95 % CI [−0.27; −0.11]). The 95 % prediction interval was −0.41 to 0.05. Heterogeneity was observed between studies ($Q = 14.80$, $df = 6$, $p = .02$, $I^2 = 59.4$ % (95 % CI [6.7 %; 82.4 %])). See Fig. 4 for forest plot of all effect sizes and confidence intervals from each individual study included. No outliers were

Table 2
Characteristics of included studies.

Study author and year	Sampling method	Participants	Sample size	Country	Age*	Percentage male sample	Resilience measures[1]	Mental health measure(s)	Measure of association*	Quality appraisal
Malliarou et al. (2020)	Convenience sampling	Asylum seeker war refugees	64	Greece	m = 36 sd = 7.4	63.5 %	CD-RISC	PHQ-9, HTQ	Resilience/Depression: $r = -0.26$, $p = .04$ Resilience/PTSD: $r = -0.44$, $p < .001$	Fair
Laufer et al. (2022)	Convenience sampling	Young adult asylum seekers and refugees	55	Germany	m = 19.47 sd = 1.45 range = 18–25	89.1 %	CD-RISC 10	PHQ-9, PCL-5	Resilience/Depression: $r = -0.34$, $p < .05$ Resilience/PTSD: r = −0.4, $p < .01$	Good
Rasheed et al. (2022)	Systematic sampling (probability sampling)	Internally displaced Yadizi Iraqi refugees	*Sample 1:* 257 *Sample 2:* 165	Iraq	*Sample 1*: m = 29.98 sd = 12.2 *Sample 2:* m = 35.75 sd = 13.2	*Sample 1:* 63.4 % *Sample 2:* 26.7 %	BRS	DASS-21	*Sample 1* Resilience/Depression: $r = -0.12$, $p > .05$ Resilience/Anxiety: $r = -0.14$, p < .05 *Sample 2* Resilience/Depression: r = −0.31, p < .001 Resilience/Anxiety: $r = -0.17$, p < .05	Good
Nam et al. (2016)	Non-probability snowball sampling	North Korean adult refugees	304	South Korea	m = 40.95 sd = 8.98	33.8 %	K-CD-RISC	CES-D	Resilience/Depression: $r = -0.48$, p < .01	Good
Poudel-Tandukar et al. (2019)	Non-random sampling	Bhutanese refugees	225	USA	m = 37.6 sd = 14.5	50.22 %	RS-25	HSCL-25	Resilience/Depression: β = −0.05, $p = .003$ Resilience/Anxiety: β = −0.04, $p = .001$	Good
Wright et al. (2017)	Computer generated random sampling	Iraqi refugees	291	USA	m = 34.3 sd = 11.37	54.3 %	RS-8	SCID-I	Resilience/Depression: AOR = 0.59, 95 % CI [0.45; 0.77] Resilience/PTSD: AOR = 0.66, 95 % CI [0.53; 0.82]	Good
von Haumeder et al. (2019)	Snowball sampling	Syrian refugees	127	Germany	m = 31.9 sd = 10.68 range = 18–67	66.1 %	RS-11	PCL-5	Resilience/PTSD: $r = -0.25$, $p < .01$	Good
Bang (2017)	Nonrandomized, snowball sampling	Chaldean Iraqi refugees	100	USA	m = 16.23 sd = 1.49 range = 14–20	53 %	RS-25	PCL-C	Resilience/PTSD: $r = -0.04$, $p > .05$	Fair
Dehnel et al. (2022)	Not reported	Syrian refugee children	339	Jordan	m = 13.4 range = 10–17	25.1 %	CYRM-28	CDI-2	Resilience/Depression: $r = -0.33$, $p < .001$	Good
Dangmann et al. (2021)	Strategic sampling	Syrian refugee children	160	Norway	m = 18.1 sd = 2.4 range = 13–24	62.5 %	CYRM-12	HSCL-10, CRIES-8	Resilience/Psychological distress: $r = -0.45$, p < .001 Resilience/PTSD: $r = -0.23$, $p < .05$	Good
Uysal et al. (2022)	Not reported	Syrian refugee children	430	Turkey	m = 15.5 sd = 1.76 range = 12–18	43.02 %	CYRM-R	DASS-21, CRIES-8	Resilience/Depression: $r = -0.42$, p < .001 Resilience/Anxiety: r = −0.3, p < .001 Resilience/PTSD: $r = -0.07$, $p = .13$	Good
Wilson et al. (2021)	Purposive sampling	Palestinian refugee children	106	Palestine	m = 13.56 sd = 11–17	49 %	CYRM-28	SDQ	Resilience/Psychological distress: $r = -0.7$, $p < .0001$	Fair

(*continued on next page*)

Table 2 (*continued*)

Study author and year	Sampling method	Participants	Sample size	Country	Age*	Percentage male sample	Resilience measures[1]	Mental health measure(s)	Measure of association*	Quality appraisal
Badri et al. (2020)	Not reported	Eritrean unaccompanied refugees	45	Sudan	m = 15.36 sd = 1.45	62.2 %	CYRM-28	HSCL-25	Resilience/Depression: $r = -0.76$, $p < .01$ Resilience/Anxiety: $r = -0.3$, $p < .05$	Fair
Panter-Brick et al. (2018)	Not reported	Syrian refugees	324	Jordan	m = 14.13 sd = 1.94	57.7 %	CYRM-12	AYMH, SDQ	Resilience/Psychological distress: $r = -0.17$, $p < .05$ Resilience/Psychological distress: $r = -0.26$, $p < .001$	Good
McEwen et al. (2022)	Not reported	Adolescent refugees	85	Australia	m = 20.78 sd = 2.29 range = 16–25	41.2 %	CYRM-R	RATS, HSCL-37A	Resilience/PTSD: $r = -0.25$, $p < .05$ Resilience/Psychological distress: $r = -0.35$, $p < .0$	Good
Seong and Park (2021)	Not reported	North Korean refugee youths	64	South Korea	m = 16.89 sd = 1.64 range = 13–23	37.5 %	BRS	CES-DC	Resilience/Depression: $r = -0.58$, $p < .001$	Fair
Park et al. (2017)	Not reported	North Korean refugee youths	131	South Korea	m = 18.47 sd = 2.82	38.93 %	BRS	CDI, CRIES-13	Resilience/Depression: $r = -0.55$, $p < .001$ Resilience/PTSD: $r = -0.51$, $p < .001$	Fair
Civan Kahve et al. (2021)	Not reported	Iraqi Turkoman refugees	101	Turkey	m = 36.03 sd = 18–68	48.5 %	RSA	CAPS	Resilience/PTSD: $r = -0.62$, $p = .001$	Fair
Miller et al. (2022)	Not reported	Adolescent refugees	322	Australia	m = 17.57 sd = 2.32 range = 14–26	36 %	CD-RISC 10	K-10	Resilience/Psychological distress: $r = -0.28$, $p < .01$	Good
Fino et al. (2020)	Convenience sampling	Asylum seekers and refugees from Middle Eastern countries	83	Albania	m = 47.7 sd = 8.4	91.6 %	BRS	GHQ-12, HTQ	Resilience/Psychological distress: $r = 0.075$, $p = .51$ Resilience/PTSD: $r = 0.35$, $p < .01$	Fair
Kim et al. (2022)	Convenience sampling	IDPs	201	Myanmar	m = 36.9 sd = 20–65	54.23 %	CD-RISC	HTQ	Resilience/PTSD: $r = -0.1$, $p = .149$	Fair
Akcan et al. (2023)	Convenience sampling	Refugee women	288	Turkey	range = 18–68	0 %	CD-RISC	WHO-5, MDI	Resilience/Psychological distress: $r = 0.37$, $p < .01$ Resilience/Depression: $r = -0.3$, $p < .01$	Good
Urbański et al. (2023)	Not reported	Ukrainian displaced students	284	Poland	m = 12.04 sd = 1.78	50.7 %	CYRM-R Personal subscale	CDI 2:SR, STAI-C state anxiety subscale	Resilience/Depression: $r = -0.35$, $p < .01$ Resilience/Anxiety: $r = -0.27$, $p < .01$	Fair
Tessitore et al. (2023)	Not reported	Nigerian male asylum seekers	36	Italy	m = 27.47 sd = 7.28	100 %	CD-RISC	HTQ-R	Resilience/PTSD: $r = 0.036$, $p > .05$	Poor
Ziaian et al. (2023)	Convenience and snowball sampling	Refugee-background youth	556	Australia	m = 18.83 sd = 2.68 range = 14–26	38.12 %	CD-RISC	K6	Resilience/Psychological distress: $r = -0.31$, $p < .01$	Fair
Ziaian et al. (2012)	Convenience and snowball sampling	Refugee-background youth	170	Australia	med = 15.56 range = 12.25–18.16	50.6 %	CD-RISC	CDI, SDQ	Resilience/Psychological distress: $r = -0.39$, $p < .001$ Resilience/Depression: $r = -0.37$, $p < .001$	Fair
Ssenyonga et al. (2013)	Random sampling	Congolese refugees	426	Uganda	m = 35.11 sd = 12.64	48.35 %	CD-RISC	PDS	Resilience/PTSD: $r = -0.017$, $p > .05$	Fair
Altinay et al. (2023)	Snowball sampling	Ukrainian refugees	135	Slovakia	16–24: 14.8 % 25–34: 19.3 % 35–44: 31.9 %	21.5 %	BRS	K10	Resilience/Psychological distress: $r = -0.286$	Good

(*continued on next page*)

Table 2 (*continued*)

Study author and year	Sampling method	Participants	Sample size	Country	Age*	Percentage male sample	Resilience measures[1]	Mental health measure(s)	Measure of association*	Quality appraisal
Norton et al. (2023)	Not reported	Unaccompanied and separated migrant children	110	France	45–54: 17.8 % 55+: 16.2 % med = 19.7 range = 18–22	92.7 %	CD-RISC 10	PCL-5, PHQ-9, GAD-7	Resilience/PTSD: $r = -0.04$, $p = .68$ Resilience/Depression: $r = -0.16$, $p = .11$ Resilience/Anxiety: $r = -0.11$, $p = .27$	Good
Veronese et al. (2021)	Not reported	Syrian refugee children	311	Jordan	m = 10.49 sd = 2.16 range = 7–14	49.8 %	CYRM-28	SDQ emotional problems subscale	Resilience/Psychological distress: $r = -0.154$, $p < .001$	Good
O'Connor and Seager (2021)	Not reported	Rohingya adolescents	361	Bangladesh	m = 16.17 range = 15–18	49.1 %	CYRM-28	PHQ-9, HTQ, GHQ-12	Resilience/Psychological distress: $r = -0.15$, $p < .01$ Resilience/Depression: $r = -0.13$, $p < .05$ Resilience/PTSD: $r = -0.083$, $p = .14$	Fair

[2] AYMH: Arab Youth Mental Health Scale (Makhoul et al., 2011); CAPS: Clinician-Administered PTSD Scale (Blake et al., 1995); CDI: Children's Depression Inventory (Kovac, 2010; Kovacs and Beck, 1977); CES-D(C): Center for Epidemiologic Studies Depression (Child) Scale (Radloff, 1977; Weissman et al., 1980); CRIES-8/13: Child Revised Impact of Events Scale (Perrin et al., 2005); DASS-21: Depression, Anxiety and Stress Scale-21 (Lovibond and Lovibond, 1995); GHQ-12: 12-item General Health Questionnaire (Goldberg et al., 1997); HSCL-25/10/37A: Hopkins Symptom Checklist-25/10/37A (Bean et al., 2004a; Derogatis et al., 1974; Strand et al., 2003); HTQ: Harvard Trauma Questionnaire (Mollica et al., 1992); IES-R: Impact of Events Scale-Revised (Horowitz et al., 1979); K-6/10: Kessler Six/Ten (Kessler et al., 2002); MDI: Major Depression Inventory (Bech et al., 2001); PCL-5/C PTSD CheckList-5/Civilian (Weathers et al., 1991; Weathers et al., 2013); PDS: Posttraumatic Diagnostic Scale (Foa, 1995); PHQ-9: Patient Health Questionnaire-9 (Kroenke et al., 2001); RATS: Reactions of Adolescents to Traumatic Stress Questionnaire (Bean et al., 2004b); SCID-I: Structured Clinical Interview for DSM-IV (First and Gibbon, 2004); SDQ: Strengths and Difficulties Questionnaire (Goodman and Goodman, 2009); STAI-C: State-Trait Anxiety Inventory for Children (Spielberger, 1973); WHO-5: World Health Organization Wellbeing Scale (Bech et al., 1996).

* Mean (m); sd (standard deviation); median (med); p (significance value); r (correlation coefficient).

[1] BRS: Brief Resilience Scale (Smith et al., 2008); (K-)CD-RISC: (Korean) Connor-Davidson Resilience Scale (Baek et al., 2010; Campbell-Sills and Stein, 2007; Connor and Davidson, 2003); CYRM-28/12/R: Child and Youth Resilience Measure-28/12/R (Jefferies et al., 2019; Liebenberg et al., 2013; Ungar and Liebenberg, 2011); RS-25/11/8: Resilience Scale-25/11/8 (Wagnild and Young, 1993); RSA: Resilience Scale for Adults (Friborg et al., 2003).

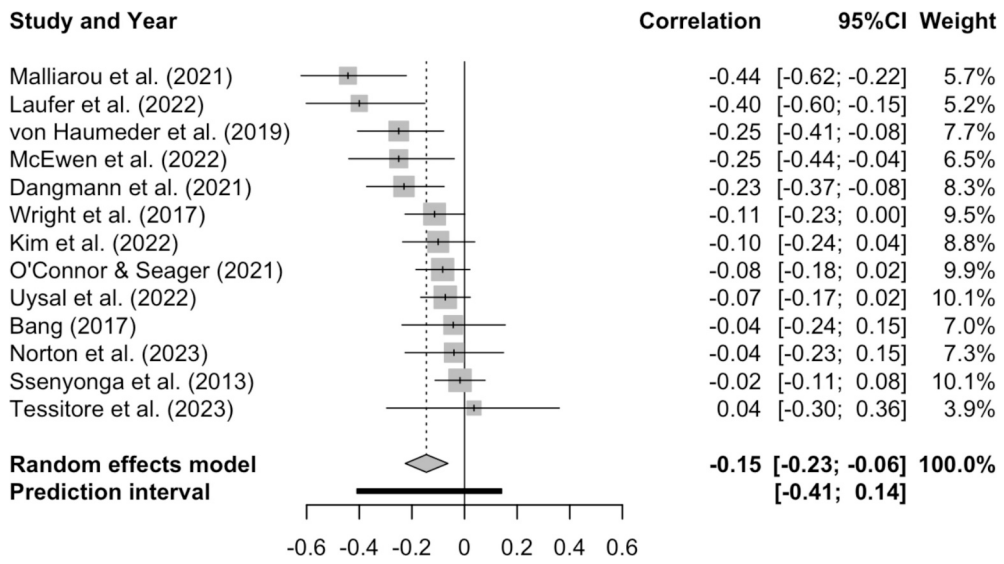

Fig. 2. Forest plot of correlation coefficients for the association between resilience and PTSD.

detected. With fewer than 10 studies included in this meta-analysis, tests for funnel plot asymmetry (i.e. publication bias) were not carried out due to insufficient power to distinguish real asymmetry from chance (Van der Kolk, 2005). This also precluded subgroup analyses (Schwarzer et al., 2015).

3.3.4. *Psychological distress*

Across the 12 studies reporting an association between resilience and psychological distress (n = 2901), the pooled correlation between resilience and psychological distress was $r = -0.31$ (95 % CI [−0.42; −0.20]) (see Supplementary Fig. 3). The 95 % prediction interval was −0.67 to 0.15. Significant heterogeneity between studies was observed ($Q = 70$, $df = 11$, $p < .0001$, $I^2 = 84.3$ % (95 % CI [74.1 %; 90.5 %])). Egger's test did not indicate the presence of funnel plot asymmetry (intercept = −2.27, $p = .4$).

Two outliers were detected (Fino et al., 2020; Wilson et al., 2021). The random-effects pooled correlation of the remaining studies ($k = 10$; $n = 2712$) was $r = -0.29$ (95 % CI [−0.36; −0.23]) and the 95 % prediction interval was −0.48 to −0.08, see Fig. 5. Heterogeneity remained moderate ($Q = 25.35$, $df = 9$, $p < .01$, $I^2 = 64.5$ % (95 % CI [30.1 %; 82.0 %])). Egger's test did not indicate the presence of funnel plot asymmetry (intercept = −2.43, $p = .28$).

Moderator analyses showed no significant differences in the association between resilience and psychological distress across subgroups, see Table 5.

4. Discussion

The present review aimed to evaluate evidence of the association between resilience and mental health difficulties among forcibly displaced groups. Results from 31 studies (32 samples) indicate that resilience is significantly negatively associated with symptoms of post-traumatic stress, depression, anxiety and psychological distress, with small-to-medium effect sizes and a large degree of heterogeneity. A significant association between resilience and broad mental health outcomes has been reported in other populations (Färber and Rosendahl, 2018, 2020; Hu et al., 2015; Mortazavi and Yarolahi, 2015). Our results corroborate and further narrative synthesis evidence by Siriwardhana et al. (2014), providing the quantitative evidence for associations between resilience and mental health difficulties among forcibly displaced groups.

We found a small effect for the association between PTSD and resilience ($r = -0.15$, 95 % CI [−0.23; −0.06], 95 % PI [−0.41; 0.14]). This suggests that participants across studies reporting fewer PTSD symptoms tended to report higher levels of resilience. However, the wide prediction interval suggests that this finding may not always be replicable, perhaps because trauma-related symptoms may present and be understood differently across cultures and there are cultural variations in resilience responses (Buse et al., 2013). A significantly stronger negative correlation between resilience and PTSD was found among high-income countries in comparison to low- or middle-income countries. Differences in experiences migrating to and residing in high vs. low- and middle-income countries and access to resilience resources may explain this finding. One interpretation is that participants residing in high-income countries had higher resilience and fewer difficulties relating to PTSD in comparison to those in low- or middle-income countries. Those residing in low- or middle-income countries may be closer to areas of conflict and might be exposed to ongoing threats to their security and welfare (Reed et al., 2012), contributing to symptoms of PTSD, and may have fewer resiliency resources. Conversely, refugees residing in high-income countries in comparison to low- or middle-income countries may have experienced more perilous migration journeys over greater distances, and have greater challenges with immigration and acculturation due to increased cultural difference and hostile policies (Fazel et al., 2012), all of which are associated with risk of mental health difficulties, particularly PTSD (Bogic et al., 2015; Jannesari et al., 2020; Porter and Haslam, 2005).

A medium effect for the association between resilience and depression was found ($r = -0.34$, 95 % CI [−0.41; −0.26], 95 % PI [−0.59; −0.03]). This effect is perhaps unsurprising, given resilience includes attitudes, beliefs and perceptions of skills and resources to cope (Connor and Davidson, 2003; Ungar and Theron, 2020). Depressive symptoms, on the other hand, are characterised by hopelessness, guilt, emotional numbness, fatigue, worthlessness and/or poor self-esteem (American Psychiatric Association, 2022; World Health Organization, 2019). It has also been argued that some resilience scales include items from depression scales that are positively worded (Färber and Rosendahl, 2018), for example the Resilience Scale (Wagnild and Young, 1993). Furthermore, resilience measures, such as the CD-RISC (Connor and Davidson, 2003), have been found to be strongly predictive of positive emotionality in general population samples and may be more closely aligned to difficulties characterised by disruptions in positive affect (Robinson et al., 2014). A significantly stronger negative correlation between resilience and depression was found among children in comparison to adults. This might be explained by the challenges related to trauma exposure and loss that refugee children may face across

Table 3
Moderator and subgroup analysis (resilience and PTSD).

Variable	k	r	95 % CI	Q	I^2 [95 % CI]	Moderation effect
Age group						–
Child[1]	2 (<4)	−0.08	[−0.15; −0.01]	0.02	0.0 %	
Adult	8	−0.16	[−0.28; −0.03]	20.80**	66.3 % [28.7 %; 84.1 %]	
Mixed[1]	3 (<4)	−0.18	[−0.31; −0.04]	2.74	27.0 % [0.0 %; 92.4 %]	
Resilience measure						$p = .88$
Individual	9	−0.15	[−0.26; −0.03]	21.25**	62.3 % [22.4 %; 81.7 %]	
Systemic	4	−0.14	[−0.23; −0.04]	4.96	39.5 % [0.0 %; 79.4 %]	
Country GNI						$p = .04$
High-income	9	−0.19	[−0.30; −0.08]	16.77*	52.3 % [0.0 %; 77.6 %]	
Low- and middle-income income	4	−0.06	[−0.12; −0.01]	1.36	0.0 % [0.0 %; 84.7 %]	
Quality rating						$p = .42$
Good	7	−0.17	[−0.27; −0.08]	11.46	47.6 % [0.0 %; 77.9 %]	
Poor or Fair	6	−0.11	[−0.24; 0.03]	11.89*	57.9 % [0.0 %; 83.0 %]	
Publication year						$p = .39$

* p < .05, ** p < .01, ***p < .001.
[1] Excluded from subgroup analysis due to number of observations in subgroup.

important developmental stages, increasing risk of various forms of dysregulation (e.g., emotional, behavioural and relational; Van der Kolk, 2005), and as such, decrease resiliency resources and increase vulnerability to depression. Furthermore, children may have had less experience of drawing on resilience. This effect might also be explained by refugee children having more resiliency resources than adult counterparts due to migrating with parents or families, buffering symptoms of depression.

We found a small effect for the association between resilience and anxiety ($r = -0.19$, 95 % CI [−0.27; −0.11], 95 % PI [−0.41; 0.05]) and a small-to-medium effect for the association between resilience and psychological distress ($r = -0.29$, 95 % CI [−0.36; −0.23], 95 % PI [−0.48; −0.08]). Measures of psychological distress are often broader and less symptom specific, for example also capturing relational difficulties (e.g., SDQ; Goodman and Goodman, 2009), which may position them well to capture psychological challenges cross-culturally. However, although the construct of psychological distress is multifaceted, it often incorporates symptoms of anxiety or depression. It is possible the current effect is driven by difficulties relating to depression and anxiety, overlapping with the findings described above.

The moderate association between resilience and depressive symptoms suggests that resilience factors are likely more relevant to depression than to PTSD or anxiety symptoms. This could reflect overlap in the constructs measured, or indicate that resilience factors, such as stress tolerance, optimism, and social support, are relevant to depressive symptomatology. Resilience traits and outlooks, such as optimism, may directly counteract depressed thoughts. The weaker associations of resilience with PTSD and anxiety symptoms may indicate that while resilience plays a role, it is not the most critical factor. Rather than focusing solely on promoting resilience factors, such as being more optimistic, more stress tolerant, or having strong social support, interventions for PTSD and anxiety may benefit more from alternative approaches (Ciaramella et al., 2022). For example, research has found that reprocessing traumatic memories (e.g., through trauma-focused therapy) and addressing avoidance behaviours (e.g., via exposure therapy) are effective in alleviating these symptoms (Parker et al., 2018; Schnyder et al., 2015).

Across the four meta-analyses presented, significant heterogeneity was observed between studies. It is hypothesised this is driven by different measures of both resilience and mental health used among different samples (e.g., URMs; IDPs; refugees with lifelong PTSD) of different ages (e.g., child vs adult) residing in different placements (e.g., resettled or residing in camps) and recruited in countries with different levels of income. Participants may in addition have differences in experiences of using psychometric measures and service access. Finally, and significantly, it is suggested that heterogeneity also derives from cultural variations in interpretations and conceptualisations of mental health disorders (Antić, 2021; Kleinman, 1980) and of resilience (Ungar, 2018). It is likely participants have different levels of fluency with Western-borne definitions and understandings of resilience and mental health challenges as captured by quantitative measures.

4.1. Limitations and strengths

The present review set no exclusion criteria according to host country, country of origin, age, sex, or duration of displacement, which may have contributed to heterogeneity between studies. Subgroup analyses served to investigate differences and possible sources of heterogeneity but these may have been underpowered (Cuijpers et al., 2021). Some subgroup variables were collapsed due to small numbers, and it was not possible to explore some areas of interest due to limited data, for instance differences according to sex or country of origin. In addition, all data included in this review were collected cross-sectionally, limiting understanding of temporal precedence between resilience and mental health symptoms as it is not possible to draw causal inference on how resilience affects mental health, or vice versa. Most studies used non-probability sampling methods, which is common due to challenges associated with recruiting forcibly displaced people in research (Blackmore et al., 2020), and did not report power analyses. Furthermore, the majority of the resilience and mental health measures were not specifically developed for refugee populations or to be used cross-culturally, despite being widely used in different cultural contexts. Included measures were, for the most part, quantitative self-report questionnaires for specific areas of mental health difficulty, the completion of which may be affected by linguistic or cultural differences despite translations. Using such measures may offer only a limited view

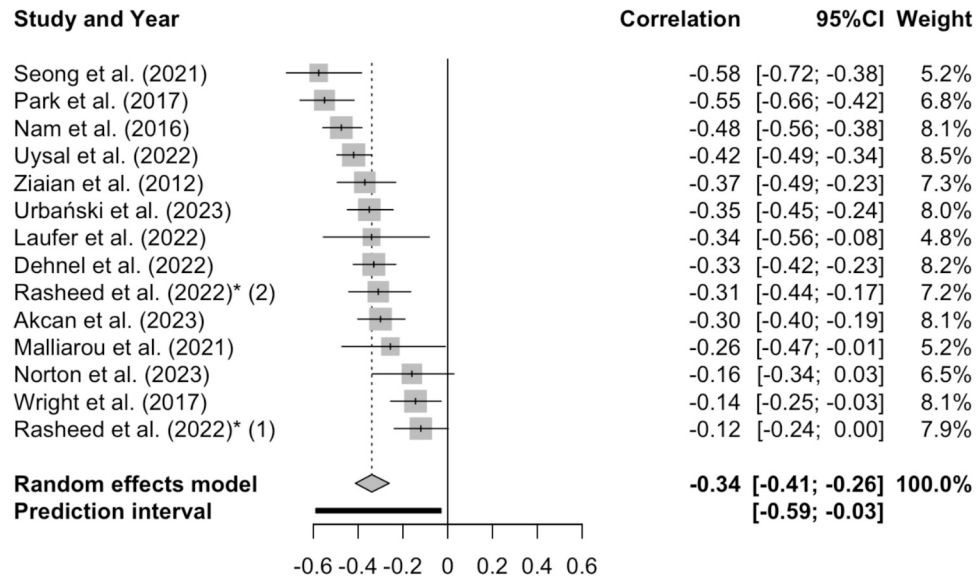

Fig. 3. Forest plot of correlation coefficients for the association between resilience and depression after outliers removed.
* The study by Rasheed et al. (2022) recruited two samples of refugees.

Table 4
Moderator and subgroup analysis (resilience and depression).

Variable	k	r	95 % CI	Q	I^2 [95 % CI]	Moderation effect
Age group						$p = .0496$
Child	4	−0.37	[−0.42; −0.32]	2.34	0.0 % [0.0 %; 84.7 %]	
Adult	8	−0.27	[−0.36; −0.17]	30.87***	77.3 % [55.1 %; 88.6 %]	
Mixed[1]	2 (<4)	−0.56	[−0.65; −0.45]	0.06	0.0 %	
Resilience measure						–
Individual	11	−0.33	[−0.42; −0.23]	52.61***	81.0 % [67.0 %; 89.1 %]	
Systemic[1]	3	−0.37	[−0.43; −0.31]	2.33	14.3 % [0.0 %; 91.1 %]	
Country GNI						$p = .39$
High-income	9	−0.36	[−0.46; −0.25]	39.41***	79.7 % [62.1 %; 89.1 %]	
Low- and middle-income	5	−0.30	[−0.39; −0.20]	17.22**	76.8 % [43.6 %; 90.4 %]	
Quality rating						$p = .09$
Good	9	−0.30	[−0.38; −0.21]	40.48***	80.2 % [63.3 %; 89.4 %]	
Poor or Fair	5	−0.42	[−0.54; −0.30]	10.85*	63.1 % [2.5 %; 86.0 %]	
Publication year						$p = .34$

* p < .05, ** p < .01, ***p < .001.
[1] Excluded from subgroup analysis due to number of observations in subgroup.

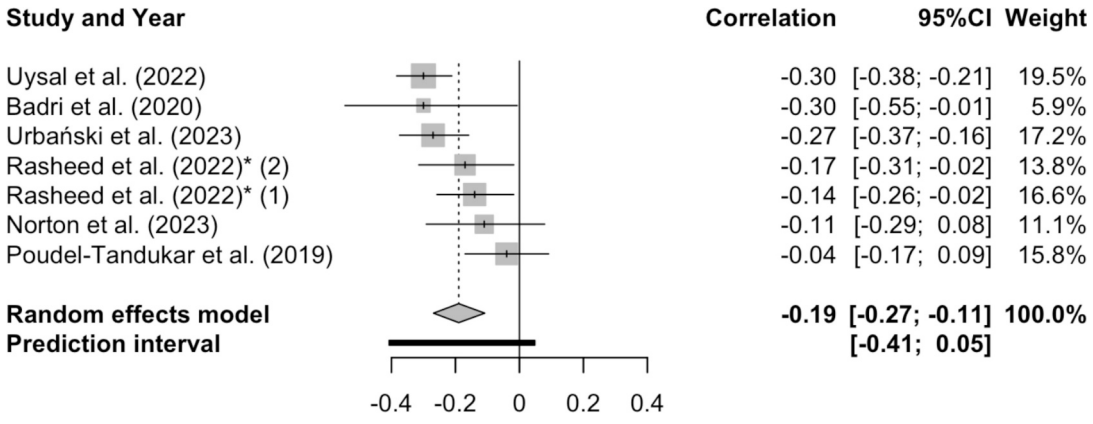

Fig. 4. Forest plot of correlation coefficients for the association between resilience and anxiety.
* The study by Rasheed et al. (2022) recruited two samples of refugees.

of the complexity and context of needs (Tessitore et al., 2023).

Studies involving participants from low-income countries are underrepresented, which could be problematic given that low- and middle-income countries collectively host almost 90 % of the global refugee population (UNHCR, 2024a). Although children are well-represented in the studies included, only two studies measuring the association

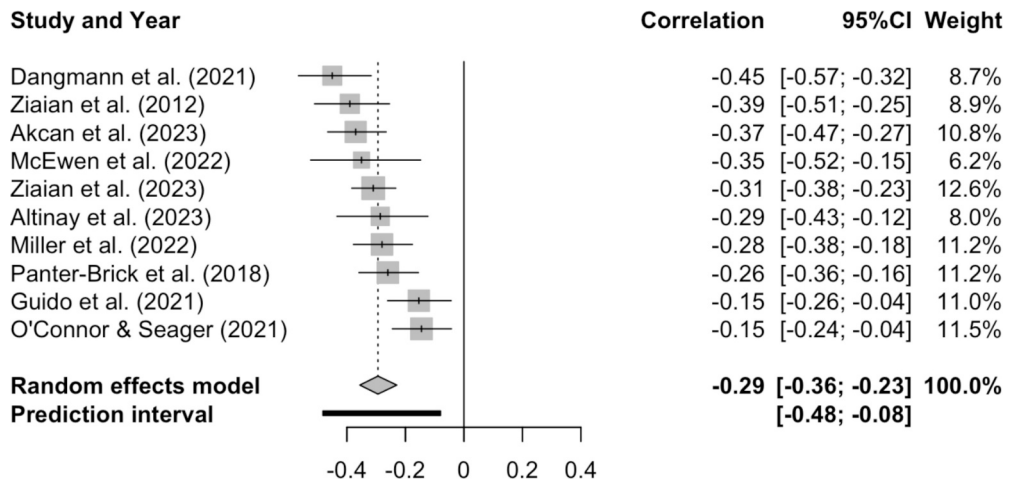

Fig. 5. Forest plot of correlation coefficients for the association between resilience and psychological distress after outliers removed.

Table 5
Moderator and subgroup analysis (resilience and psychological distress).

Variable	k	r	95 % CI	Q	I^2 [95 % CI]	Moderation effect
Age group						$p = .14$
Child	4	−0.23	[−0.34; −0.12]	10.07*	70.2 % [14.5 %; 89.6 %]	
Adult[1]	2	−0.34	[−0.43; −0.24]	0.80	0.0 %	
Mixed	4	−0.34	[−0.41; −0.25]	4.42	32.1 % [0.0 %; 75.7 %]	
Resilience measure						$p = .36$
Individual	5	−0.32	[−0.38; −0.27]	2.85	0.0 % [0.0 %; 79.2 %]	
Systemic	5	−0.26	[−0.38; −0.14]	16.27**	75.4 % [39.6 %; 90.0 %]	
Country GNI						$p = .09$
High-income	6	−0.34	[−0.40; −0.27]	5.55	10.0 % [0.0 %; 77.2 %]	
Low- and middle-income	4	−0.23	[−0.33; −0.13]	11.79**	74.6 % [29.2 %; 90.9 %]	
Quality rating						–
Good	8	−0.30	[−0.36; −0.24]	14.99*	53.3 % [0.0 %; 79.0 %]	
Poor or Fair[1]	2	−0.27	[−0.48; −0.02]	8.03**	87.5 % [51.6 %; 96.8 %]	
Publication year						$p = .65$

* p < .05, ** p < .01, ***p < .001.
[1] Excluded from subgroup analysis due to number of observations in subgroup.

between resilience and mental health outcomes among unaccompanied refugee minors (URMs) were identified in this review (Badri et al., 2020; Norton et al., 2023), both with relatively small samples. There is also a lack of studies sampling older adults which met criteria for inclusion, although this may be explained by the finding that few older adults choose or are able to be displaced (van Boetzelaer et al., 2023).

To the best of the authors' knowledge, this is the first quantitative synthesis of evidence of association between resilience and mental health outcomes among forcibly displaced populations. This review explores differences across conceptualisations of resilience (individual vs. systemic), although notes that no adult only studies adopted systemic measures of resilience, despite these being argued to be more cross-culturally relevant (Ungar and Liebenberg, 2011). Measures of resilience with known psychometric properties (CD-RISC, BRS and RSA; Windle et al., 2011), that are the most widely used (RS; Windle et al., 2011) and cross-culturally valid (CD-RISC and CYRM; Terrana and Al-Delaimy, 2023) were included. Corresponding authors of studies with unreported association coefficients were contacted to maximise the data included. In addition, the present review reports prediction intervals, as recommended in meta-analyses (IntHout et al., 2016), aiding with the interpretation of findings.

4.2. Clinical implications and future directions

Several research implications are noted. To improve the generalisability of future meta-analytic reviews, more research is needed to focus on those who reside in low-income countries, older adults, and URMs. In addition, longitudinal study designs may be helpful to understand the temporal relationship between resilience and mental health in this population. Future research could examine the impact of resilience building interventions among forcibly displaced groups, similarly to reviews conducted in the general population (e.g., Liu et al., 2020). It is worth noting that more than half of the studies excluded during the full-text screening were due to not having adopted one of the better-validated or most used and cross-culturally valid measures of resilience (for example, instead using a proxy measure or non-validated measure of resilience). In addition, many publications referred to the construct of resilience without making the theoretical framework explicit. This illustrates the challenge of searching and drawing from resilience research. It is imperative to the resilience research field for researchers to define resilience and use validated measures of the construct to enhance comparability and interpretation.

Qualitative research could be employed to improve understanding of the how resilience manifests and shed light on context and the mechanisms by which resilience and mental health difficulties are associated. Due to known challenges in defining resilience both within and across cultures (Davydov et al., 2010; Hawkes et al., 2021), research may explore constructs representing tangible and active resiliency processes, such as coping (Rice and Liu, 2016). Exploration according to culture or country of origin was out of the scope of the review, however, is important to consider given cross-cultural differences in resilience are

noted in the literature (Ungar, 2018). In addition, differences in perceptions and experiences of mental health difficulties are also reported. For example, studies have suggested that cultures within the global south may hold a heightened somatic focus and experience mental health difficulties somatically (Ma-Kellams, 2014) and may not always attune with Western-borne understandings and delineations of mental health problems. Further investigation is warranted to understand how somatic symptoms and resilience are associated.

Regarding clinical implications, the negative correlations between resilience and mental health suggests fostering resilience could be key to improve mental health outcomes, particularly depression. However, the differences in the strengths of association suggest that resilience may be more helpful to foster and promote during interventions or preventative efforts for certain mental health difficulties over others. The present review found no significant differences in the association between resilience and mental health outcomes when measured by individual resilience or systemic resilience measures, supporting the idea that fostering individual resilience and systemic resilience may be equally important in improving mental health outcomes.

5. Conclusion

This review found that resilience is negatively associated with anxiety, depression, PTSD, and general psychological distress among forcibly displaced groups, with the strongest effect size reported for depression.

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CRediT authorship contribution statement

Rebecca Lane: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Hannah Taylor:** Writing – review & editing, Supervision, Conceptualization. **Fiona Ellis:** Writing – review & editing, Data curation. **Imogen Rushworth:** Writing – review & editing, Supervision. **Kenny Chiu:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

Author statement

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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