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Review article

COVID-19 depression and its risk factors in Asia Pacific – A systematic review and meta-analysis

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ABSTRACT

Background: This systematic review and meta-analysis aim to synthesize the extant literature reporting the effects of COVID-19 pandemic based on the pooled prevalence of depression among affected populations in Asia Pacific, as well as its risk factors.

Method: A systematic review and meta-analysis approach was adopted as per the PRISMA guidelines, targeting articles published in PubMed, Google Scholar and Scopus from January 2021 to March 30, 2021. The screening resulted in 82 papers.

Results: The overall pooled depression prevalence among 201,953 respondents was 34% (95%CI, 29–38, 99.7%), with no significant differences observed between the cohorts, timelines, and regions ($p > 0.05$). Dominant risk factors found were fear of COVID-19 infection (13%), gender (i.e., females; 12%) and deterioration of underlying medical conditions (8.3%), regardless of the sub-groups. Specifically, fear of COVID-19 infection was the most reported risk factor among general population ($k = 14$) and healthcare workers ($k = 8$). Gender ($k = 7$) and increased workload ($k = 7$) were reported among healthcare workers whereas education disruption among students ($k = 7$).

Limitation: The review is limited to articles published in three electronic databases.

Conclusion The pandemic has caused depression among the populations across Asia Pacific, specifically among the general population, healthcare workers and students. Immediate attention and interventions from the concerned authorities are needed in addressing this issue.

1. Introduction

The Coronavirus disease 2019 (COVID-19) was first reported in December 2019 after a cluster of atypical cases of pneumonia was reported in Wuhan, China. It was subsequently characterized as a pandemic by the World Health Organization (WHO) on March 11, 2020 (World Health Organization, 2020). The latest data as of September 2021 indicate over 200 million[1] positive cases worldwide, with 54.2 million[2] cases in Asia Pacific region alone.

It has been widely reported that the on-going pandemic is compromising physical health, as well as mental health including elevated stress, anxiety, distress and depression caused by uncertainties, fear of COVID-19 infection, increasing work pressure, and lockdowns etc. (Le et al., 2020; Wong et al., 2021b). These adverse mental health effect has been observed worldwide, notably in the Asia Pacific region, dominantly in countries such as China where the first COVID-19 case was reported in 2019 (Hao et al., 2021; Peng et al., 2021; Yan et al., 2021). Currently, many countries in this region are experiencing a spike in daily positive cases, most of which linked to the highly transmissible Delta variant that was first detected in India.

Evidence exists showing elevated depression prevalence across the COVID-19 affected populations in Asia Pacific, for instance, Wong et al. (2021b) examined the level of mental health among Malaysian adults using different timelines ranging from May 2020 to September 2020,

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[1] https://www.worldometers.info/coronavirus/
[2] https://interactive.unocha.org/data/ap-covid19-portal/

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with results indicating depression prevalence to have increased overwhelmingly as the pandemic progressed. In fact, the authors found depression to have the highest prevalence (59.2%) compared to anxiety (55.1%) and stress (30.6%). Another study in China targeting the healthcare workers (HCWs) also reported a high depression prevalence of 50.9% (H. Wang et al., 2021a).

Studies have also reported depression prevalence among various cohorts including HCWs (Matsumoto et al., 2021; Young et al., 2021), general population (Liu et al., 2020; Veldhius et al., 2021), students (Wu et al., 2021a; R. Yadav et al., 2021b), and further identified risk factors contributing to increased depression (Tee et al., 2021; Wickens et al., 2021; Yan et al., 2021). Further, a search of the literature revealed meta-analytics indicating estimated pooled prevalence of depression of 22.8% among HCWs in Asian countries in May 2020 (Pappa et al., 2020) whilst another review among global HCWs conducted in November 2020 reported a higher overall prevalence of depression of 40% (Saragih et al., 2021).

As evidence shows that depression prevalence to have increased as the time progressed, there is a need to update and extend the literature to encompass more recent studies, particularly a year after the beginning of the COVID-19 pandemic across the affected population. This systematic review and meta-analysis aim to (a) analyze the pooled prevalence of depression among the affected populations in Asia Pacific, (b) compare the prevalence among the highly affected cohorts, and (c) identify the risk factors based on cohorts and regions.

2. Materials and method

The current review follows the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines (Moher et al., 2009), and the protocol has been registered in the International Prospective Register of Systematic Reviews (PROSPERO) to avoid duplication. The review is a sub-study of a much larger project, hence the steps presented in the subsequent sections are specifically for this review.

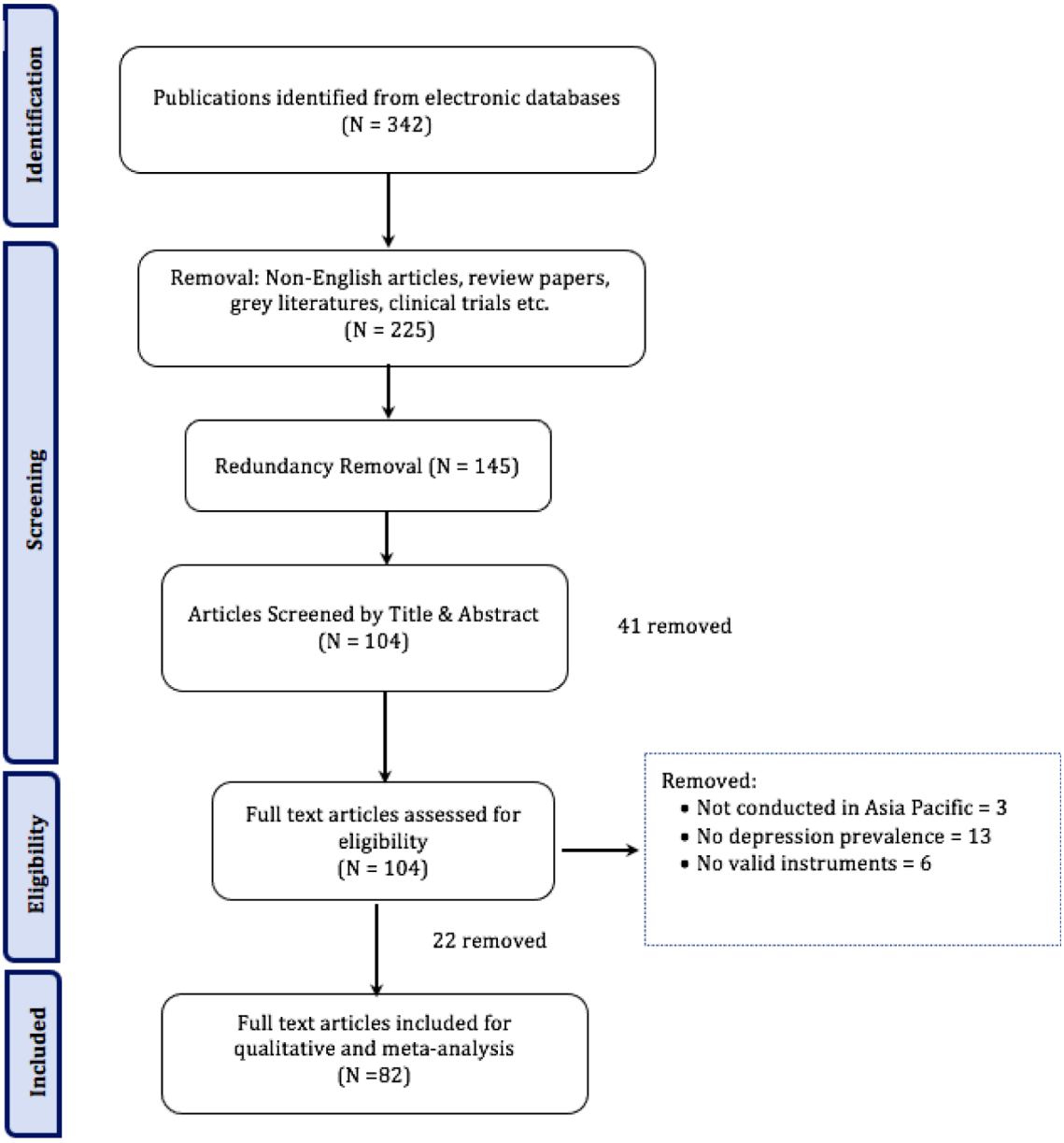

Fig. 1. PRISMA flowchart.

2.1. Search strategy

Scholarly publications related to COVID-19 and mental health were sought from three electronic databases, namely, PubMed, Google Scholar and Scopus, from January 2021 and March 2021. Numerous keywords manipulated with Boolean and wildcard operators were used in the search strategy, including "mental health and pandemic", "mental health and C*", "mental health and outbreak" and "mental health and epidemic". In addition, specific keywords were also replaced (e.g., "mental health" with mental issues, stress*, depression, anxiety, emotion* and psycho*), resulting in more than 35 different combinations. This resulted in a total of 208 articles.

2.2. Eligibility criteria

The Population, Issue of interest, Comparison, Outcome, and Study design (PICOS) (Liberati et al., 2009) approach was adopted to determine the eligibility criteria. The inclusion criteria were: (i) journals published between January 2021 and March 2021, (ii) written in English and targeting Asia Pacific (including multi-country studies), (iii) online surveys (cross-sectional, longitudinal etc.), (iv) the use of validated research instruments for mental health assessments, and (v) report prevalence of depression. Studies not meeting the PICOS criteria, gray literatures, book chapters, reviews and short communications, clinical trials, etc. were excluded. Four authors were involved in screening the articles, and further determining the suitability of the studies based on the titles and abstracts. In instances where the inclusion criteria were unclear, the reviewers checked the full text before a decision is made. This stage resulted in a total of 82 articles (see Fig. 1).

2.3. Data extraction

Four authors independently performed the data extraction which involves the mapping of the articles in terms of quantity, characteristics and sources of evidence in accordance with the aim of this review. This includes details such as author, year, country, sample cohort, sample size, age, timeline of the study, scales/instrument, depression prevalence results and risk factors.

2.4. Quality assessment

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline that assesses cross-sectional studies for risk of bias was used to determine the quality of the articles (von Elm et al., 2007). According to STROBE, risk of bias is deemed to be low if the study reported sufficient data for quality assessment and fulfilled the criteria for the quality item, partial if incomplete data for the quality item were reported, or high if the study reported sufficient data for quality assessment but didn't fulfill the criteria for the quality item.

2.5. Statistical analysis

Statistical heterogeneity was assessed using I^2 (Higgins, 2003), in which proportions of 25%, 50%, and 75% indicate low, moderate, and high heterogeneity, respectively along with random-effects meta--analysis to pool the raw data. Between group analysis was done to examine the differences in the pooled prevalence between the cohorts (i.e., populations), regions, and timelines using a series of random-effects meta-analysis models. Cochran's Q test was used to compare the statistical significance of the subgroup differences (Wu et al., 2021a, b). All the results are considered significant at $p < 0.05$. Publication bias was assessed using the Egger's regression (Egger et al., 1997) and visual assessment of funnel plots. The analyses were done using JASP (0.14.1.0), an open-source tool for statistical analysis.

3. Results

3.1. Study characteristics

All the studies included in the systematic review and meta-analysis were conducted using online surveys, somewhat expected considering the worldwide lockdowns due to the COVID-19 pandemic. As shown in Table 1, a vast majority of the studies were conducted in China (41%) as the virus was first detected in this nation, followed by the USA (15.7%). A further categorization of the countries based on the regions indicate slightly more than half of the studies were conducted in East Asia (50.6%), followed by North America (22.9%) and South Asia (18.1%). The top three cohorts were the general population (39.8%), (HCWs (27.7%), and students (18%). The rest of the cohorts include patients with pre-existing medical conditions (e.g., mental health disorder, cancer, COVID-19 etc.) with eight studies in total, one involving COVID-19 quarantined individuals (Kang et al., 2021), and one targeting children (Glynn et al., 2021). These cohorts were regrouped as Others for the between group analysis. As for the study instruments, the Patient Health Questionnaire (PHQ) and its variants emerged to be most popular (53%), followed by the Depression, Anxiety, and Stress Scale (DASS)−21 (18.1%) and Center for Epidemiological Studies Depression (CESD) (12%). The study timelines ranged between January and December 2020. The complete analysis can be found in Supplementary 1.

3.2. Publication bias

The visual assessment of the funnel plot indicates low publication bias (Supplementary 2), which was confirmed by the Egger's test ($p = 0.249$).

3.3. Quality assessment

All the studies fulfilled most of the criteria in the STROBE checklist (Supplementary 3). However, of these four did not specify timeline, 10

Table 1
Study characteristics of the papers reviewed.

Region	N (%)	Country	N (%)	Cohort	N (%)
East Asia	41 (50.0)	China	33 (40.2)	General Population	32 (39.0)
		Japan	5 (6.1)	Healthcare Workers	23 (28.1)
		Hong Kong	2 (2.4)	Students	15 (18.3)
		South Korea	1 (1.2)	Others	12 (14.6)
North America	19 (23.2)	USA	13 (15.9)		
		Canada	6 (7.3)	Scale	
South Asia	15 (18.2)	Bangladesh	7 (8.5)	PHQ	43 (52.4)
		India	4 (4.9)	DASS −21	16 (19.5)
		Nepal	3 (3.7)	CESD	10 (12.2)
		Sri Lanka	1 (1.2)	SDS	5 (6.1)
				HADS	3 (3.7)
Oceania	4 (4.9)	Australia	4 (4.89)	Others	5 (6.1)
Southeast Asia	3 (3.7)	Malaysia	3 (3.7)		

Note: PHQ: Patient Health Questionnaire; DASS-21: Depression, Anxiety, and Stress Scale; CESD: Center for Epidemiological Studies Depression; SDS: Self-rating Depression Scale; HADS: Hospital Anxiety and Depression Scale; Others: Beck's Depression Inventory; Edinburgh Postpartum Depression Scale; Geriatric Depression Scale; Quick Inventory of Depressive Symptomatology; Short Mood and Feelings Questionnaire.

did not describe limitations, 43 did not provide sample size calculations, 47 had limited generalizability and 23 did not disclose information on financial support. This may justify the low-risk bias present in the studies as shown in the funnel plot (Supplementary 2).

3.4. Depression prevalence

The prevalence of depression was analyzed in 82 studies, with 201, 953 respondents. The overall pooled prevalence of depression was 34% (95% CI: 29.0 –38.0%), ranging between 6.8% and 73.85% (Fig. 2). The I^2 value of 99.7% also indicates a high degree of heterogeneity, a pattern that is commonly reported among systematic review and meta-analyses studies due to the varying methodologies, experimentations and scales adopted within each individual study (Böger et al., 2021; Levin et al., 2020; Wu et al., 2021b).

3.5. Between group analysis

We performed between group analyses based on the cohorts, timelines and regions, and the results are shown in Table 2.

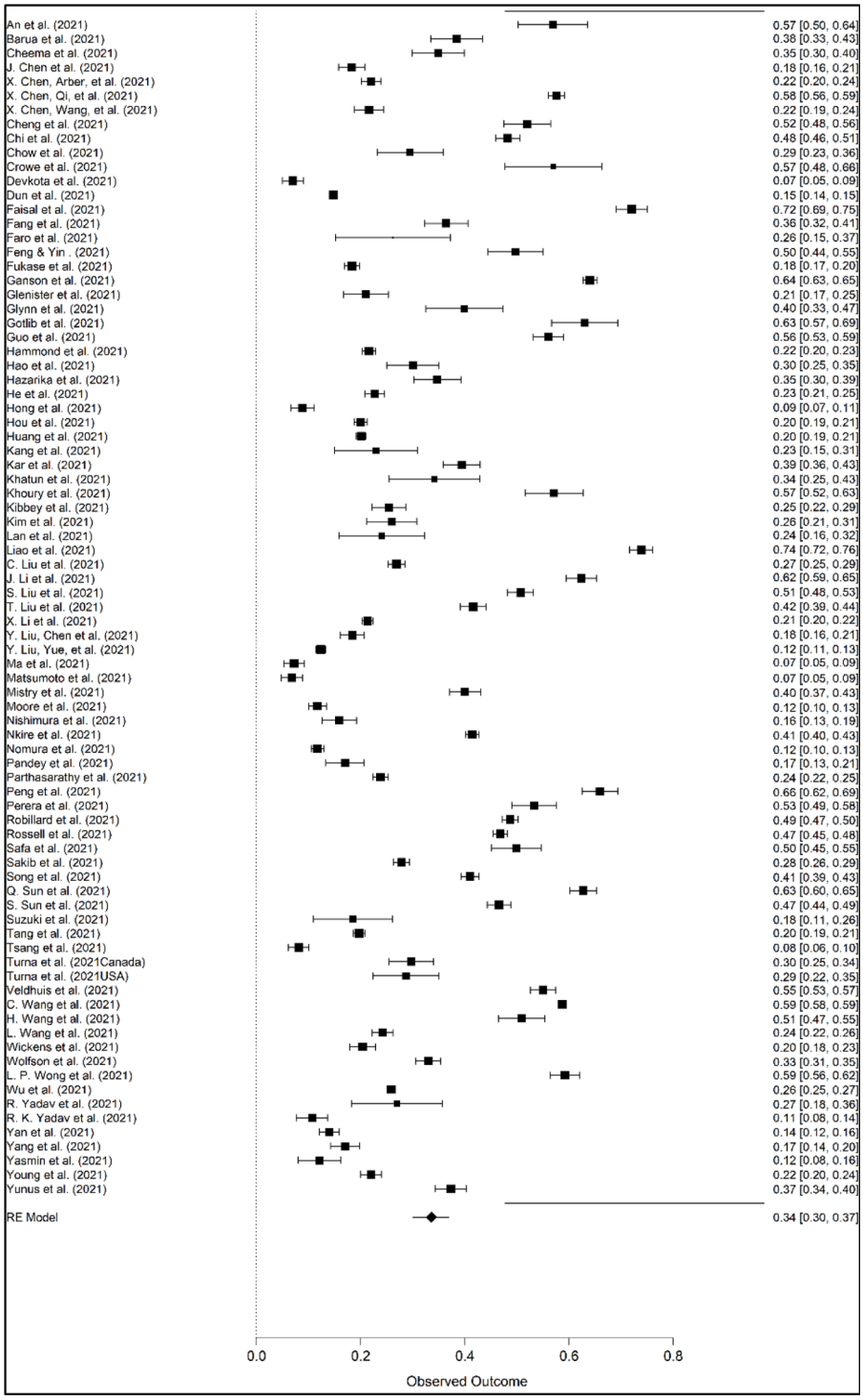

Fig. 2. Forest plot for depression pooled prevalence.

Table 2
Between group analyses.

Categories		Number of Studies (k)	Pooled Prevalence	CI	I^2	Q	P-value
Overall	Overall	83	34	29–38	99.742		
Cohort	HCW	23	34	29–39	99.431	0.254	0.968
	GP	33	34	27–42	99.832		
	Students	15	34	25–42	99.838		
	Others	12	31	20–42	98.289		
Region	East Asia	42	33	26–39	99.845	0.929	0.92
	South Asia	15	32	24–41	99.281		
	Southeast Asia	3	42	24–60	98.55		
	North America	4	31	15–47	99.257		
	Oceania	19	36	27–45	99.458		
Timeline	Jan - Apr	45	36	30–42	99.785	1.06	0.589
	May - Aug	32	31	24–38	99.679		
	Sept - Dec	2	30	29–38	96.235		

Note: HCW: Healthcare workers; GP: General population.

The pooled prevalence of depression among cohorts ($k = 4$, $N = 83$) for HCWs, General population, Students and Others were 34% (95% C1:29–39%), 34% (95% C1:27–42%), 34% (95% C1:25–42%) and 31% (95% C1:20–42%), respectively. The Q-statistics indicate no significant differences between the depression levels for each cohort ($p > 0.05$). A similar observation was noted for regions ($k = 5$, $N = 83$) with $p > 0.05$. Finally, the pooled prevalence of depression between different timelines ($k = 3$, $N = 78$) indicate most studies were conducted during the early phase of the outbreak (Jan - Mar 2020) resulting in a pooled prevalence of 36% CI 95% [30%; 42%]. However, no significant differences were observed between the timelines ($p > 0.05$). Results of the between group analysis are attached as Supplementary 4.

3.6. Risk factors

Dominant risk factors for depression revealed to be fear of COVID-19 infection (13%), gender (females, 12%) and deterioration of underlying medical conditions (8.3%). Others include income disruption, lack of social support, increased workload, job security, job burnout etc. Table 3 provides the details whereas the complete analysis is presented in Supplementary 5.

3.6.1. Risk factors between cohorts

Fear of COVID-19 infection (13%) emerged to be the most common risk factor for depression among all the cohorts ($k = 33$), especially within the general population ($k = 14$). As for the students, the disruption of education ($k = 7$) was identified as the most evident risk factor whilst the HCW listed gender ($k = 7$) and increased workload ($k = 7$) as risk factors apart from fear of COVID-19 infection ($k = 8$). Interestingly, among the COVID-19 infected cohort, the factor that was identified as a risk for depression was isolation and lack of community support ($k = 2$). Others include high stress levels ($k = 4$), lack of access to medical attention ($k = 3$), being away from family ($k = 3$), food security ($k = 3$), past trauma ($k = 2$), addictive behavior ($k = 2$), stigmatization ($k = 2$), sexuality ($k = 1$) and parental mental condition ($k = 1$).

3.6.2. Risk factors between regions

Dominant risk factors for countries within the Asian region (East Asia, South Asia, Southeast Asia) were fear of COVID-19 infection ($k = 25$), gender ($k = 22$) and deterioration of underlying medical conditions ($k = 15$). East Asia recorded the highest number of studies ($k = 18$) identifying fear of COVID-19 infection as a risk factor for depression. The major risk factors in North America and Oceania were age ($k = 9$), gender, fear of infection ($k = 8$) and income disruption/financial restraint ($k = 6$). Similar to risk factors between cohorts, the common risk factors identified within the Asia Pacific region was the fear of COVID-19 infection ($k = 33$), gender ($k = 30$) and deterioration in underlying medical conditions ($k = 21$).

4. Discussion

This systematic review and meta-analysis analyzed the pooled prevalence of depression among populations in Asia Pacific and identified its risk factors. Further analysis indicates depression was more common among women, younger adults, unmarried individuals, people with lower socioeconomic status, and those who were at high risk of COVID-19 infection (suspected/confirmed cases, living in a hard-hit area etc.). Furthermore, data indicates that increased familial and social support, as well as learning effective coping method aid in lowering the likelihood of depression.

Our overall pooled prevalence of depression (34%) was found to be in coherent with Wang et al. (2020) and Luo et al. (2020) who reported prevalence of 30% and 28%, respectively based on their meta-analyses on the general population. A further examination of the subgroups revealed no significant differences between the cohorts and depression prevalence, in line with Spoorthy et al. (2020). Studies related to mental health conditions of HCWs revealed that they were more likely to develop posttraumatic stress disorder compared to depression due to the conditions they had to deal with daily throughout this pandemic (Liu et al., 2020a; Spoorthy et al., 2020). Nevertheless, a deeper investigation needs to be administered to examine the non-differential levels of depression amongst HCWs and the general population to determine if the former is suppressing their emotions due to obligations of being front liners.

No significant differences were observed between regions as well with regards to the depression prevalence, although studies have revealed residents who are closer to ground zero tend to be at a higher risk of depression (DePierro et al., 2020; Han et al., 2021). This shows that the mental well-being of the population across Asia Pacific is affected similarly, regardless of the country of residence. This could also be attributed to different risk factors contributing to the decline in their mental health, such as living in isolation among residents in East Asia (Fang et al., 2021; Kang et al., 2021) and lack of access to medical attention as hospitals were full with COVID-19 patients for those within the Oceania region (Cheema et al., 2021; Glenister et al., 2021).

Fear of COVID-19 infection was found to be the most dominant risk factors, regardless of the cohorts, timelines, and regions. This was somewhat expected as new information regarding the virus was being discovered as it progressed (X. Chen et al., 2021b), coupled with the fear of the unknown that was further exacerbated by information overload due to a greater access to COVID-19 information through social media (Hong et al., 2021; Sakib et al., 2021; B. Ye et al., 2020a, b). The risk factor was also found to be commonly reported among HCWs, probably because they dealing with a virus they had minimal knowledge about

Table 3
Risk factors for depression.

Risk Factors	Number of Studies	Percentage (%)	Author
Fear of COVID-19 infection	33	13.04	(An et al., 2021), (J. J. Chen et al., 2021), (Xi J. Chen et al., 2021), (Cheng et al., 2021), (Faisal et al., 2021), (Feng et al., 2021) (Hammond et al., 2021), (Hao et al., 2021), (Hazarika et al., 2021), (He et al., 2021), (Hong et al., 2021), (Khoury et al., 2021), (Kibbey et al., 2020), (Lan et al., 2021), (J. Li et al., 2021), (T. S. Liu et al., 2021), (Liu et al., 2020), (Pandey et al., 2021), (Peng et al., 2021), (Rossell et al., 2021), (Safa et al., 2021), (Sakib et al., 2021), (S. Q. Sun et al., 2021), (Q. Q. Sun et al., 2021), (Tsang et al., 2021), (H. H. Wang et al., 2021), (Y. H. Wang et al., 2021), (Wickens et al., 2021), (Wu et al., 2021a), (R. R. Yadav et al., 2021), (Yan et al., 2021), (Yasmin et al., 2021), (Young et al., 2021)
Gender	30	11.86	(Xu J. Chen et al., 2021), (Chi et al., 2021), (Devkota et al., 2021), (Fang et al., 2021), (Glenister et al., 2021), (Huang et al., 2021), (Rashid et al., 2021), (Kibbey et al., 2020), (S. S. Liu et al., 2021), (Liu et al., 2020), (Matsumoto et al., 2021), (Moore et al., 2021), (Nomura et al., 2021), (Matsumoto et al., 2021), (Moore et al., 2021), (Nomura et al., 2021), (Pandey et al., 2021), (Parthasarathy et al., 2021), (Peng et al., 2021), (Robillard et al., 2021), (Rossell et al., 2021), (Safa et al., 2021), (Sakib et al., 2021), (Song et al., 2020), (Suzuki et al., 2021), (Turna et al., 2021), (Veldhuis et al., 2021), (Y. H. Wang et al., 2021), (Wong et al., 2021), (Wu et al., 2021a), (R. R. Yadav et al., 2021), (Yan et al., 2021)
Deterioration of medical problems/ medical condition/ diagnosed disease/ underlying disease	21	8.30	(J. J. Chen et al., 2021), (Barua et al., 2020), (X. J. Chen et al., 2021), (Fang et al., 2021), (Fukase et al., 2021), (Gotlib et al., 2021), (Hammond et al., 2021), (Hao et al., 2021), (Hazarika et al., 2021), (Kibbey et al., 2020), (Liu et al., 2020), (Mistry et al., 2021), (Nishimura et al., 2021), (Robillard et al., 2021), (Sakib et al.,

Table 3 (*continued*)

Risk Factors	Number of Studies	Percentage (%)	Author
			2021), (Suzuki et al., 2021), (Tsang et al., 2021), (Y. H. Wang et al., 2021), (Wong et al., 2021), (Yang et al., 2021), (Young et al., 2021)
Age	20	7.91	(An et al., 2021), (Cheema et al., 2021), (Fukase et al., 2021), (Glenister et al., 2021), (Kar et al., 2021), (Kar et al., 2021), (Rashid et al., 2021), (Kim et al., 2021), (Matsumoto et al., 2021), (Nkire et al., 2021), (Robillard et al., 2021), (Rossell et al., 2021), (Song et al., 2021), (Tang et al., 2021), (Turna et al., 2021), (Veldhuis et al., 2021), (Wong et al., 2021), (Yan et al., 2021), (Yang et al., 2021), (Yunus et al., 2020)
Income disruption/ financial restraints	19	7.51	(Xian Chen et al., 2021), (Cheng et al., 2021), (Devkota et al., 2021), (Fukase et al., 2021), (Ganson et al., 2021), (Gotlib et al., 2021), (He et al., 2021), (Hou et al., 2021), (Kar et al., 2021), (Khoury et al., 2021), (Mistry et al., 2021), (Robillard et al., 2021), (Q. Sun et al., 2021), (S.Q. Sun et al., 2021), (Y. H. Wang et al., 2021), (Wickens et al., 2021), (Wolfson et al., 2021), (Wolfson et al., 2021), (Wong et al., 2021), (Yan et al., 2021)
Living alone/ isolation	13	5.14	(X. J. Chen et al., 2021), (Cheng et al., 2021), (Fang et al., 2021), (Kang et al., 2021), (Khoury et al., 2021), (Lan et al., 2021), (Yan Liu et al., 2021), (Yu an Liu et al., 2021), (Liu et al., 2020), (Mistry et al., 2021), (Nkire et al., 2021), (Veldhuis et al., 2021), (H. Wang et al., 2021)
Lack of social support / community support	10	3.95	(Feng et al., 2021), (Glenister et al., 2021), (Hong et al., 2021), (Kang et al., 2021), (Khoury et al., 2021), (Yuan Liu et al., 2021), (Nkire et al., 2021), (Q. Sun et al., 2021), (Wang et al., 2021), (H. H. Wang et al., 2021)
Geographical location of cohort	10	3.95	(Ganson et al., 2021), (Glenister et al., 2021), (Guo et al., 2021), (Rashid et al., 2021), (Kim et al., 2021), (Rossell et al., 2021), (Wu et al., 2021a), (Yan et al., 2021), (Yasmin et al., 2021), (Yunus et al., 2021)

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Table 3 (*continued*)

Risk Factors	Number of Studies	Percentage (%)	Author
Increase workload/ workload changes / working conditions	9	3.56	(J. J. Chen et al., 2021), (Crowe et al., 2021), (Fang et al., 2021), (Hammond et al., 2021), (He et al., 2021), (J. Li et al., 2021), (Y. S. Liu et al., 2021), (Parthasarathy et al., 2021), (Perera et al., 2021)
Maritial status	7	2.77	(Fukase et al., 2021), (Hazarika et al., 2021), (Rashid et al., 2021), (Yu an Liu et al., 2021), (Sakib et al., 2021), (Veldhuis et al., 2021), (Yan et al., 2021)
Education level	7	2.77	(Fang et al., 2021), (Guo et al., 2021), (Kar et al., 2021), (Kim et al., 2021), (Liu et al., 2020), (Song et al., 2021), (Yan et al., 2021)
Lack of outdoor activity/exercise	7	2.77	(Xu J. Chen et al., 2021), (Chi et al., 2021), (Dun et al., 2021), (Faro et al., 2021), (Suzuki et al., 2021), (R. K. R. Yadav et al., 2021), (Yasmin et al., 2021)
Disruption of education	7	2.77	(Xu J. Chen et al., 2021), (Chi et al., 2021), (Gotlib et al., 2021), (Y. S. Liu et al., 2021), (Ma et al., 2021), (Nishimura et al., 2021), (Yunus et al., 2021)
Information overload & reliability	7	2.77	(Crowe et al., 2021), (Gotlib et al., 2021), (Guo et al., 2021), (Hammond et al., 2021), (Hong et al., 2021), (Hou et al., 2021), (Yang et al., 2021)
Coping style	7	2.77	(J. J. Chen et al., 2021), (X. J. Chen et al., 2021), Chowetal2021, (Feng et al., 2021), (Kar et al., 2021), (Song et al., 2021), (H. H. Wang et al., 2021)
Inadequate medical resource & attention (PPE/other medical resource)	6	2.37	(Barua et al., 2020), (Hammond et al., 2021), (Pandey et al., 2021), (Sakib et al., 2021), (Suzuki et al., 2021), (Young et al., 2021)
Sleep disturbance/ insomnia	6	2.37	(Barua et al., 2020), (Xu J. Chen et al., 2021), (Khoury et al., 2021), (S. S. Liu et al., 2021), (Y. S. Liu et al., 2021), (Wang et al., 2021)
Lack of education/ awareness towards COVID	5	1.98	(Cheema et al., 2021), (Cheng et al., 2021), (Faisal et al., 2021), (Hazarika et al., 2021), (Yang et al., 2021)
Being HCW	4	1.58	(Huang et al., 2021), (Kar et al., 2021), (S. Liu et al., 2021), (Matsumoto et al., 2021)
Job burnout	4	1.58	(J. J. Chen et al., 2021), (He et al., 2021), (Rashid et al., 2021), (Young et al., 2021)
Others	21	8.32	(An et al., 2021) (Yuan Liu et al., 2021), (Robillard et al., 2021), (Suzuki et al., 2021), (Cheema et al., 2021), (Glenister et al., 2021), (Nishimura et al., 2021), (Devkota et al., 2021), (Y. S. Liu et al., 2021), (Matsumoto et al., 2021), (Gotlib et al., 2021), (Wolfson et al., 2021), Lietal 2021a, (Nomura et al., 2021), (Perera et al., 2021), (S.Q. Sun et al., 2021), (Moore et al., 2021)

with looming fear that they may infect their family members (Feng et al., 2021; Hammond et al., 2021; Matsumoto et al., 2021). Furthermore, the drastic increase in the number of patients as well as increased workload also led to an elevated depression among the HCWs (Crowe et al., 2021; Parthasarathy et al., 2021; Perera et al., 2021).

Students in Asia Pacific generally reported concern due to disruption to their education, a phenomenon not only evident among those at the tertiary level but also amongst students in secondary and primary levels as they were struggling to cope with online classes, and the challenges that come with it (Chi et al., 2021; Gotlib et al., 2021; Nishimura et al., 2021). Other concern include uncertainty towards their academic future and job prospects (Ma et al., 2021; Yunus et al., 2020).

Income disruption and financial strain were identified as risk factors among countries on the Pacific region of Asia Pacific (Ganson et al., 2021; Robillard et al., 2021; Wickens et al., 2021; Wolfson et al., 2021). In fact, recent report indicates that North American countries experienced income loss by 10.3% compared to those in Asia (6.6%) (International Labor Organization, 2021). Other risk factors identified include age (younger) and gender(female) (Glenister et al., 2021; Huang et al., 2021; Veldhuis et al., 2021). This is especially evident among the Asian countries and could be attributed to the cultural gendered roles and the biological means of women resulting in them handling stressful situations differently than men (Hidayati et al., 2020). This however warrants further investigation.

5. Conclusion, recommendation, and limitations

The systematic review and meta-analysis examined the pooled prevalence of depression among the affected populations in Asia Pacific and identified the risk factors leading to an increased depression. Further, between group analyses were conducted for the cohorts, regions and timelines. The review shows prevalence of depression due to the COVID-19 pandemic, regardless of the cohorts and regions. In fact, no significant differences were observed between the groups and the depression prevalence, indicating that the pandemic has hit the Asia Pacific populations hard, psychologically. Findings also revealed some common risk factors across the studies reviewed, with fear of COVID-19 infection to be highly reported. Unique risk factors were also found for the specific cohorts. The study provides evidence for the urgent need for attention and strategic interventions providing a holistic care to the affected populations.

The prevalence, cohorts and risk factors identified in this review provide insights into the populations with higher risk of depression, hence interventions can be tailored accordingly. For example, low-intensity psychosocial interventions such as social/family/peer support, education programs, computerized self-help Cognitive Behavioral Therapy (CBT) etc., can be initiated for people with milder depression whereas high-intensity interventions (i.e., formal psychological therapies) can be initiated for those with severe depression symptoms (NICE

2009). Further, other effective treatments such as task-shifting approaches with trained counsellors (Patel et al., 2017) should be considered as well. We, therefore, propose a variety of intervention approaches coupled with telehealth to target the affected populations in Asia Pacific.

We identify several limitations. Firstly, the articles were limited to three electronic databases, hence this may have resulted in the majority of the studies reviewed to over-represent general population and HCWs. Further, all the studies were based on online surveys, resulting in most of the samples studied to be urbanites with Internet connections, thus creating a selection bias in the populations studied. Also, all the studies assessed depression through self-reported questionnaires, and thus may have brought bias to an overestimation/underestimation of the prevalence of depression. A high heterogeneity rate was also observed in this study probably due to the various measurement instruments and scales adopted with varying cut-off points, cohorts as well as different regions across the Asia Pacific. Therefore, the results should be interpreted with caution. Further, a vast majority of the studies were from China (40%), thus probably contributing to the high heterogeneity in the results. This could also be attributed to the disproportionate sample populations investigated, instruments with varying cut-off points etc.

Author's contribution

Balakrishnan - designed the study, screening, visualization, drafting manuscript, manuscript revision; Ng - designed the study, screening, drafted the manuscript; Wandeep - article search, data extraction and screening; Kumanan - article search, data extraction and screening; Lek - article search, data extraction and screening.

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Declaration of competing interest

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Supplementary materials

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