

# Anxiety and depression of general population in the early phase of COVID-19 pandemic: A systematic review of cross-sectional studies

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## Abstract

**Background:** The rapid outbreak of COVID-19 pandemic promptly changed people's daily lives, influenced human interactions and economic activities and induced mental reactions.

**Objective:** This review synthesized the evidence of correlation between demographic factors, social media exposure, stressors and anxiety and depression status in the early phase of COVID-19.

**Method:** A systematically search included observational studies published before May15, 2020. We selected studies designed with valid measuring instruments of anxiety and depression.

**Result:** 20 articles were included (19 cross-sectional) for review. People who were divorced/widowed, with poor self-rated health status, chronic illness and previous psychiatric illness had higher anxiety and depression prevalence. Higher COVID-19 awareness (including COVID-19 knowledge and precautionary measure) decreased anxiety and depression. The protective measures to reduce anxiety and depression levels included avoiding sharing meals, frequently washing hands and wearing mask. Economic loss, academic delay, influence of daily life, worrying and symptoms related to infection were stressors of anxiety and depression. There were lots of inconsistent results due to convenience sampling and diverse measuring instrument.

**Conclusion:** Our review suggested that reliable information from health authorities, enhancing health literacies and prevention measures of general population can reduce anxiety and depression levels.

**Keywords:** Anxiety, Depression, COVID-19, Social media exposure, Stressors, Public health

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## Introduction

The novel coronavirus disease (COVID-19) has a nature of high transmissibility and mortality<sup>1,2</sup>. The rapid outbreak promptly changed people's daily lives, with disruptions of the social connection and economic activities<sup>3</sup>. Enforcement of social distancing in many countries reduced the disease transmission but may exaggerate the disturbance of lives<sup>4</sup>. These influences on daily activities, human interactions and economic impacts, combined with the fears of being infected with COVID-19 and poor clinical outcomes are possible stressors of mental reactions<sup>5</sup>. In addition, excessively delivering the above information and misinformation via news media may create more emotional impacts<sup>6,7</sup>. An article reviewing the psychological responses of SARS, Ebola and H1N1 found the common presence of anxiety and depression during disease outbreaks<sup>8</sup>. The aim of this study was to review the anxiety and depression status of general population in the early phase of COVID-19 and their correlation with demographic factors, social media exposure and psychological stressors.

## Methods

### Data sources and search strategy

A systematically electronic search of PUBMED/MEDLINE, EMBASE and Cochrane was undertaken in May 2020. All studies published before May15, 2020 were included. The search strategy used the following descriptors and combinations: “novel coronavirus”, “COVID”, “anxiety”, “depression”, “mental health” and “psychiatry”. Citation searching of the reference lists was also performed. The search was conducted by two reviewers (Lin, C. Y. and Lin, Y.L.).

### Inclusion and exclusion criteria

Studies (1) recruiting general population; (2) with valid measuring instruments to evaluate anxiety or depressive symptoms; (3) available in English or Chinese were included. There was no restriction on age and publication area. Studies were excluded if (1) they were abstracts, opinion-based publications, intervention studies or case-report; (2) targeting only on health care worker; (3) focusing on previous epidemic.



## Risk of bias assessment

The modified Newcastle-Ottawa Scale (NOS) for cross sectional studies was used to evaluate the quality of included study(NOS; <http://www.ohri.ca/programs>). The appraisal tool includes seven assessment items including 'selection', 'comparability' and 'outcome'. The tool is valid for assessing the quality of non-randomized studies. The NOS adapted for cross sectional studies uses a ten-star rating system with a maximum of five points available for selection, two for comparability and three for assessment of the outcome or exposure. According to the standard of NOS, the quality of cross-sectional studies could be classified as low (scores of 0–4), moderate (scores of 5–6) and high (scores  $\geq 7$ ). Appraisal of the quality was undertaken by two authors (Lin, C. Y. and Lin, Y.L.).

## Data extraction

All data were extracted initially by one author (Lin, C. Y.) and verified by a second author (Lin, Y.L.). The following data were extracted from each included study: (1) authors name, (2) study design, (3) country, (4) number of participants, (5) study population, (5) demographic characteristics (e.g., sex, age), (6) measuring instruments and (7) main conclusions.

## Results

### Literature search and selection

A total of 1016 articles were identified through electronic searching in PubMed/Medline, EMBase, Cochrane and citation searching. After removing duplicates, there were 521 records. 76 of them were selected by viewing titles. 42 were excluded after abstracts screening. Full-text screening of 34 studies was done and 14 were excluded based on our exclusion criteria. Finally, 20 articles were included for this systematic review. Figure 1 presents the results of the literature search and study identification process.

### Quality assessment

The quality of the included articles is shown in Table 1. Nineteen articles had low quality. Most studies used convenience or snowball sampling, which had high risk of non-representative of population, and the demographic characteristics of participants were not comparable between groups. No study explained the reasons and

characteristics of non-respondents. One study from Denmark had weighted the sample of participants and was the only one awarded moderate quality.

### Study characteristics

The characteristics of the included articles are summarized in Table 2. and Table 3. Twenty articles from nineteen observational studies involving 59,891 study subjects were included, with eighteen articles discussing anxiety (53,486 subjects) and seventeen articles discussing depression (41,824subjects). Most of the studies (fifteen articles) were conducted in China. Other five studies were conducted in Italy, Iran, Turkey, Vietnam and Denmark respectively. There was only one longitudinal study. All of the other studies were cross-sectional. Sixteen articles collected data online by snowball or convenience sampling and the other studies recruited participants from school, inpatients, outpatient and those under self-isolation. The measuring instruments of anxiety include Generalized Anxiety Disorder-7 (GAD-7, six articles), Depression, Anxiety and Stress Scales-21 (DASS-21, six articles), Self-Rating Anxiety Scale (SAS, three articles), Beck Anxiety Inventory (BAI, one article) and Hospital Anxiety and Depression Scale (HADS, two articles). Instruments used to evaluate depression include Patient Health Questionnaire-9 (PHQ-9, four articles), Depression, Anxiety and Stress Scales-21 (five articles), Self-rating depression scale (SDS, two articles), Hospital Anxiety and Depression Scale (two articles), World Health Organization Well-Being Index-5 (WHO-5, two articles), Beck Depression Inventory (one article) and Center for Epidemiology Scale for Depression (one article).

### Comparison of anxiety and depression levels based on different variables

#### Demographic factors

**Anxiety:** 10.4%-35.1% of participants were found with moderate to severe GAD-7, DASS-anxiety levels, and positive BAI, HADS scores<sup>9-19</sup>. Several studies had relative low anxiety prevalence, including two studies targeting at college students (3.4%-3.6%; mostly with medical background)<sup>20,21</sup>, one study discussing workforce returning to work (6.1%)<sup>22</sup> and two studies using SAS to evaluate anxiety levels (6.3% and 8.3%)<sup>23,24</sup>. One Turkish study showed relative high anxiety prevalence in general population by HADS(45.1%)<sup>25</sup>.

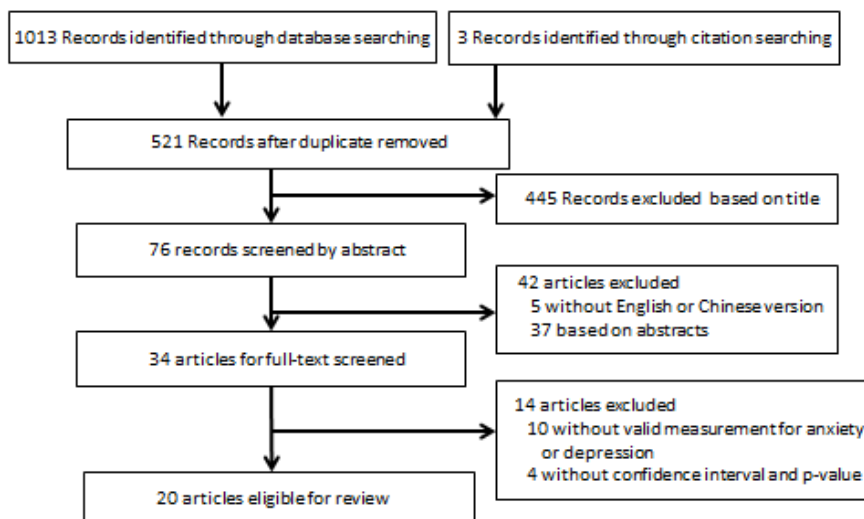


Figure 1. Flow diagram of literature search and study selection

Table 1. Risk of bias assessment

Author	Selection	Comparability	Outcome	Total No.stars (Max 10)	Quality of study
Huang, Y, et al. <sup>9</sup>	**	-	**	4	Low
Gao, J., et al. <sup>10</sup>	*	-	**	3	Low
Zhou, S.J., et al. <sup>11</sup>	*	-	**	3	Low
Zhu, S., et al. <sup>12</sup>	**	-	**	4	Low
Wang, C., et al. <sup>13</sup>	*	-	**	3	Low
Wang, C., et al. <sup>14</sup>	*	-	**	3	Low
Hao, F., et al. <sup>15</sup>	*	-	**	3	Low
Mazza, C., et al. <sup>16</sup>	*	-	**	3	Low
Moghanibashi-Mansourieh, A. <sup>17</sup>	*	-	**	3	Low
Ahmed, M.Z., et al. <sup>18</sup>	*	-	**	3	Low
Yuan, R., et al. <sup>19</sup>	*	-	**	3	Low
Cao, W., et al. <sup>20</sup>	*	-	**	3	Low
Chang, J., et al. <sup>21</sup>	*	-	**	3	Low
Tan, W., et al. <sup>22</sup>	-	-	**	2	Low
Lei, L., et al. <sup>23</sup>	*	-	**	3	Low
Wang, Y., et al. <sup>24</sup>	-	-	**	2	Low
Özdin, S., et al. <sup>25</sup>	*	-	**	3	Low
Nguyen, H.C., et al. <sup>26</sup>	*	-	**	3	Low
Sønderskov, K.M., et al. <sup>27</sup>	***	*	**	6	Moderate
Xiao, H., et al. <sup>28</sup>	-	-	**	2	Low

Table 2. Study characteristics of articles evaluating anxiety

Study characteristics	Participants characteristics	Measuring instruments	Correlation between demographic factors and anxiety	SME, COVID knowledge, behaviors and stressors
Huang, Y, et al. <sup>9</sup> Cross sectional China Online survey	7236 general population Male:3284(45.4%) Female:3952(54.6%) Age (Mean±SD) 35.3±5.6	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety:35.1% No significant difference in anxiety symptoms by gender More anxiety among age < 35 years than age >35 years (38% versus 32.9%)	Time spent focusing on the COVID-19 (≥ 3 hours per day compared to <1 hour) were associated with GAD (OR=1.91)
Gao, J., et al. <sup>10</sup> Cross sectional China Online survey	4872 general population Male:1560(32.3%) Female:3267(67.7%) Age (Mean±SD): 32.3±10.0 years 21–30 years: 2312(47.9%) College: 3002(62.2%) Urban: 3920(81.2%) SME: less:8.8%; sometimes:9.2%; frequently:82.0%	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety:22.6% Greater anxiety among those aged 31–40 years (OR = 1.63) compared with those aged <20 years Less anxiety among those with college (OR = 0.40) and master (OR = 0.31) than those with middle school Participants from other provinces had lower adjusted odds (OR = 0.49) of anxiety than those from Hubei province More anxiety among those with good/general/poor SRH (OR = 1.77) compared with those with excellent SRH	frequently SME with higher anxiety (OR = 1.72)
Zhou, S.J., et al. <sup>11</sup> Cross sectional China Online survey	8079 Adolescents Male:3753 (46.5%) Female:4326 (53.5%) City; Rural:38.4%; 61.6%	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety: 37.4% mild 27%; moderate:7.4%; severe:3% More anxiety in female gender than male(38.4% versus 36.2%) The higher the grade, the greater the prevalence of anxiety Less anxiety among students in cities than rural areas (32.5% versus 40.4%). Hubei province was a risk factor for anxiety symptoms (OR= 1.64).	COVID-19 knowledge, prevention and control measures were higher among students without anxiety
Zhu, S., et al. <sup>12</sup> Cross sectional China Online survey	2279 general population Quarantine:1443 without quarantine: 836	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety :21.7%	No significant change between with and without quarantine of GAD (22.2% vs. 20.8%)

Cao, W., et al. <sup>20</sup> Cross sectional China Cluster sampling	7143 medical college students Male:2168 (30.4%) Female:4975 (69.6%) Urban;Rural-urban;Rural:36.8%; 20.2%; 43.8%	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety: 24.9% mild 21.3%; moderate:2.7%; severe:0.9% Living in urban areas (OR = 0.810), family income stability (OR = 0.726) and living with parents (OR = 0.752) were protective factors against anxiety	Worrying about the economic influences of the epidemic ( $r = 0.327$ , $P < .001$ ), academic delays ( $r = 0.315$ , $P < .001$ ), influence of the epidemic on daily-life ( $r = 0.316$ , $P < .001$ ) were positively related to the levels of anxiety in college students
Chang, J., et al. <sup>21</sup> Cross sectional China Online survey	3881 college students Male:1434 (37%) Female:2447 (63%) medical student:86.55% City: 76.1%	Generalized Anxiety Disorder 7-item (GAD-7)	Overall anxiety: 26.6% mild 23.2%; moderate:2.7%; severe:0.7% More anxiety in college students from rural area than those from urban area More anxiety in non-medical students than medical students Students in higher grade had less anxiety symptoms	n/a
Wang, C., et al. <sup>13</sup> Cross sectional China Online survey	1210 general population Male:396 (32.7%) Female:814 (67.3%) Age 21.4–30.8: 53.1%	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall anxiety: 36.6% mild 7.5%; moderate:20.4%; severe:8.4% More anxiety in female gender, student status, people with physical symptoms, poor SRH status and chronic illness	Concerns about a child getting infection was associated with higher anxiety levels precautionary measures such as avoiding sharing chopsticks during meals, washing hands with soap, washing hands more frequently and wearing mask were associated with a lower levels of anxiety
Wang, C., et al. <sup>14</sup> Longitudinal China Online survey first survey:Jan.31 to Feb.2 Second survey: Feb.28 to Mar.1	1738 general population 1st survey:1210(13) 2nd survey:861 Female:75% Age 21.4–30.8: 46.5% Both survey:333	Depression, Anxiety and Stress Scales 21-item (DASS-21)	No significant longitudinal changes in anxiety levels	More anxiety in those accept health information mainly via radio People with physical symptoms had higher levels of anxiety symptoms Recent quarantine were significantly associated with anxiety scores, which was not observed among the first survey participants Precautionary measures such as covering mouth when coughing or sneezing, washing hands with soap, washing hands more frequently and wearing mask were associated with a lower levels of anxiety
Hao, F., et al. <sup>15</sup> Cross sectional China Online survey	185 participants 76 psychiatric patients; 109 healthy control subjects Male:66 (35.7%) Female:119 (64.3%)	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall anxiety: 14.6% mild 3.2%; moderate:4.9%; severe:6.5% Anxiety in 26.3% psychiatric patients and 6.4% healthy controls	People with recent physical symptoms in the past 14 days had higher anxiety scores More anxiety in people with no change or worse SRH than those reported healthier.
Mazza, C., et al. <sup>16</sup> Cross sectional Italy Online survey	2766 general population Male:784 (28.4%) Female:1982 (71.6%) Age (Mean±SD): 32.94±13.2 years	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall anxiety(above average):18.7% More anxiety among female gender People with history of stressful situations and medical problems had more anxiety symptoms More anxiety if childless	Being infected and family member infected were associated with more depression
Moghanibashi-Mansourieh, A. <sup>17</sup> Cross sectional Iran Online survey	10754 general population Male:3681 (34.2%) Female:7073 (65.8%) Age 21-40: 65%	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall anxiety(above average): 19.1% More anxiety among women, the age group of 21–40 years and living in regions with higher COVID-19 prevalence The increasing levels of education had and increasing impact on anxiety levels	More anxiety among people who more followed corona-related news The levels of anxiety were significantly higher among people who had family member, relative, or friend infected with COVID-19 disease
Tan, W., et al. <sup>22</sup> Cross sectional China Online survey	673 workforce returning to work Male:501 (74.4%) Age (Mean±SD): 30.8±7.4 years Married; single; divorced/widow: 54.4%; 42.2%; 3.4%	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall anxiety: 6.1% mild 2.2%; moderate:2.5%; severe:1.3% The anxiety levels were highest in those divorced/widowed. Single marital status was found to have more anxiety symptoms than married	Respondents presented with physical symptoms had significantly higher anxiety Prevention measures including hand hygiene were associated with less severe anxiety symptoms

Lei, L., et al. <sup>23</sup> Cross sectional China Online survey	1593 general population Male: 617 (38.7%) Female: 976 (61.3%) Age (Mean±SD): 32.±9.8 years 18-39: 77.1% Married; single; divorced/ widow: 56.4%; 40.9%; 2.8% Urban: 85.5% Affected; unaffected by COVID-19: 26.4%; 73.6%	Self-Rating Anxiety Scale (SAS)	Overall anxiety: 8.3% More anxiety in female, younger people and those who were divorced/widowed Living in urban area was associated with less anxiety	More anxiety in affected group (12.9%) than unaffected group (6.7%) Worse SRH condition, more worry about being infected, more economic loss, and receiving financial support or practical help were also significantly associated with higher anxiety scores.
Wang, Y., et al. <sup>24</sup> Cross sectional China Online survey	600 general population Male: 267 (44.5%) Female: 333 (55.5%) Age (Mean±SD): 34 ± 12 years Educational levels: Master:6.3% bachelor:27.5% junior college:39.33% high school:26.83%	Self-Rating Anxiety Scale (SAS)	Overall anxiety: 6.3% Female had higher anxiety risk (OR=3.01)	n/a
Xiao, H., et al. <sup>28</sup> Cross sectional China Cluster sampling	170 participants self-isolated at home for 14 days Male:101 (59.4%) Female:69 (40.5%) Age (Mean±SD): 37.78 ± 4.12 years	Self-Rating Anxiety Scale (SAS)	Higher social capital reduced anxiety levels	Anxiety of isolated individuals were at high levels(55.4 ±14.3)
Ahmed, M.Z., et al. <sup>18</sup> Cross sectional China Online survey	1074 general population Male:571(53.2 %) Female:503(46.8 %) Province Hubei:678(63.1 %);Other:396(36.9 %)	Beck Anxiety Inventory (BAI)	Overall anxiety: 18.9% (moderate to severe) No significant interaction of gender with anxiety More anxiety among age 21–30 years	n/a
Yuan, R., et al. <sup>19</sup> Cross sectional China	100 Parents of hospitalized children Male:43 Female:57	Hospital Anxiety and Depression Scale (HADS)	Overall anxiety: 25%	21% parents with children hospitalized in epidemic area and 4% parents with children hospitalized in non-epidemic area had anxiety
Özdin, S., et al. <sup>25</sup> Cross sectional Turkey Online survey	343 general population Male: 174(50.7%) Female: 169(49.2%) Age (Mean±SD): 37.16 ± 10.31 years Urban: 278(81%); Rural: 65(19%)	Hospital Anxiety and Depression Scale (HADS)	Overall anxiety: 45.1% Female gender(OR= 2.48), living in urban areas(OR= 0.36) and previous psychiatric illness history(OR= 0.36) were found as risk factors for anxiety	n/a

SME, Social media exposure; SRH, self-rated health; S-COVID-19-S, suspected COVID-19 symptoms ; n/a, not available

Table 3. Study characteristics of articles evaluating depression

Study characteristics	Participants characteristics	Measuring instruments	Correlation between demographic factors and depression	SME, COVID knowledge, behaviors and stressors
Zhou, S.J., et al. <sup>11</sup> Cross sectional China Online survey	8079 Adolescents Male:3753 (46.5%) Female:4326 (53.5%) City; Rural:38.4%; 61.6%	Patient Health Questionnaire-9 (PHQ-9)	Overall depression: 43.7% mild: 26.4%; moderate: 10.1%; moderately severe: 4.5%; severe: 2.7% more depression in female gender than male (45.5% versus 41.7%) Depression among students in cities was lower than that in rural areas (37.7% versus 47.5%) The higher the grade, the greater the prevalence of depressive symptoms Hubei province was a risk factor for depressive symptoms (OR= 1.58).	COVID-19 knowledge, prevention and control measures were higher among students without depression
Zhu, S., et al. <sup>12</sup> Cross sectional China Online survey	2279 general population Quarantine:1443 without quarantine: 836	Patient Health Questionnaire-9 (PHQ-9)	Overall depression:21.6%	No significant change between with and without quarantine of depression (22.1% vs.20.8%)

Chang, J., et al. <sup>21</sup> Cross sectional China Online survey	3881 college students Male:1434 (37%) Female:2447 (63%) medical student:86.55% City: 76.1%	Patient Health Questionnaire-9 (PHQ-9)	Overall depression: 21.2% mild 17%; moderate:3.2%; severe:1%	More future health behaviors change was associated with less depression among the students
Nguyen, H.C., et al. <sup>26</sup> Cross sectional Vietnam	3947 participants from outpatient department Male: 1747 (44.3%) Female: 2197 (55.7%) Age (Mean±SD): 44.4±17 years 18-39 years: 45.3% 40-59 years: 31.2% 60 years or above: 23.5% S-COVID-19-S: 35.1%	Patient Health Questionnaire-9 (PHQ-9)	Overall depression:7.4% More depression in older patient, lower economic and social status No depression difference between gender Less depression in education level of high school	People with S-COVID-19-S had a higher depression risk (OR=2.88) Higher depressive symptoms related to worse health literacy(HL) People having S-COVID-19-S had 0.4% lower depression following 1 score increment of HL Those eating healthier, and doing more exercise had less depressive symptoms
Wang, C., et al. <sup>13</sup> Cross sectional China Online survey	1210 general population Male:396 (32.7%) Female:814 (67.3%) Age 21.4–30.8: 53.1%	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall depression: 30.3% mild 13.8%; moderate:12.2%; severe:4.3% More depression in female gender, student status, poor SRH status and chronic illness	Precautionary measures such as avoiding sharing chopsticks during meals, washing hands with soap, washing hands more frequently and wearing mask were associated with a lower levels of depression More depression in people with physical symptoms
Wang, C., et al. <sup>14</sup> Longitudinal China Online survey first survey:Jan.31 to Feb.2 Second survey: Feb.28 to Mar.1	1738 general population 1st survey:1210(13) 2nd survey:861 Female:75% Age 21.4–30.8: 46.5% Both survey:333	Depression, Anxiety and Stress Scales 21-item (DASS-21)	No significant longitudinal changes in depression levels	More depression in those accept health information mainly via radio People with physical symptoms had higher levels of depressive symptoms Precautionary measures such as covering mouth when coughing or sneezing, washing hands with soap, washing hands more frequently and wearing mask were associated with a lower levels of depression Recent quarantine were significantly associated with depression scores, which was not observed among the first survey participants
Hao, F., et al. <sup>15</sup> Cross sectional China Online survey	185 participants 76 psychiatric patients; 109 healthy control subjects Male:66 (35.7%) Female:119 (64.3%)	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall depression: 15.2% mild 5.4%; moderate:3.8%; severe:5.9% Depression in 34.2% psychiatric patients and 1.8% healthy control	More depression in people with no change, poor or worse SRH than those reported healthier or better health
Mazza, C., et al. <sup>16</sup> Cross sectional Italy Online survey	2766 general population Male:784 (28.4%) Female:1982 (71.6%) Age (Mean±SD): 32.94±13.2 years	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall depression(above average): 32.8% Female gender was associated with higher levels of depression More depression with history of stressful situations and medical problems More depression if childless	More depression if being infected
Tan, W., et al. <sup>(22)</sup> Cross sectional China Online survey	673 workforce returning to work Male:501 (74.4%) Age (Mean±SD): 30.8±7.4 years Married; single; divorced/widow: 54.4%; 42.2%; 3.4%	Depression, Anxiety and Stress Scales 21-item (DASS-21)	Overall depression: 5.9% mild 2.2%; moderate:2.8%; severe:0.9% The depressive levels of divorced/widowed participants were higher than single and married	Respondents with physical symptoms had higher depression levels Prevention measures including hand hygiene were associated with less severe depressive symptoms
Lei, L., et al. <sup>23</sup> Cross sectional China Online survey	1593 general population Male: 617 (38.7%) Female: 976 (61.3%) Age (Mean±SD): 32.±9.8 years 18-39: 77.1% Married; single; divorced/widow: 56.4%; 40.9%; 2.8% Urban: 85.5% Affected; unaffected by COVID-19: 26.4%; 73.6%	Self-rating depression scale (SDS)	Overall depression: 14.6% More depression in female, younger people, students and lower average household income Those who were divorced/widowed had highest depression scores, whereas those single had more depression than those married/cohabiting.	More depression in affected group (22.4%) than unaffected group (11.9%) Worse SRH condition, more worry about being infected, more economic loss, and receiving financial support or practical help were associated with higher depression scores.

Wang, Y., et al. <sup>24</sup> Cross sectional China Online survey	600 general population Male: 267 (44.5%) Female: 333 (55.5%) Age (Mean±SD): 34 ± 12 years Educational levels: Master:6.3% bachelor:27.5% junior college:39.33% high school:26.83%	Self-rating depression scale (SDS)	Overall depression: 17.2% People with a master's degree or above had a depression risk compared with lower educational level	n/a
Yuan, R., et al.(19) Cross sectional China	100 Parents of hospitalized children Male:43 Female:57	Hospital Anxiety and Depression Scale (HADS)	Overall depression: 28%	24% parents with children hospitalized in epidemic area and 4% parents with children hospitalized in non-epidemic area had depression
Özdin, S., et al. <sup>25</sup> Cross sectional Turkey Online survey	343 general population Male: 174(50.7%) Female: 169(49.2) Age (Mean±SD): 37.16 ± 10.31 years Urban: 278(81%) Rural: 65(19%)	Hospital Anxiety and Depression Scale(HADS)	Overall depression: 23.6% Living in urban areas was found as risk factor for depression(OR= 0.53)	n/a
Gao, J., et al. <sup>10</sup> Cross sectional China Online survey	4872 general population Male:1560(32.3%) Female:3267(67.7%) Age (Mean±SD): 32.3±10.0 years 21–30 years: 2312(47.9%) College: 3002(62.2%) Urban: 3920(81.2%) SME:less:8.8%; sometimes:9.2%; frequently:82.0%	World Health Organization Well-Being Index 5-item (WHO-5)	Overall depression:48.3% More depression among age 21–30 years(OR = 1.49) and 31–40 years (OR = 1.54) compared with aged <20 years Less depression among those with college (OR = 0.69) and master (OR = 0.63) than those with middle school Participants from rural area had lower adjusted odds (OR = 0.74) of depression than those from urban area The decrease of SRH significantly accompanied the increased odds of depression	No significant association between depression and SME
Sønderskov, K.M., et al. <sup>27</sup> Cross sectional Denmark Online survey	2458 general population Female:51% Mean age: 49.1 years	World Health Organization Well-Being Index 5-item (WHO-5)	Overall depression:25.4% Female gender had higher depression risk than male(28.8% versus 21.8%)	n/a
Ahmed, M.Z., et al. <sup>18</sup> Cross sectional China Online survey	1074 general population Male:571(53.2%) Female:503(46.8%) Province Hubei:678(63.1%) Other:396(36.9%)	Beck Depression Inventory (BDI)	Overall depression: 26.9% (moderate to severe) Living in Hubei showed significant higher rate of depression(29.5%) than other provinces(22.5%) No significant interaction of gender with depression More depressive among age 21–30 years	n/a
Huang, Y, et al. <sup>9</sup> Cross sectional China Online survey	7236 general population Male:3284(45.4%) Female:3952(54.6%) Age (Mean±SD) 35.3±5.6	Center for Epidemiology Scale for Depression (CESD)	Overall depression: 20.1% No significant difference in depression symptoms by gender More depression among age < 35 years than age>35 years(22.1% versus 18.5%)	n/a

SME, Social media exposure; S-COVID-19-S, suspected COVID-19 symptoms ; n/a, not available

Seven studies revealed higher anxiety in female gender<sup>11,13,16,17,23-25</sup>. However, most studies (4/5) using GAD-7<sup>9,10,20,21</sup> showed no significant difference of anxiety prevalence between genders. The data of studies using GAD-7 were combined, and the result of meta-analysis still showed no difference between genders (Figure 2). Five studies with adult participants found the highest anxiety among age 21–40 years<sup>9,10,17,18,23</sup>. However, the numbers were imbalanced between groups in most studies, with age group 21–40 years account for 65%–77% of total participants. Two studies targeting at students mentioned the change of anxiety levels between different grades<sup>11,21</sup>. High school students in higher grades had more anxiety symptoms<sup>11</sup>. By contrast, another study focusing

on college students found that students in higher grade had less anxiety symptoms<sup>21</sup>.

Living in Hubei or other epicenter regions were found to be a risk factor for anxiety<sup>10,11,17</sup>. Urban area had protective effect in four studies of China<sup>11,20,21,23</sup>; while one Turkish study with a relatively small proportion of rural residents (18.9%) showed that people in rural area had lower HADS<sup>25</sup>. 2 studied from different countries found different results of the association between educational levels and anxiety<sup>10,17</sup>. The study from China showed people with lower educational levels had higher prevalence of anxiety<sup>10</sup>; while anxiety scales were higher among those with higher educational levels in another study from Iran<sup>17</sup>.

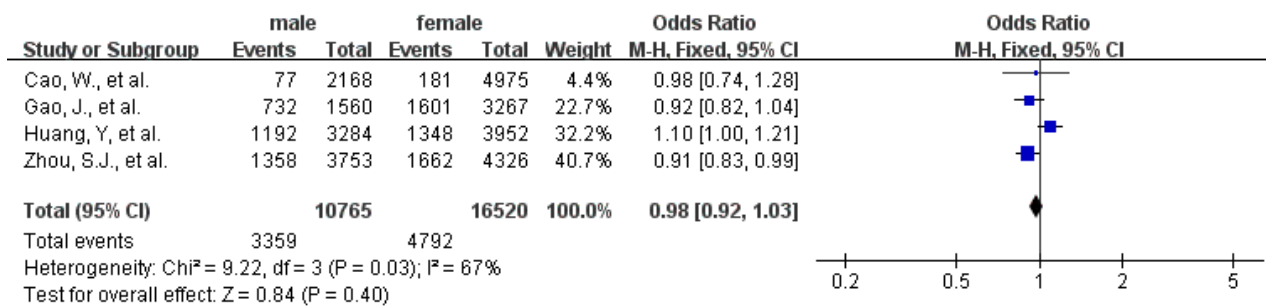


Figure 2. Forest plot of the odds ratio with anxiety (measuring instruments: Generalized Anxiety Disorder 7-item) between genders (male to female)

Concerning past history or underlying diseases, people with poor self-rated health status and chronic illness had more severe anxiety symptoms<sup>10,13,15,16,23</sup>. In addition, previous psychiatric illness and stressful situations were found to be risk factors of anxiety<sup>15,16,25</sup>. Students, especially non-medical students were vulnerable to anxiety<sup>13,21</sup>. Two studies showed higher anxiety in those who were divorced/widowed<sup>22,23</sup>, and one of the two studies found that single marital status have more anxiety symptoms than married<sup>22</sup>.

**Depression:** The heterogeneity of depression prevalence between studies was high (5.9%–48.3%) due to different measuring instruments and populations<sup>9-13,15,16,18,21-27</sup>. One study conducted in Italy found relatively high depression prevalence (32.8%)<sup>16</sup>; while another study assessing Chinese workforce returning to work reported relatively low depression prevalence (5.9%)<sup>22</sup>. When WHO-5 was used for screening, 48.3% of the participants in China<sup>10</sup> and 25.4% of respondents in Denmark<sup>27</sup> had poor well-being.

There were twelve studies showing the relationship between gender and depression with high heterogeneity<sup>9-11,13,16,18,21,23-27</sup>. Female gender was associated with higher levels of depression in five studies<sup>11,13,16,23,27</sup>; whereas the other seven studies showed no significant interaction<sup>9,10,18,21,24-26</sup>. Four studies revealed highest depression prevalence among age 21–30 years<sup>9,10,18,23</sup>. A Vietnam study, contrary to other studies recruiting participants online, conducted interviews in outpatient department and had relatively balanced case numbers between age groups (45.3% aged 18-39, 31.2% aged 40-59 and 23.5% older than 60)<sup>26</sup>. The study indicated that people older than 60 had significantly higher prevalence of depression. A study found high school students in higher grades had greater depressive symptoms<sup>11</sup>.

Two studies indicated that people living in Hubei had higher depressive symptoms<sup>11,18</sup>. Most of the studies comparing depressive symptoms between urban and rural residents had imbalanced numbers with urban residents accounting for 76.1%–85.5%<sup>10,21,23,25</sup> and inconsistent results were found. Regarding education, one study showed positive emotional trend when educational levels increased<sup>10</sup>. In another study, people with a master's degree had higher depression than bachelor or below<sup>24</sup>. However, this study recruited relatively few master's degrees (6.3%) and when comparing bachelor to high school, the increasing of education didn't shared the similar trend. One Vietnam study showed that high school educational levels had the lowest depression prevalence<sup>26</sup>.

Depressive symptoms were higher in people with chronic illness, psychiatric illness, poor self-rated health and history of stressful situation<sup>10,13,15,16,23</sup>. Students were found to have higher levels of depression in two studies<sup>13,23</sup>. Divorced/widowed was risk factor of depression in two studies<sup>22,23</sup>, and one of the two studies revealed that single marital status had more depression than married<sup>23</sup>.

Childless people were associated with higher depression<sup>16</sup>. Two studies indicated that people with the lower average household income and social status had the higher depressive score<sup>26</sup>.

#### Social media exposure and COVID-19 awareness

**Anxiety:** Four studies mentioned the relation between social media exposure and anxiety during COVID-19<sup>9,10,14,17</sup>. More time spent on the social media was associated with more anxiety symptoms<sup>9,10,17</sup>. Those accepted health information mainly via radio was found to have higher levels of anxiety than those receiving COVID-19 information via internet, television, family members and other resources in one study<sup>14</sup>.

There were four studies discussing the effects of COVID-19 awareness (including COVID-19 knowledge and precautionary measure) on anxiety<sup>11,13,14,22</sup>. Higher awareness was a significant protective factor. Specific prevention measures were assessed by three studies<sup>13,14,22</sup>, which found that avoiding sharing chopsticks during meals, washing hands with soap, washing hands more frequently and wearing mask were associated with a lower levels of anxiety.

**Depression:** A study comparing mental problem between those with and without COVID-19 symptoms found that although people with suspected COVID-19 symptoms had higher depressive symptoms, higher health literacy can become a protective factor<sup>26</sup>. The protective effect of COVID-19 awareness on depression was revealed<sup>11,13,14,22</sup>. Those precautionary measures mentioned before (i.e. avoiding sharing meals, frequently washing hands and wearing mask) also had positive effects on depression, same as anxiety.

Regarding social media exposure, people acquired health information through radio had more severe depressive symptoms<sup>14</sup>. However, there was no study found significant relationship between time of social media exposure and depression.

#### Stressors

**Anxiety:** There were two studies focusing more on relationship between anxiety and the different impacts of COVID-19 on daily-life<sup>20,23</sup>. One study used GAD-7 to screen anxiety of students from a medical college<sup>20</sup>. The result showed family income stability (OR = 0.726) and living with parents (OR = 0.752) were protective factors against anxiety for college students. On the contrary, worrying about academic delays ( $r = 0.315$ ,  $P < .001$ ), worrying about the economic influences ( $r = 0.327$ ,  $P < .001$ ) and the influence of the epidemic on daily-life ( $r = 0.316$ ,  $P < .001$ ) were positively related to the levels of anxiety in college students. Some stressors were indicated by another study aiming to compare anxiety between those affected and



unaffected by quarantine<sup>23</sup>. More economic loss, receiving financial support or practical help and worrying about being infected were significantly associated with higher anxiety scores. People having suspected symptoms suffered from higher anxiety<sup>13-15,22</sup>, and those having or worrying family members getting infected with COVID-19 also had higher anxiety<sup>13,16,17,19</sup>. The psychological effects of quarantine were assessed in five studies<sup>12-14,23,28</sup>. Three of them showed that people affected by quarantine or self-isolation had higher anxiety levels<sup>14,23,28</sup>. However, two studies trying to identify the immediate impacts of COVID-19 failed to prove the significant difference in anxiety prevalence between those with and without quarantine<sup>12,13</sup>.

**Depression:** There were four studies discussing the depression severity of people with quarantine. Two of them found significantly higher prevalence of depression in the affected group than in the unaffected group<sup>14,23</sup>, but the other two studies assessing the immediate impact of COVID-19 showed no significant difference between with and without quarantine<sup>12,13</sup>. Being infected with COVID-19, having suspected symptoms and worrying about being infected were risk factors of depression<sup>13,14,16,22,23,26</sup>. Depression risk of parents of hospitalized children was assessed in one study, which revealed that 24% parents with children hospitalized in epidemic area and 4% in non-epidemic area had depression ( $t = 5.9, p < 0.001$ )<sup>19</sup>. More economic loss, and receiving financial support or practical help were also significantly associated with higher depression scores<sup>23</sup>.

## Discussion

This study aimed to identify the vulnerable populations to anxiety and depression during COVID-19 and find the correlation between social media exposure, stressors and emotional status. In present review, COVID-19 pandemic significantly increased anxiety and depression levels in the early phase, compatible with the psychological responses in past infectious disease outbreaks<sup>8</sup>. Due to the rapid spread of novel coronavirus and the lack of understanding of transmission risk in the early phase of outbreak, social distancing was enforced by most countries. Face-to-face interviewing participants became difficult, so most of the studies recruited respondents online, leading to poor representativeness and high selection bias of participants. Although the quality of studies was relatively low, there were still lots of valuable information from these cross-sectional studies.

Female gender was vulnerable to anxiety in most studies. However, after combining anxiety prevalence evaluated by GAD-7, no significant difference between genders was found. Comparing the questions to other instruments, GAD-7 less focused on the physiological symptoms, which may indicated that female gender had more somatic symptoms during disease outbreaks than male. People aged 21-30 years were found to have highest anxiety and depression levels. This age group tends to have more social media exposure, economic loss and financial burden. Notably, the accessibility of online survey had severe influence on the age group of participants. Most of the respondents were young age, which may bias the age-related outcome. The only one survey interviewing participants from outpatient had more elderly subjects, who had significantly higher depressive symptoms<sup>26</sup>. Considering the increasing infection and mortality rate, survey focusing on mental impact of elderly should be performed. People with poor self-rated health status, previous psychiatric illness, chronic illness, students, divorced/widowed marital status, childless, lower average household income, social status and those who lived in epicenter

area had higher risk of mental problems. Most of the high risk group had some communion, such as less social support, higher infected risk or more influenced by COVID-19. Therefore, detection of these group and timely referral to specialist were important. Health care workers should pay more attention when these people come to our help, no matter the reasons.

Though the causality can't be confirmed because there was no longitudinal study, the correlation between anxiety and social media exposure was significant. On the other hand, the evidence showed that higher awareness of COVID-19 was related to lower anxiety and depressive levels. One study noticed that people receiving information via radio had more anxiety and depression symptoms than those via internet and television<sup>14</sup>. These evidences may indicate that the route, quality and quantity of information were decisive factors in mental impact of social media. Similar results was noted in previous review, which showed that health information online can promote healthier behaviors, but exposure more than 2 hours daily may be harmful<sup>29</sup>. Previous experimental study also found that compared to positive or neutral emotional content, negative emotional news triggered anxiety and worries about academic, interpersonal relationship or financial concerns<sup>30</sup>. Moreover, during COVID-19 pandemic, a new concern of "infodemic" has become a severe public health issue<sup>31,32</sup>. Summarizing the above evidences of social media, Governments need to establish reliable information platforms to timely release simple-to-understand knowledge of updated situation (e.g. numbers of infection, cured and death), health policy and precautionary measures in neutral emotional context. The present review revealed that prevention measures including avoiding sharing meals, washing hands more frequently with soap and wearing mask were associated with lower levels of anxiety and depression. In addition, among those with suspected COVID-19 symptoms, higher health literacy can become a protective factor to depression. Health authorities can significantly reduce the mental impact of COVID-19 by improving population health literacy and enhancing specific useful precautionary measures.

The presents study found multiple stressors of anxiety and depression, including economic loss, academic delay and influence of daily life. To relieve these problems, the social capital need to be emphasized and the authorities may consider policies for financial support (i.e. rescue measures or financial stimulus packages). The concerns of being infected, family member being infected, having suspected coronavirus symptoms and confirmed infection significantly increased the anxiety and depression levels. These people had more opportunities to access medical staff. Therefore, different specialists need to keep patients' mental status in mind and give timely psychological consultant. Being quarantine or self-isolation were risk factors of anxiety and depression. The governments should clearly explain the purpose of quarantine and the way to implement it. As the mental impact of quarantine increasing by time, the facilities should maintain online care to ensure safety, provide sufficient assistance and psychological support during quarantine. The web-based counseling may be offered if mental problems were detected during isolation.

Studies included in this review had several limitations. First of all, restricted by social distancing, online recruitment was performed in most studies and few of them had weighted or matched the participants, which significantly reduced the representativeness of population. These studies also had severe selection bias that non-respondents obviously tended to use fewer internets and made it difficult to assess the mental status of elderly, poverities, rural residents and other population with few accesses to internet. Secondly, most of the studies were designed in cross-

sectional methodology. Therefore, the causality of variables and mental problems cannot be confirmed. In addition, there were many different measuring instruments, which may lead to inconsistent results and difficulty in combining the data. Furthermore, most studies were conducted in China, and directly applying the results to other country was inappropriate due to different culture, health policy and economic issues. Finally, there were still few studies discussing the etiology and stressors of mental problems, which were needed to develop the efficient managements.

## Conclusion

This is the first study to review the mental impact on general population in the early phase of COVID-19 pandemic. Although the majority of the included articles had low quality, current evidence still noted the importance of reliable information from health authorities and indicated that enhancing health literacies and prevention measures of general population can reduce anxiety and depression levels. The present review also identifies some stressors and vulnerable populations to mental problems. Further high quality studies with weighted participants and longitudinal comparisons were needed to confirm the risk and protective factors and to clarify the causalities between variables, anxiety and depression. We're not sure how long it takes to pass the peak, which restricted social distance. Still, we could conduct studies in systematic sampling methods in the post-pandemic phase. The effects of COVID-19 on psychological trauma and behavior change are also important issues as the globe recovering from COVID-19. The present study reviewed the correlation between demographic factors, social media, stressors and emotional status during pandemic; meanwhile found the knowledge gap for further survey.

## Conflicts of interest

No other author has reported a potential conflict of interest relevant to this article.

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