Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Review article

Gender and COVID-19 related fear and anxiety: A meta-analysis

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ABSTRACT

Studies conducted during the pandemic revealed strong associations between gender and COVID-19 related fear and anxiety. Females perceive coronavirus as a greater threat to personal health and population than males. The aim of the current meta-analysis is to estimate gender difference in COVID-19 related fear and anxiety. The second purpose of this study is to clarify the role of potential moderators in COVID-19 fear and anxiety. For these reasons, studies published between March 2020 and October 2021 were searched in various databases (Web of Science, SCOPUS, PubMed, and Google Scholar). In total, 315 studies met the inclusion criteria, and 60 studies for COVID-19 related fear and 23 studies for COVID-19 related anxiety were included in the current study. Cohen's d effect size values were calculated based on these individual studies showing the difference between males and females in terms of COVID-19 related fear and anxiety. Results revealed that gender has a moderate and statistically significant effect on COVID-19 related fear ($ES = 0.307$) and anxiety ($ES = 0.316$) in favor of females. Moderator analyses showed that continent variable was a statistically significant moderator of gender difference in COVID-19 related fear and anxiety. The highest effect size of gender differences in COVID-related fear and anxiety were obtained from the studies conducted in Europe. However, other moderators (the average age of sample, culture, timing, and population) were not statistically significant. Although this meta-analysis has a few limitations, the findings showed that COVID-19 outbreak negatively affected females more.

1. Introduction

Although the COVID-19 disease has been considered a global epidemic since March 2020, it was seen at the end of 2019 (WHO, 2021a). Over 246 million cases and approximately 5 million deaths have been reported worldwide (WHO, 2021b) since the day it was first seen. Many countries had to take various measures to prevent the spread of the virus. Some of these measures are quarantine, restriction, wearing masks, avoiding public areas, and physical distancing. Although 2020 passed with these measures, the vaccines developed in 2021 allowed some measures to be stretched. Vaccines have started to prevent hospitalizations (WHO, 2021c). On the other hand, the rapid spread of SARS-CoV-2 has led to the development of various variants, and this has begun to limit the effectiveness of vaccines. People have been trying to cope with the pandemic process for about two years. The pandemic has affected human life in many ways. One of these effects is the psychological factor. Studies, especially when quarantine measures were taken in 2020, reported that individuals were mentally affected (Metin et al., 2021; Santabárbara et al., 2021a, 2021b). In addition, many uncertainties during the pandemic process have caused anxiety and fear (Santabárbara et al., 2021a, 2021b). Anxiety and fear are related emotions to each other. Fear is the primary reaction of human beings in the face of danger or threat (Ekman, 2007), and it mediates the survival of humans (Matsumoto & Hwang, 2013). It is claimed that there is a difference between the two affects, although anxiety also performs similar functions. Anxiety is about the dangers in the inner world; fear is also a reaction to the threat in the outside world (Akhtar, 2018).

The limited information about COVID-19, especially in the early stages of the pandemic, is one of the factors that cause increased COVID-19 related fear and anxiety. Meta-analysis studies on this issue showed that COVID-19 related anxiety and fear have a negative effect on people (Erbiçer et al., 2021; Lasheras et al., 2020; Santabárbara et al., 2021a, 2021b; Wang et al., 2021). It is seen that COVID-19 anxiety and fear are positively correlated with depression, addiction, PTSD, insomnia, mood swing, and stress (Dubey et al., 2020; Kira et al., 2020; Özdin and Bayrak Özdin, 2020; Şahin et al., 2020), while negatively correlated with

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resilience, life satisfaction, and well-being (Alyami et al., 2021; Karataş and Tagay, 2021; Özmen et al., 2021; Satici et al., 2020). This negative situation may differ according to gender.

1.1. Gender and COVID-19 related fear and anxiety

Studies conducted during the pandemic found strong associations between gender and COVID-19 related fear and anxiety (Evren et al., 2020; Hossain et al., 2020; Padovan-Neto et al., 2021; Reznik et al., 2020; Sakib et al., 2020; Tsipropoulou et al., 2020). Females perceive coronavirus as a greater threat to personal health and population than males (Niño et al., 2021; Pérez-Fuentes et al., 2020). This is also the case for both COVID-19 related fear and anxiety. Many studies reported higher fear of COVID-19 and threat perception in females (Nguyen et al., 2020; Reznik et al., 2020; Sakib et al., 2020). Similar results were obtained in studies for COVID-19 anxiety (Akyildiz and Durna, 2021; Bhattacharya et al., 2021; Orrù et al., 2021). On the other hand, some studies showed that males have higher COVID-19 anxiety levels (Ashoor et al., 2021; Curtis et al., 2021; Saravanan et al., 2020; Srivastava et al., 2020). Also, many studies revealed males have higher fear of COVID-19 levels than females (Abdelgwad and Abdelaziz, 2021; Alnazly et al., 2021; Ghaderi et al., 2021; Osagiator Ariyo et al., 2021). In addition, Parlak and Akgün Şahin (2021) and Wakashima et al. (2020) found no gender difference in COVID-19 related fear and anxiety. Therefore, it would be useful to clarify gender differences on this matter. To our knowledge, the current study is the first and most extensive meta-analysis to estimate the effect size of gender difference in COVID-19 related fear and anxiety. Also, providing an overview of gender difference on COVID-19 related fear and anxiety can be an important guide in prevention and intervention programs to reduce the mental health effects of the COVID-19 outbreak.

1.2. Potential moderators

Various variables may have affected gender differences in COVID-19 related fear and anxiety. Target population was considered in this meta-analysis as a potential moderator. Studies have revealed inconsistent findings regarding gender differences in COVID-19 related fear and anxiety across different populations. For instance, according to Osagiator Ariyo et al. (2021), males had higher fear of COVID-19 than females in healthcare professionals. In contrast, Morales-Rodríguez (2021) found that females had higher fear of COVID-19 than males in university students. However, Parlak and Akgün Şahin (2021) found no gender differences in fear of COVID-19 level among the general population. In addition, studies conducted with different populations to determine COVID-19 related anxiety levels by gender revealed that males had higher levels of COVID-19 anxiety than females among the university students (Saravanan et al., 2020), whereas Lee et al. (2020) found that females had a higher level of COVID-19 anxiety in the general population. Yet, Ashoor et al. (2021) revealed no difference according to gender in hospital staff. Hence, target population was added as a categorical moderator in this meta-analysis to assess moderating effect of different populations. During the first wave of the COVID-19 outbreak, as we have misconceptions on how to prevent infection, individuals exhibit a stronger threat perception to disease. Especially, threat perception to COVID-19 was higher in females than males (Pérez-Fuentes et al., 2020). Threat perception plays an essential role in the psychological adjustment of individuals (Cui et al., 2020). First wave studies during the COVID-19 outbreak revealed that COVID-19 related fear and anxiety levels were higher in females (Sakib et al., 2020; Broche-Pérez et al., 2020; Evren et al., 2020; Srivastava et al., 2020). However, as individuals' knowledge level about preventing and controlling the COVID-19 disease has increased, gender differences may have changed in COVID-19 related fear and anxiety. Indeed, some recent studies revealed that there was no difference between the levels of COVID-19 related fear and anxiety in terms of gender (Magano et al., 2021; Mahmoud et al., 2021). Therefore, data collection time (timing) could be one of the moderators affecting gender differences in COVID-19 related fear and anxiety. Another potential moderator of the meta-analysis was the average age of the sample. The immune system weakens, and health problems increase with aging. This leads to more deaths related to COVID-19 as age increase (WHO, 2021d). Global data shows that death rates related to COVID-19 are higher in males than in females (The Sex, Gender, and COVID-19 Project, 2021). In addition, females live longer than males due to genetic structure, chromosomes, hormones, and other ecological factors (Austad, 2006; Eskes and Haanen, 2007; Vina and Borras, 2010; Zarulli et al., 2018). For that reason, age may moderate gender difference in COVID-19 related fear and anxiety. In addition, cultural factors might influence individuals' psychological responses to diseases or epidemics (Fincher et al., 2008; Kim et al., 2016). One of the most important cultural factors is the categorization of collectivism and individualism (Schimmack et al., 2005; Triandis et al., 1988). While a desire for self-sufficiency and independence characterizes individualistic orientation, collectivistic orientation emphasizes the traditional understanding of males as masculine and females as feminine (Chun et al., 2006; Kim et al., 1994; Shafiro et al., 2003; Williams and Best, 1990). The cultural orientation of the country in which the study was conducted may lead to gender differences in COVID-19 related fear and anxiety. Therefore, culture (individualism vs. collectivism) was added in the meta-analysis as a categorical moderator. Finally, continent was added in the meta-analysis as a potential moderator to assess the moderating effect of different countries. In most studies conducted in North America, females had higher levels of COVID-19 related fear and anxiety than males (Barbosa-Camacho et al., 2021; Grande and Doyle-Baker, 2021; García-Reyna et al., 2021; Gélinas et al., 2021; Landa-Blanco et al., 2021; Lee et al., 2020; Pérez-Fuentes et al., 2020; Ojalehto et al., 2021). In addition, studies conducted in Europe, female's COVID-19 related fear and anxiety levels were higher (Bakioğlu et al., 2020; Kaçoğlu et al., 2021; Morales-Rodríguez, 2021; Orrù et al., 2021; Tsipropoulou et al., 2020; Ypsilanti et al., 2021). On the other hand, some studies conducted in Middle East countries showed that males had higher levels of COVID-19 related fear and anxiety than females (Abdelgwad and Abdelaziz, 2021; Alnazly et al., 2021; Ashoor et al., 2021; Ghaderi et al., 2021; Saravanan et al., 2020). These studies revealed inconsistent findings regarding gender differences in COVID-19 related fear and anxiety across different continents. To clarify this, it would be useful to add continent as a categorical moderator. Overall, the average age of sample, culture, continent, timing, and target population were considered potential moderators as these variables were treated as moderators in the studies included in this meta-analysis (e.g., Alothman et al., 2021; Chorwe-Sungani, 2021; Gélinas et al., 2021; Ojalehto et al., 2021; Saravanan et al., 2020; Wakashima et al., 2020; Yalçın et al., 2022; Ypsilanti et al., 2021).

Based on all these, the second purpose of the current research is to examine the effect of the potential moderators on gender difference in COVID-19 related fear and anxiety. For these purposes, the following questions were addressed:

Research Question 1: Is there a statistically significant gender difference in COVID-19 related fear and anxiety?

Research Question 2: How do gender differences in COVID-19 related fear and anxiety change as a function of moderators?

2. Method

The PRISMA statement was followed in reporting this meta-analysis (Page et al., 2021).

2.1. Literature search

Literature search was conducted between September and October 2021. PubMed, Web of Science, SCOPUS, and Google Scholar databases were used to locate all relevant studies. To estimate gender difference in

COVID-19 related fear, the studies cited The Fear of COVID-19 Scale (FCV-19-S; Ahorsu et al., 2020) were examined in these databases. In addition, references of the studies included were reviewed to identify the studies that might be relevant. Keywords used for the search were: "Fear of COVID-19 Scale", "COVID-19 Related Fear", "Fear of COVID-19", and "COVID-19 Fear". The FCV-19S (Ahorsu et al., 2020) is the only tool used in the meta-analysis to assess gender differences in fear of COVID-19. The FCV-19S was developed by Ahorsu et al. (2020) to measure individuals' fear of COVID-19. The scale consists of 7 items of 5-point Likert type. The lowest score that can be achieved from the scale is 7; the highest score is 35. The higher score on the scale means that the fear of COVID-19 is high. Some of the scale items are: "*I am most afraid of coronavirus-19*"; "*It makes me uncomfortable to think about coronavirus-19*".

To evaluate gender differences in COVID-19 related anxiety, studies cited Coronavirus Anxiety Scale (CAS; Lee, 2020) were also examined in these databases. In addition, references of included studies were reviewed to find the studies that might be relevant. Keywords used for the search were: "Coronavirus Anxiety", "Coronavirus Anxiety Scale", "COVID-19 Related Anxiety", "COVID-19 Anxiety", and "COVID-19 Anxiety Scale". CAS (Lee, 2020) is the only tool used in the meta-analysis to assess gender differences in COVID-19 related anxiety. CAS was developed by Lee et al. (2020) to assess individuals' COVID-19 related anxiety. The scale consists of five items of 5-point Likert type, ranging from never (0) to almost every day (4). The lowest and highest scores can be obtained from the scale is zero and twenty, respectively. A higher score on the scale means higher COVID-19 related anxiety. Some of the scale items are: "*I had trouble falling or staying asleep because I was thinking about the coronavirus*", "*I lost interest in eating when I thought about or was exposed to information about the coronavirus*".

Although there are other measures to assess COVID-19 related fear and anxiety (e.g., COVID-19 Anxiety Syndrome Scale – Nikčević and Spada, 2020; Brief Coronavirus Threat Scale – Chiacchia et al., 2022; COVID-19 Phobia Scale – Arpaci et al., 2020) the more well-established and most frequently reported scales (FCV-19S and CAS) were selected in this meta-analysis. In addition, these scales have robust psychometric properties and are reliable and valid in assessing COVID-19 related fear and anxiety (Ahorsu et al., 2020; Lee, 2020). As we conducted a meta-analysis of the means produced from these two scales, combining the average scores from different scales with different metrics may not be meaningful. Thus, we decided not to include the studies where the COVID-19 related fear and anxiety were assessed with other scales.

The criteria used to determine which article to include were: 1) Examining COVID-19 related fear or anxiety during COVID-19 pandemic, 2) using The FCV-19S or CAS as the measurement tool, 3) studies adapting the FCV-19S or CAS to different languages, 4) cross-

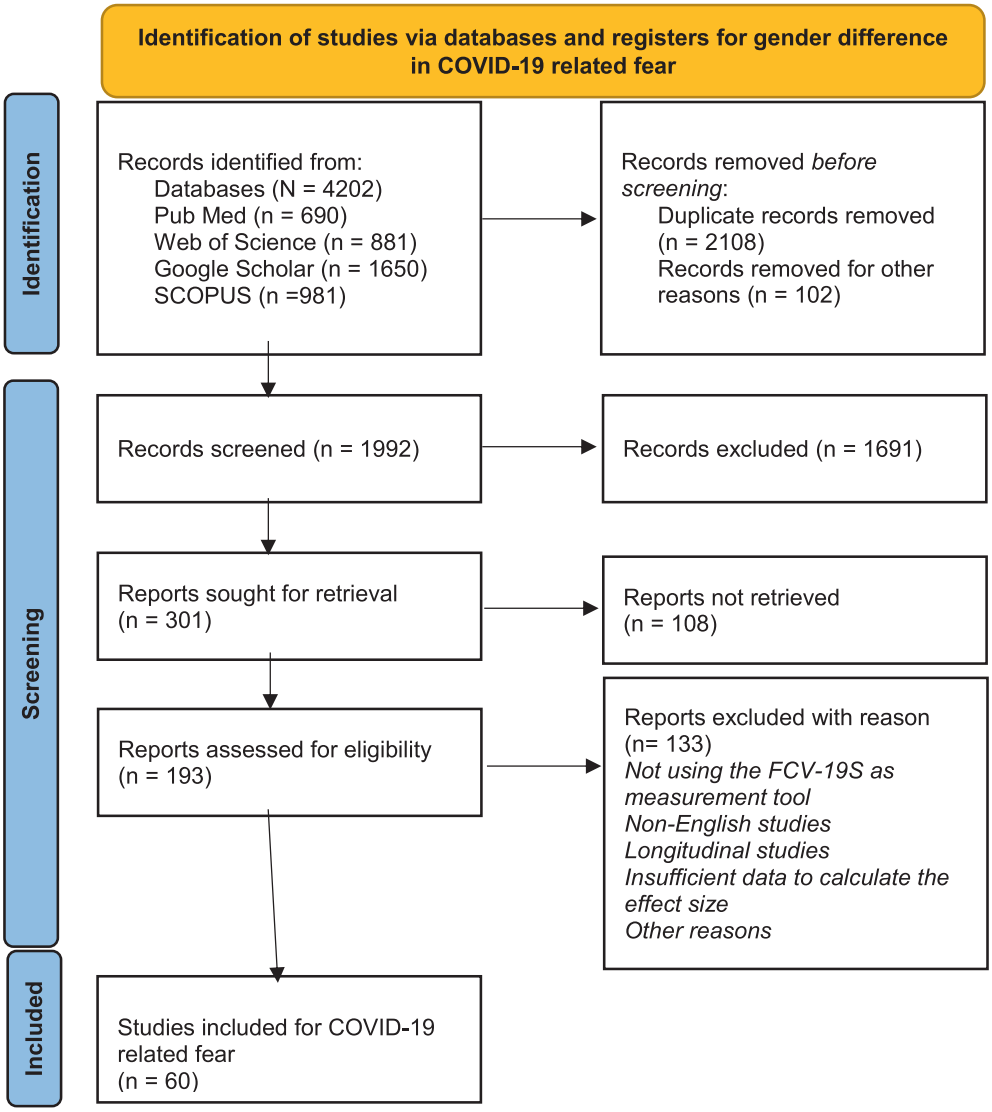

Fig. 1. PRISMA flow diagram for literature search.

sectional studies, 5) quantitative studies, 6) studies published in English, 7) the mean and standard deviation of COVID-19 related fear or anxiety were calculated by gender. Exclusion criteria: 1) Studies did not use the FCV-19S or CAS, 2) longitudinal studies, 3) non-English studies, 4) reports, 5) case reports, 6) qualitative studies, 7) dissertation/thesis, 8) conference paper, 9) school project 10) books or e-books 11) experimental studies, and 12) insufficient data to calculate the effect size. Sixty studies were determined for COVID-19 related fear and 23 studies for COVID-19 related anxiety based on the inclusion and exclusion criteria included in the meta-analysis. Results of the literature review are shown in Figs. 1 and 2.

2.2. Quality assessment and coding

Quality Appraisal Tool for Cross-Sectional Studies (AXIS) was used to evaluate the quality of the studies included in this meta-analysis (Downes et al., 2016). Critical appraisal (CA) was developed for use in assessing observational cross-sectional studies. There are many key areas to CA including study design, sample size justification, target population, sampling frame, sample selection, measurement validity and reliability, and overall methods. These key areas need to be identified in CA for good reporting of the study, making it difficult to assess relevance and bias if the study is under-reported. Appraisal of Cross-sectional Studies consisted of 20 items. CA has areas to record a "Yes", "No" or "Unclear/Not known" answer for each question. The items were coded as Unclear/Not known "0", No "0", and Yes "1". A higher score obtained indicated a better quality of the study. The scores obtained from the studies included in the meta-analysis were 75% and above (see Appendix 1). Quality Assessment was performed by two different authors. It is also recommended that at least two independent reviewers conduct the quality assessment process and increase inter-rater reliability and study validity. Afterward, quality assessments done by two independent raters were compared with a Kappa coefficient (0.84), and disagreements were resolved by consensus.

A coding key was created to identify studies to be included in the meta-analysis and to facilitate data analysis. The first author's name, publication year, sample size (*n*), data collection time, country, female proportion, quality of the studies and to estimate gender difference in COVID-19 related fear and anxiety, calculated values for two genders (mean, SD, and *n* for females and males) were entered into the coding sheet. In addition, potential moderators including the average age of sample, culture, continent, timing, and target population were also collected from the studies included in this meta-analysis. The coding key was coded by two independent researchers. Then, the coding sheets were compared to avoid errors in data entry. To establish intercoder reliability, an agreement index was calculated between the codes done

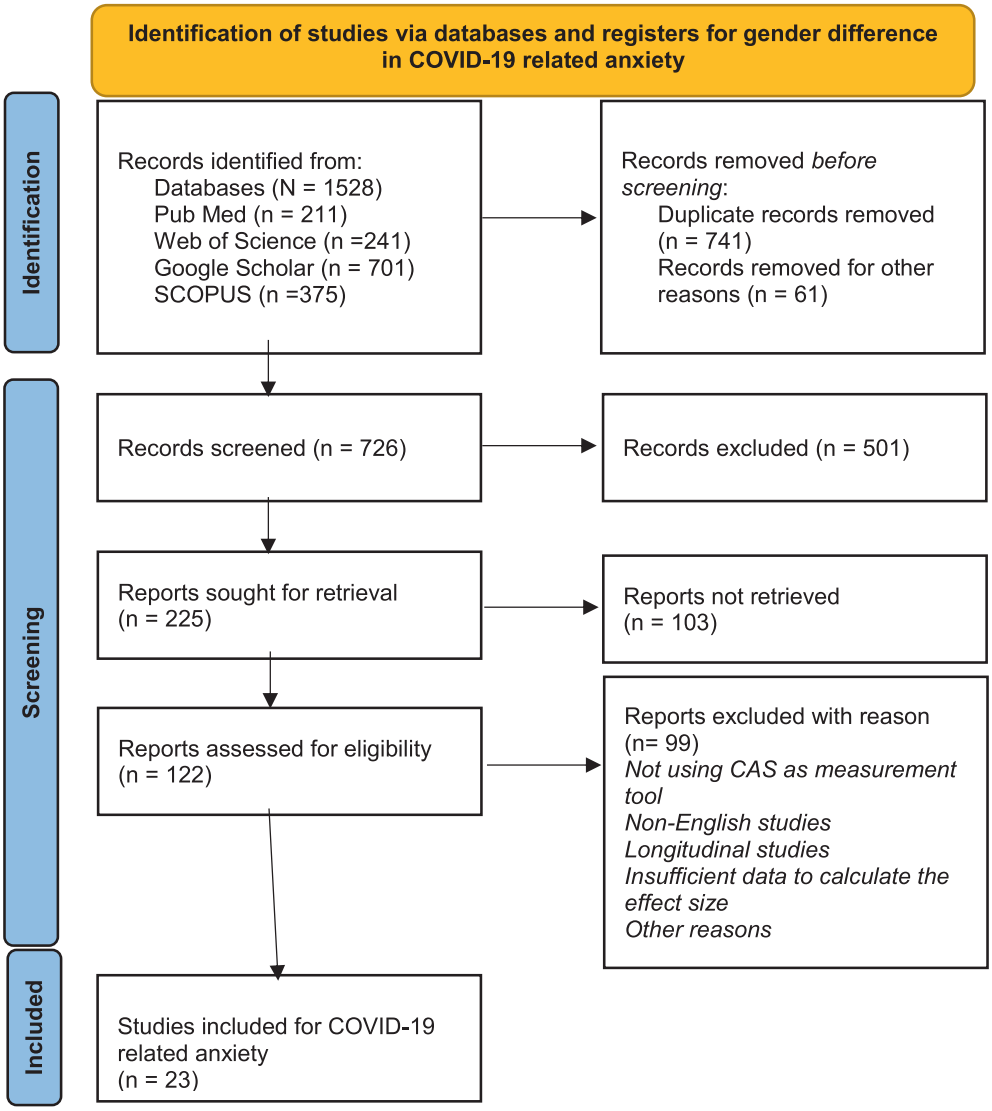

Fig. 2. PRISMA flow diagram for literature search.

by two independent raters (first two authors). An intercoder reliability of 0.95 was achieved. Disagreements between two raters were resolved before proceeding to analyses.

2.3. Data analysis

A random effects meta-analysis model was used to estimate overall effect size value in this study. Cohen's *d* coefficient was calculated for each included study to estimate gender difference in COVID-19 related fear and anxiety. Positive effect size values indicate that there is an effect in favor of females, and negative values indicates that there is an effect in favor of males in terms of both fear and anxiety variables. The confidence level was taken as 95% in all calculations regarding the effect size. The effect sizes were interpreted as follow: 0.20 = small; 0.50 = medium; and 0.80 = large (Cohen, 1988).

Q test was used to assess heterogeneity between studies included in the meta-analysis (Borenstein et al., 2011). I^2 value was used as another criterion for heterogeneity in the meta-analysis. I^2 value was interpreted as follows: 25% low heterogeneity; 50% medium heterogeneity; and 75% high heterogeneity (Cooper et al., 2009). Restricted maximum likelihood was used as a heterogeneity variance estimator (Langan et al., 2015).

We performed the analog to the ANOVA and meta-regression analyses to detect the possible sources of heterogeneity between the studies. It is recommended to have two or more studies in each subgroup to perform analog to the ANOVA, and ten or more studies to perform meta-regression analysis (Borenstein et al., 2011). Moderator analyses were performed with the variables meeting these criteria. Possible moderators were: the average age of sample, culture, continent, timing, and target population. The primary moderator was the average age of the sample. Typically, the average age of sample was used and if the age range of the sample was not available, coded as Not Available (N.A.). Culture was coded as individualism or collectivism. Hofstede's classification (Hofstede's Insights, 2021) was used to identify whether the country from which the sample was collected was characterized by individualistic or collectivistic orientation (e.g., Turkey, Iran, China, Brazil, Mexico coded as collectivism; Canada, Spain, USA, Portugal coded as individualism). The studies included in the meta-analysis collected data from nearly all continents except for Oceania. Effect sizes were coded into five categories of continents (Africa, Asia, Europe, North America, and South America) and one region (Middle East). For example, Portugal, Spain, UK, and Turkey were categorized as Europe; India, China, Malaysia, and Philippines were categorized as Asia; Canada, USA, Mexico, and Cuba were categorized as North America; Peru, and Brazil were categorized as South America; and United Arab Emirates, Saudi Arabia, Egypt, and Iran were categorized as Middle East. As SARS-CoV-2 firstly was reported in Wuhan, Hubei province, China on December 2019 (Wang and Zhang, 2020), we included the studies from January 2020 onwards. Data collection time (timing) was coded chronologically (e.g., January 2020 coded as "1"; February 2020 "2"; March 2020 "3"; January 2021 "13"). If data were collected over two or more months, the average of the numbers given to each month was calculated (i.e., between March and April 2020 coded as "3.5"). The studies included in the meta-analysis consisted of different populations. Target population was coded into nine categories (general population, hospital staff, mental health professionals, medical, healthcare students, academics, university students, high school personnel, older adults). For instance, doctor, nurse, and other hospital worker samples were categorized as hospital staff; psychologist, counselor, social worker samples were categorized as mental health professionals; and college students' sample except medical and nursing students were categorized as university students.

In this meta-analysis, possibility of publication bias was assessed using several methods including fail-safe *N*, Funnel plot, Egger's regression test and Begg and Mazumdar's rank correlation test. The calculated Fail-safe *N* value $< 5k + 10$ (k = the number of observed effect sizes) indicates that the meta-analysis result may be susceptible to publication bias (Rosenthal, 1979). Nonsignificant *p*-values obtained from two tests indicate the lack of publication bias. In the funnel plot, an asymmetrical distribution is expected in case of publication bias (Borenstein et al., 2011). All the analyses were conducted using the Comprehensive Meta-Analysis (CMA Version 3.0) software package in this study.

3. Results

3.1. Study characteristics

Eighty-three studies having 86,167 participants were included in the meta-analysis. Of these studies, 75,176 participants were used for the FCV-19S, 10,991 participants were used for CAS. The FCV-19S was used as the data collection tool in sixty of these studies (87.2%), while CAS was used in twenty-three studies (12.8%).

Eighteen (30%) studies were conducted in Europe, twenty (33.33%) in Asia, twelve (20%) in North and South America, eight (13.33%) in the Middle East, and two (0.33%) in Africa for the FCV-19S. In addition, twelve of the studies (20%) were published in 2020 and forty-eight (80%) in 2021. It has been reported that data from fifty-eight studies (96.67%) were collected in 2020, and two studies (3.33%) in 2021. Data from thirty studies (50%) were collected from the general population, twelve studies (20%) from hospital staff, three studies (5%) from healthcare workers and students, three studies (5%) from medical, one study (1.66%) from high school personnel, ten studies (16.66%) from university students, and one study (1.66%) from elderly individuals. The average age range of the participants was between 20 and 48. Finally, the cultures of the participants in the four studies (6.66%) were individualistic, while those of the fifty-six studies (93.33%) were collectivist.

Ten (43.47%) studies were conducted in Europe, three (13.04%) in Asia, six (26.08%) in North and South America, two (8.69%) in the Middle East, and two (8.69%) in Africa for the CAS. In addition, four of the studies (17.39%) were published in 2020, and nineteen (82.61%) in 2021. It has been reported that data from fifteen studies (65.21%) were collected in 2020, and one study (4.34%) in 2021. No information was reported regarding the time of data collection in seven studies (30.43%). Data from twelve studies (52.17%) were collected from the general population, six studies (26.08%) from hospital staff, one study (4.34%) from healthcare students, one study (4.34%) from medical professionals, one study (4.34%) from mental health professionals, one study (4.34%) from university students, and one study (4.34%) from academia. The average age range of the participants was between 29 and 65. Finally, the cultures of the participants in six studies (26.08%) were individualistic, while those of seventeen studies (73.91%) were collectivist. Detailed information about the studies included is presented in Table 1.

3.2. Publication bias

Before proceeding to the main findings of meta-analyses, possibility of publication bias was assessed using the methods mentioned above. First, the fail-safe *N* number was calculated to be 1074 and 7831 for anxiety and fear, respectively. Such large values indicated a lack of publication bias. This finding was also confirmed by the results of the two tests based on regression and rank correlation. Both of Egger's regression test and Begg and Mazumdar's rank correlation test produced non-significant *p*-values ($p > .05$) for anxiety and fear analyses. So, we have additional evidence for the lack of publication bias. In addition, visual inspections were conducted using funnel plot of anxiety and fear. As shown in Figs. S1 and S2, the funnel plot for the standard error vs. Cohen's *d* values showed that a weak publication bias was detected. Overall, we can conclude that publication bias would not be a concern for the present study.

Table 1
Study characteristics.

Author	Sample size	Timing of COVID-19	Country	Continent	Target population	Sample age (mean)
Studies included in the meta-analysis for gender and COVID-19 related fear						
Nguyen et al., 2020	5423	4	Vietnam	Asia	University students	22.00
Sakib et al., 2020	8550	4	Bangladesh	Asia	General population	25.50
Doshi et al., 2020	1499	4	India	Asia	General population	N.A.
Pérez-Fuentes et al., 2020	772	4.5	Cuba	North America	General population	36.00
García-Reyna et al., 2020	2860	N.A.	Mexico	North America	Hospital staff	N.A.
Tsipropoulou et al., 2020	2970	N.A.	Greece	Europe	General population	N.A.
Hossain et al., 2020	2157	3.5	Bangladesh	Asia	General population	33.48
Haktanir et al., 2020	668	N.A.	Turkey	Europe	General population	31.04
Bakioğlu et al., 2020	960	3.5	Turkey	Europe	General population	29.74
Abdelgwad and Abdelaziz, 2021	382	N.A.	Egypt	Middle East	University students	21.93
Aksoy et al., 2021	1060	7.5	Turkey	Europe	General population	29.76
Alnazly et al., 2021	365	8	Jordan	Middle East	Hospital staff	N.A.
Alothman et al., 2021	554	5.5	Saudi Arabia	Middle East	General population	34.5
Antonio and Elizabeth, 2021	438	N.A.	Mexico	North America	General population	N.A.
Aslam et al., 2021	250	N.A.	Pakistan	Asia	General population	24.02
Aslan and Dinç, n.d.	845	8	Turkey	Europe	Hospital staff	N.A.
Barbosa-Camacho et al., 2021	1216	5	Mexico	North America	General population	37.5
Broche-Pérez et al., 2020	772	4.5	Cuba	North America	General population	36
Bukhari et al., 2021	200	N.A.	Pakistan	Asia	General population	N.A.
Cervantes-Guevara et al., 2021	1529	7	Mexico	North America	High school personnel	N.A.
De los Santos and Labrague, 2021	385	6	Philippines	Asia	Hospital staff	32.65
De Los Santos et al., 2021	261	6	Philippines	Asia	Healthcare students	20.7
Doğan et al., 2021	135	N.A.	Turkey	Europe	Medical	47.39
Elsayed and Ghazi, 2021	275	6.5	Egypt	Middle East	Healthcare students	N.A.
Ghaderi et al., 2021	457	4.5	Iran	Middle East	General population	37.86
Grande and Doyle-Baker, 2021	680	13.5	Canada	North America	University students	23
Green et al., 2021	608	9	Pakistan	Asia	University students	24.76
Gélinas et al., 2021	1517	N.A.	Canada	North America	Hospital staff	41.11
Jafari-Oori et al., 2021	350	N.A.	Iran	Middle East	General population	N.A.
Jan et al., 2021	530	4	Pakistan	Asia	General population	N.A.
Kaçoğlu et al., 2021	176	12	Turkey	Europe	University students	22.6
Kakodkar et al., 2021	198	4.5	India	Asia	University students	N.A.
Karadem et al., 2021	527	N.A.	Turkey	Europe	Hospital staff	35.7
Karahan et al., 2021	138	12.5	Turkey	Europe	Hospital staff	37.6
Kardaş, 2021	679	9	Turkey	Europe	General population	26.7
Krägeloh et al., 2021	1029	4.5	Saudi Arabia	Middle East	General population	33.7
Landa-Blanco et al., 2021	595	N.A.	Honduras	North America	General population	25.1
Mahmoud et al., 2021	382	11.5	Egypt	Middle East	Hospital staff	33.83
Malik et al., 2021	421	4.5	Pakistan	Asia	Hospital staff	30.81
Mamun, 2021	10,052	4	Bangladesh	Asia	General population	26.95
Mistry et al., 2021	1032	10	Bangladesh	Asia	Older adults	N.A.
Montag et al., 2021	932	N.A.	China	Asia	University students	21.1
Osagiator Ariyo et al., 2021	413	N.A.	Nigeria	Africa	Hospital staff	38.7
Öztürk Altınayak and Yılar Erkek, 2021	1749	11	Turkey	Europe	General population	32.9
Parlak and Akgün Şahin, 2021	70	N.A.	Turkey	Europe	Medical	N.A.
Siddique et al., 2021	521	N.A.	Bangladesh	Asia	General population	24.78
Sotomayor-Beltran et al., 2021	449	9	Peru	South America	General population	40.75
Sürme et al., 2021	639	11	Turkey	Europe	Medical	46.12
Tan et al., 2021	352	N.A.	Turkey	Europe	University students	20.04
Ünver and Yeniğün, 2021	202	N.A.	Turkey	Europe	Hospital staff	35.54
Wakashima et al., 2020	450	4	Japan	Asia	General population	48.13
Yaşar Can and Dilmen Bayar, 2021	171	N.A.	Turkey	Europe	Hospital staff	N.A.
Midorikawa et al., 2021	6750	8	Japan	Asia	General population	N.A.
Morales-Rodríguez, 2021	180	4.5	Spain	Europe	University students	20.76
Giordani et al., 2021a	4638	7	Brazil	South America	General population	41.50
Kassim et al., 2021	255	5.5	Malaysia	Asia	General population	N.A.
Giordani et al., 2021b	387	9.5	Mozambic	Africa	General population	34.50
Ahammed et al., 2021	1317	4	Bangladesh	Asia	University students	N.A.
Yalçın et al., 2022	588	6.5	Turkey	Europe	General population	30.42
Studies included in the meta-analysis for gender and COVID-19 related anxiety						
Magano et al., 2021	1122	10.5	Portugal	Europe	General population	31.90
van de Venter et al., 2021	248	N.A.	South Africa	Africa	Hospital staff	N.A.
Ypsilanti et al., 2021	101	5.5	UK	Europe	General population	29.10
Sarıgedik and Bahar Ölmez, 2021	407	13.5	Turkey	Europe	General population	29.54
Guzel et al., 2021	370	12	Turkey	Europe	Healthcare students	N.A.
Öztekin et al., 2021	479	N.A.	Turkey	Europe	General population	N.A.
Ojalehto et al., 2021	438	N.A.	USA	North America	General population	30.29
Eşkut et al., 2021	247	N.A.	Turkey	Europe	Medical	45.95
Chorwe-Sungani, 2021	102	8	Malawi	Africa	Hospital staff	36.70
García-Reyna et al., 2021	2140	5.5	Mexico	North America	Hospital staff	36.10
Curtis et al., 2021	281	7.5	USA	North America	General population	64.69
Çakmak and Öztürk, 2021	162	N.A.	Turkey	Europe	Hospital staff	36.9

(*continued on next page*)

Table 1 (*continued*)

Author	Sample size	Timing of COVID-19	Country	Continent	Target population	Sample age (mean)
Ashoor et al., 2021	129	6	Saudi Arabia	Middle East	Hospital staff	N.A.
Bhattacharya et al., 2021	154	N.A.	India	Asia	Mental health workers	33.89
Broche-Pérez et al., 2021	373	8	Cuban	North America	General population	32.1
Akyildiz and Durna, 2021	290	8	Turkey	Europe	Academics	N.A.
Padovan-Neto et al., 2021	505	8	Brazil	South America	General population	N.A.
Srivastava et al., 2020	66	6.5	India	Asia	General population	N.A.
Orrù et al., 2021	697	10	Italy	Europe	General population	N.A.
Labrague and De Los Santos, 2021	736	9.5	Philippines	Asia	Hospital staff	31.9
Saravanan et al., 2020	433	5	UAE	Middle East	University students	21
Lee et al., 2020	398	N.A.	USA	North America	General population	35.91
Evren et al., 2020	1113	5	Turkey	Europe	General population	43.32

3.3. Heterogeneity and meta-analyses of effect sizes

The mean effect size estimates under the random-effects model and heterogeneity statistics for anxiety and fear variables are presented in Table 2. Under the random-effects model, the mean ES value for anxiety was found to be 0.316, with a 95% confidence interval of 0.183–0.449. The test of the null (when the mean ES is 0.0) yielded a Z-value of 4.664 and a corresponding *p*-value of <.001. The Q-statistics was found to be significant ($p < .001$, Q = 208.325 with $df = 22$) and failed to reject the hypothesis of homogeneity at $\alpha = 0.05$. In addition, I^2 percentage was calculated as 89.440. Thus, these findings provided evidence for heterogeneity. Similarly, the mean ES value for fear was found to be 0.307, with a 95% confidence interval of 0.255–0.359 under the random-effects model. The test of the null produced a Z-value of 11.622 and a corresponding p-value of <.001. The Q-statistics was found to be significant ($p < .001$, Q = 578.342 with $df = 59$) and I^2 percentage was calculated as 89.798 which indicated the heterogeneity between studies. Besides, forest plots (Figs. S3 and S4) presented can be examined to see the distribution of effect sizes obtained from each study included in the meta-analysis.

3.4. Moderator analyses

Possible sources of heterogeneity can be examined with analog to the ANOVA and meta-regression approaches in the presence of heterogeneity (Lipsey and Wilson, 2001). Thus, these approaches were used for anxiety and fear variables in this study. First, the analog to the ANOVA method was used to examine whether the categorical moderators (continent, culture, and target population) can be responsible for the heterogeneity between studies. Second, meta-regression was used for the analyses with continuous moderators (i.e., age, and timing).

Results of the analog to the ANOVA method for anxiety and fear variables are presented in Table 3. The Q-Between (Q_B) line tells us that the difference between groups is statistically significant in terms of average effect size. To investigate the effect of continent, we divided the continent variable into five categories for anxiety variable: Africa ($k = 2$), Asia ($k = 3$), Europe ($k = 10$), Middle East ($k = 2$), and North America ($k = 5$). The moderator analysis showed that the combined effect size values between five continents were statistically significantly different ($Q = 12.815$, $df = 4$, $p = .012$). The statistically significantly *p*-value indicated significant heterogeneity in effect sizes among five continents. The estimated mean effect size was the highest (i.e., 0.478) for Europe while the lowest (i.e., 0.189) for North America. The other postulated categorical moderators (culture and target population) did not influence the effect of gender on anxiety. To investigate the effect of culture on anxiety, we divided the culture variable into two categories for anxiety variable: Collectivism ($k = 17$), and individualism ($k = 6$). Similarly, we divided the target population variable into two categories for anxiety variable: General ($k = 12$), and hospital staff ($k = 6$) to investigate the effect of population. The moderator analysis showed that there were no differences in terms of culture ($Q = 0.208$, $df = 1$, $p = .648$) and target population (Q = 0.137; $df = 1$; $p = .711$). The statistically nonsignificant *p*-values indicate the lack of significant heterogeneity in effect sizes among the subgroups.

Similar analyses were also conducted for fear variable. To investigate the effect of continent, we divided the continent variable into four categories: Asia ($k = 20$), Europe ($k = 18$), Middle East ($k = 8$), and North America ($k = 10$). The moderator analysis showed that the combined effect size values between four continents were statistically significantly different ($Q = 9.050$, $df = 3$, $p = .029$). The statistically significantly *p*-value indicated significant heterogeneity in effect sizes among four continents. The estimated mean effect size was the highest (i.e., 0.390) for Europe while the lowest (i.e., 0.048) for Middle East. The other postulated categorical moderator (i.e., culture and target population) did not influence the effect of gender on fear. To investigate the effect of type of culture, we divided the examined culture variable into two major categories: Collectivism ($k = 56$) and individualism ($k = 4$). Similarly, we divided the target population variable into four categories for fear variable: General ($k = 30$), hospital staff ($k = 13$), medical ($k = 3$), and university students ($k = 10$). The moderator analysis showed that there were no statistically significant differences in terms of culture ($Q = 2.128$, $df = 1$, $p = .145$) and target population (Q = 1.593; $df = 3$; $p = .661$). The statistically nonsignificant *p*-values indicated the lack of significant heterogeneity in effect sizes among the subgroups. It should be noted that non-significant results in this study may occur due to unevenly distributed cells.

To investigate the effect of continuous moderators (i.e., age and timing) on anxiety and fear variables, we conducted meta-regression analyses. Two separate meta-regression models with a random effects model using unrestricted maximum likelihood estimation were analyzed with these two continuous moderators for both anxiety and fear outcomes. Results of the meta-regression analyses for anxiety and fear variables are presented in Table 4. As shown in Table 4, no significant effect was found for two continuous moderators (age and timing) in terms of anxiety and fear outcomes ($p < .05$).

Table 2
Results of the random effects meta-analyses.

Measures	*k*	*N*	ES_r	95% CI	*Z*	p_z	Cochran's *Q*	p_Q	I^2 (%)
Anxiety	23	10,991	0.316	[0.183, 0.449]	4.664	<.001	208.325	<.001	89.440
Fear	60	75,176	0.307	[0.255, 0.359]	11.622	<.001	578.342	<.001	89.798

Note. k = number of studies, Cochran's Q = tests of heterogeneity, N = number of participants in all studies, CI = confidence interval.

Table 3
Results of categorical moderator analyses.

Outcome	Predictors	Categories	*k*	*d*	95% CI	Q-between
COVID-19 anxiety	Continent	Africa	2	0.370*	[0.071, 0.699]	12.815*
		Asia	3	0.360	[−0.004, 0.725]	
		Europe	10	0.478***	[0.319, 0.637]	
		Middle East	2	−0.392	[−1.099, 0.314]	
		North America	5	0.189***	[0.083, 0.295]	
	Culture	Collectivism	17	0.326***	[0.149, 0.504]	0.208
		Individualism	6	0.274***	[0.132, 0.415]	
	Population	General	12	0.331***	[0.228, 0.434]	0.137
		Hospital staff	6	0.296***	[0.140, 0.352]	
COVID-19 fear	Continent	Asia	20	0.288***	[0.226, 0.351]	9.050*
		Europe	18	0.390***	[0.255, 0.525]	
		Middle East	8	0.048	[−0.157, 0.254]	
		North America	10	0.367***	[0.258, 0.476]	
	Culture	Collectivism	56	0.296***	[0.243, 0.349]	2.128
		Individualism	4	0.466***	[0.244, 0.688]	
	Population	General	30	0.316***	[0.246, 0.387]	1.593
		Hospital staff	13	0.248***	[0.121, 0.375]	
		Medical	3	0.357***	[0.123, 0.591]	
		University	10	0.360***	[0.220, 0.501]	

Note. k = number of studies, Cochran's Q = tests of heterogeneity, CI: confidence interval.
* $p < .05$.
*** $p < .001$.

Table 4
Results of meta regression analyses for anxiety and fear.

Predictors	COVID-19 anxiety			COVID-19 fear		
	B	*S.E.*	*z*	*B*	*S.E.*	*z*
Average age of sample	0.002	0.008	0.232	−0.002	0.005	−0.523
Timing	0.058	0.038	−0.594	0.012	0.014	0.382

Note. β = regression coefficient; *S.E.* = standard error; z = Significance of moderator.

4. Discussion

The findings of the meta-analysis showed that COVID-19 related fear and anxiety was higher in females. These findings are consistent with previous studies, reporting that female is more anxious than males (Robichaud et al., 2003; Stavosky & Borkovec, 1987). In addition, it is known that females have higher rates than males in other psychological disorders related to anxiety and fear (Kessler, 2003; Pigott, 1999). In the pandemic, the female gender was significantly associated with higher stress, anxiety, and depression. In addition, the psychological effects of the epidemic were greater in females. Although some studies showed that males had more COVID-19 anxiety than females (e.g., Ashoor et al., 2021; Curtis et al., 2021; Saravanan et al., 2020), it was found that females had more in this meta-analysis.

Females have more anxiety and fears than males is a situation observed pre-pandemic (e.g., McLean et al., 2011; Pigott, 1999; Wenjuan et al., 2020). Various reasons have been reported for females to be more anxious than males (Rossi et al., 2020; Wang et al., 2020). One of these reasons for the higher fear and anxiety scores of females may be due to their relationship with gender roles (Block, 1983; Zalta & Chambless, 2012). Females' anxiety reactions may have been higher because expressing distress is more encouraged (Chambless & Mason, 1986). Studies showed that females had a higher perception of COVID-19 risk and saw this pandemic as more dangerous for the population (Niño et al., 2021; Nguyen et al., 2020; Reznik et al., 2020; Sakib et al., 2020). Besides, females express their emotions easily, whereas males tend to suppress them and appear strong (Bakioğlu et al., 2020). Another reason females have high levels of fear and anxiety may be related to biological factors. In other words, hormonal factors and reproductive cycles may mediate increasing females' anxiety-related feelings (Pigott, 1999). These biological differences between males and females seem to be significant in explaining the difference in anxiety-related feelings. Our results are consistent with these pre-pandemic findings-females more anxious than males. COVID-19 related fear and anxiety as a new phenomenon may be related to the emergence of existing anxiety and fear. In other words, COVID-19 outbreak may have played a triggering role. For example, information about the pandemic may have exacerbated anxiety and fear in individuals who are more prone to anxiety and fear.

The moderator analyses revealed the highest effect size of gender differences in COVID-19 related fear, and anxiety obtained from the studies conducted in Europe. Also, contrary to what we expected, Middle East samples surprisingly revealed no gender difference in COVID-19 related fear and anxiety. Considering the higher risk perception of females in individualistic societies, their greater awareness of danger, maladaptation in facing threats, and more negative perceptions about the health risks of the pandemics (Alsharawy et al., 2021; Bengtsson et al., 2005; Magano et al., 2021; Morales-Rodríguez, 2021; Niño et al., 2021; Orrù et al., 2021; Tsipropoulou et al., 2020; Ypsilanti et al., 2021), and some cultural factors, the highest effect size in favor of females is expected in European samples. In addition, the effect size of gender difference in COVID-19 related fear was higher in individualistic orientation than collectivistic, while in COVID-19 related anxiety was higher in collectivistic orientation than individualistic, but there were no statistically significant differences. Finally, other moderators, the average age of the sample, timing, and target population, were not significant moderators for gender differences in COVID-19 related fear and anxiety. Overall, the continent variable provided partial evidence for gender difference in COVID-19 related fear and anxiety. However, the findings of other moderators revealed that the source of heterogeneity is not the characteristic of sample or the study characteristic. Other sources such as lockdown and social isolation period, economic growth (GDP), COVID-19 death rate, Gini index, and data availability may result in heterogeneity in this meta-analysis.

4.1. Implications and future research

Results of this study highlighted the need for prevention and intervention programs. Considering the relationship between COVID-19 related fear and anxiety and depression, stress, mood swings, general irritability, insomnia, attention deficit, suicide, addiction, and PTSD, it is a threat to the well-being of individuals. Therefore, psycho-education programs on coping skills and adverse thoughts about the virus

implemented by mental health professionals and more explicit and accurate information about COVID-19 provided by decision-makers is necessary. It should be considered that COVID-19 related fear and anxiety were higher in females while applying these programs and information. The results of this study also showed that females in Europe had higher fear and anxiety related to COVID-19 than females in Middle East. Therefore, cultural factors such as gender roles should be considered when designing prevention and intervention programs. In addition, the reasons for these intercontinental differences could be investigated in future research. In this study, we only estimated the effect of gender on COVID-19 related fear and anxiety. In future studies, the effect of gender on COVID-19 related phobia, perceived risk, and stress would be examined to find evidence for convergent validity. Finally, there may be various reasons for the higher fear and anxiety associated with COVID-19 in females, such as gender equality, gender roles, and some cultural factors which could be examined in future studies.

4.2. Limitations

The current study has a few limitations. First, only articles written in English were included. Thus, studies conducted in other languages (i.e., Spanish, German, Arabic) were not included in this meta-analysis. Second, articles using the FCV-19S (Ahorsu et al., 2020) and CAS (Lee, 2020) screening tools for the assessment of COVID-19 fear and anxiety were included. Other screening tools assessing COVID-19 related fear and anxiety were not included in the current study. Third, there was a high level of heterogeneity among the studies included in this meta-analysis. As a result of the moderator analyses to explain the heterogeneity, it was observed that only continent variable partially explained the heterogeneity. Therefore, this situation should be considered when interpreting the study results. Fourth, we considered culture, continent, the average age of the sample, timing, and target population as potential moderators. However, to determine heterogeneity between the studies, we could not include other potential moderators (e.g., lockdown period, COVID-19 death rate, Gini index) because details were not available for these moderators in the studies included in the current meta-analysis. Finally, gender is not always divided along the binary lines of female and male. But we could not address other identities as there were insufficient data to calculate the mean and SD of other gender identities in the studies included in this meta-analysis.

5. Conclusion

COVID-19 outbreak has negatively affected individuals in many ways such as psychological, economics, sociological etc. To our knowledge, this meta-analysis is the most extensive and the first study to estimate gender difference in COVID-19 related fear and anxiety. Although this study has some limitations, our study showed that COVID-19 related fear and anxiety was higher in females. Also, in this current study we found additional evidence to the higher COVID-19 related fear and anxiety, those who are females in Europe. In conclusion, COVID-19 outbreak negatively affected females more.

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All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

CRediT authorship contribution statement

Eyüp Sabır Erbiçer: Writing, methodology, theoretical basis, literature review, and data analysis.
Ahmet Metin: Writing, methodology, theoretical basis, and literature review.
Sedat Şen: Writing and data analysis.
Ali Çetinkaya: Literature review.

Conflict of interest

The authors do not report any conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2022.05.036.

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