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REVIEW ARTICLE

Prevalence of postpartum depression symptoms in high-income and low- and middle-income countries in the COVID-19 pandemic: a systematic review with meta-analysis

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Objective: To compare the prevalence of postpartum depression (PPD) symptoms between high-income countries (HIC) and low- and middle-income countries (LMIC) during the COVID-19 pandemic.
Methods: The PubMed, Embase, Virtual Health Library, Scopus, Web of Science, PsycINFO, and CINAHL databases were searched until October 2022 for studies that collected data during the pandemic. The *metaprop* command was used in the Stata statistical software version 12.0 to run a random-effects meta-analysis.
Results: A total of 15 studies with 4,788 postpartum women were included. The overall prevalence of PPD symptoms was 31% (95%CI 21.85-40.99). The pooled prevalence of PPD symptoms among women from HIC (30.5% [95%CI 16.95-46.02]) did not differ significantly from that of women from LMIC (31.5% [95%CI 19.26-45.15]). However, studies that analyzed women up to 1 month after childbirth reported a lower prevalence of PPD symptoms (17.5% [95%CI 9.85-26.62]) compared to those that observed them up to 1 year after childbirth (38.3% [95%CI 33.96-42.83]).
Conclusions: The prevalence of PPD symptoms was high across countries, regardless of human development index. This condition must be regularly tracked worldwide to assess, discuss, and recommend more assertive steps that may be implemented to address it based on the particular characteristics of each country.
Registration number: PROSPERO CRD42022346861.

Keywords: Postpartum depression; COVID-19; pandemic; human development index; prevalence

Introduction

Postpartum depression (PPD) is the most common postnatal illness,[1] affecting between 17 and 22% of women around the world,[2] with onset until 4 weeks after delivery.[3] There are substantial differences in rates of PPD when marital status, educational level, social support, spousal care, violence, gestational age, breast-feeding status, child mortality, pregnancy plan, financial difficulties, partnerships, life stress, smoking status, alcohol intake, and living conditions are considered. Country development and income inequalities may have a major effect on PPD epidemiology.[2] PPD threatens not only the health of mothers but also that of infants, as children of depressed mothers may have developmental disorders, reduced cognitive function, and problems pertaining to social communication with their parents and peers.[4]

Several studies have been conducted to investigate the association between the coronavirus disease 2019 (COVID-19) pandemic and PPD.[5] Comprehensive studies, such as systematic reviews with meta-analyses, have also been published on this subject, but few have compared the prevalence of PPD symptoms between high-income countries (HIC) and low- and middle-income countries (LMIC) in the context of the COVID-19 pandemic.

Understanding the prevalence of PPD symptoms helps identify risk factors, which in turn can inform implementation of more targeted prevention and intervention strategies. Knowing the difference in the extent of PPD symptoms across countries with different economic realities allows health systems to adapt and improve.

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Therefore, the present study aimed to carry out a systematic literature review of cross-sectional studies that assessed the prevalence of PPD symptoms during the COVID-19 pandemic, and then perform a meta-analysis and comparison of the prevalence between HIC and LMIC.

Methods

This systematic review with meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[6] and prospectively registered in PROSPERO (CRD420223 46861).

Eligibility criteria and search strategies

We conducted a comprehensive search of the PubMed, Embase, Virtual Health Library, Scopus, Web of Science, PsycINFO, and CINAHL databases from inception to October 2022 for studies that collected data during the COVID-19 pandemic and reported the prevalence of PPD symptoms. In addition, the reference lists of the included articles were cross-checked to identify articles that were not assessed in the search strings.

The following free terms in English were used in the search strategy: (''Postnatal Depression'' OR ''Post-Partum Depression'' OR ''Post Partum Depression'' OR ''Postpartum Depression'' OR ''Post-Natal Depression'' OR ''Post Natal Depression'') AND (COVID-19 OR SARS-CoV-2 OR coronavirus OR pandemic) AND (''cross sectional'' OR ''cross-sectional'' OR prevalence). The descriptors were adapted according to the indexing rules of each database. We searched by title and abstract. There was no restriction regarding language.

Inclusion and exclusion criteria

The inclusion criteria in this meta-analysis were as follows: 1) studies including puerperal women aged $\geqslant$ 18 years; 2) studies that collected data during the COVID-19 pandemic period; 3) studies that evaluated major depression symptoms using the Edinburgh Postnatal Depression Scale (EPDS); and 4) studies with a cross-sectional design.

The exclusion criteria were as follows: 1) cohort studies, case-control studies, clinical trials, systematic reviews with or without meta-analysis, commentaries, conference abstracts, editorials, case reports, letters, and short communications; 2) studies that exclusively included women who had preterm birth or whose children required intensive care unit (ICU) admission; 3) studies that exclusively included women who had complications during childbirth or were hospitalized; 4) studies that mixed the results of pregnant and puerperal women; and 5) studies that included women diagnosed with previous psychiatric illnesses.

The search results were imported into the Rayyan online platform,[7] in which duplicates were identified and excluded; study selection was then performed. The first stage of selection consisted of reading the titles and abstracts to identify and remove studies that did not meet the objective of this systematic review. All articles that passed this first filtering process were read in full to apply the eligibility criteria. The entire selection process was conducted by two independent reviewers (IV and FM), with conflicts resolved by a third reviewer (MV).

Data extraction process

Data were extracted by two investigators (IV and FM) into online spreadsheets (Google Sheets). The following data were extracted: name of the first author, year of publication, study country, EPDS cutoff score, mean age, total sample size, number of participants with PPD symptoms, postpartum period evaluated, proportion of vaginal deliveries, other methods of delivery, breastfeeding status, parity, comorbidities assessed, inclusion criteria, exclusion criteria, human development index (HDI) of the study country, clinical outcomes, and main results.

Quality assessment of studies

Included studies were categorized as having a high (score $\leqslant$ 3), moderate (5 and 6) or low (7 and 8) risk of bias according to the Joanna Briggs Institute (JBI) critical appraisal checklist for analytical cross-sectional studies.[8] Two reviewers (IV and FM) independently evaluated each included study and the results were cross-checked. Conflicts were resolved by a third reviewer (MV).

Summary measures

The pooled PPD symptoms prevalence was calculated. Subgroup analyses were also performed using the country in which the original studies were performed. The prevalence was calculated by dividing the total number of women with PPD symptoms by the total sample size and multiplying it by 100. The binomial distribution formula was used to compute the standard error for each original study.

Statistical methods and analysis

A meta-analysis was performed using a random effects model with inverse variance weighting to obtain the summary measure using the *metaprop* command (Stata version 12.0 statistical software).

A meta-regression with the following variables was performed to assess heterogeneity and observe the effects of the variables on PPD symptoms: mean/median age, EPDS cutoff utilized, HDI, breastfeeding status, and parity. As the dependent variable is a proportion, the data were logit-transformed for the meta-regression, using the ''logit()'' command in Stata.

The World Bank classification of the world's economies was used to determine each country's development level.[9]

The following subgroup analyses were performed: 1) an analysis of studies conducted in HIC and LMIC; 2) an analysis considering the most homogeneous patterns to

evaluate the postpartum period, which was categorized as "up to 1 month," "up to 3 months," and "up to 12 months"; and 3) an analysis of studies that used EPDS cutoff points of $\leqslant 12$ and > 12.

The results are presented as overall prevalences and their respective 95%CI. Statistical heterogeneity was assessed using the I^2 statistic and its respective 95%CI, where $I^2 \geqslant 50\%$ was considered to indicate substantial heterogeneity. The results are shown as forest plots and tables. Given the small number of probability samples, Doi plots and the Luis Furuya-Kanamori (LFK) index were used to detect publication bias where applicable.[10]

Results

The initial search strategy identified 691 studies. After screening of titles and abstracts and exclusion of duplicates, 170 studies were selected for full-text evaluation. Of these, 15 studies met the eligibility criteria and were included in the qualitative synthesis and meta-analysis. Figure 1 shows the PRISMA flow diagram of the study search and selection process.

Tables 1 and 2 show the main characteristics of the included studies. Eight studies were conducted in LMIC, and seven studies in HIC.

The 15 studies included 4,788 postpartum women. The mean age among studies in LMIC ranged from 24.2 to 31 years, and that among studies in HIC, from 30.9 to 34.77 years.

The overall prevalence of PPD symptoms was 31% (95%CI 21.85-40.99). High heterogeneity was detected across studies (I^2 = 98%, $p < 0.001$). The pooled prevalence of PPD symptoms among women from HIC (30.5% [95%CI 16.95-46.02]) did not differ significantly from that among women from LMIC (31.5% [95%CI 19.26-45.15]) (Figure 2).

Studies that analyzed women up to 1 month after childbirth reported a lower prevalence of PPD symptoms (17.5% [95%CI 9.85-26.62]) than those that observed women up to 1 year after childbirth (38.3% [95%CI 33.96-42.83]) (Figure 3).

EPDS cutoff points varied widely among the selected articles: one utilized a cutoff point of $\geqslant 9$, five utilized a cutoff point of $\geqslant 10$, one utilized a cutoff point of $\geqslant 11$, one utilized a cutoff point of $\geqslant 12$, five utilized a cutoff point of $\geqslant 13$, and two utilized a cutoff point of $\geqslant 14$. Considering the most homogeneous patterns, studies that analyzed PPD symptoms using an EPDS cutoff point of $\leqslant 12$ (30.3% [95%CI 17.32-45.12]) did not differ significantly from those using an EPDS

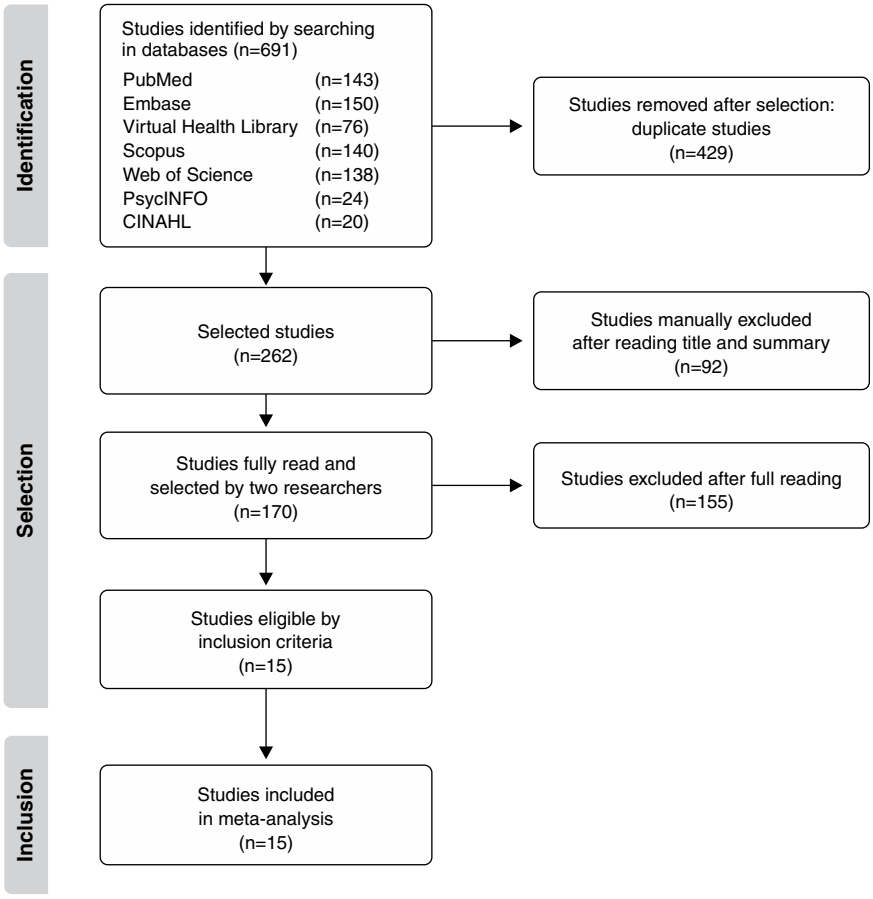

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram summarizing the article search and selection process for meta-analysis.

Table 1 Main characteristics of the studies from HIC included in the systematic review and meta-analysis

Author	Country	EPDS cutoff used	Mean age	Sample size	With PPD	Evaluated postpartum period	Vaginal delivery (%)	Other route of delivery (%)	Breastfed (%)	Primigravida or primipara (%)
Fallon[11]	United Kingdom	13	30.9	614	264	0 to 3 months	63.4	36.6	69.0	48.7
Gildner[12]	United States	13	32.0	971	103	2 to 89 days postpartum	NR	NR	NR	NR
Mariño-Narvaez[13]	Spain	10	34.2	75	28	0 to 1 month postpartum	69.3	NR	NR	62.7
Ostacoli[14]	Italy	11	34.8	163	72	NR	47.9	52.1	88.3	45.4
Shuman[15]	United States	10	31.8	670	256	Average of 7.46 weeks postpartum	NR	NR	85.0	NR
Spinola[16]	Italy	12	34.0	243	108	0 to 52 weeks	NR	NR	81.1	64.6
Terada[17]	Japan	9	33.0	461	35	1 month postpartum	NR	NR	35.1	50.8

EPDS = Edinburgh Postnatal Depression Scale; HIC = high-income countries; NR = not reported; PPD = postpartum depression.

Table 2 Main characteristics of the studies from LMIC included in the systematic review and meta-analysis

Author	Country	EPDS cutoff used	Mean age	Sample size	With PPD	Evaluated postpartum period	Vaginal delivery (%)	Other route of delivery (%)	Breastfed (%)	Primigravida or primipara (%)
Ambriz-López[18]	Mexico	10	26.0	116	17	24 a 48 hours postpartum	35.3	42.2	78.4	NR
An[19]	China	10	30.4	209	119	NR	54.5	NR	NR	61.2
Chainani[20]	India	13	27.5	200	108	1 to 6 weeks postpartum	57.0	NR	NR	NR
Gupta[21]	India	14	24.2	61	15	Immediate postpartum period	37.7	NR	NR	52.5
Myo[22]	Myanmar	13	NR	220	70	$\leqslant$ to 6 months	47.7	NR	78.2	57.3
Suárez-Rico[23]	Mexico	13	NR	293	115	4 to 12 weeks postpartum	30.7	NR	NR	32.8
Tariq[24]	Pakistan	14	31.0	84	21	NR	48.8	NR	NR	21.4
VidhiChaudhary[25]	India	10	25.5	408	51	2 to 7 days	83.3	NR	NR	52.0

EPDS = Edinburgh Postnatal Depression Scale; LMIC = low- and middle-income countries; NR = not reported; PPD = postpartum depression.

cutoff point of $>$ 12 (31.84% [95%CI 18.05-47.45]) (Figure 4).

On meta-regression analysis, the proportion of breastfeeding was directly associated with the prevalence of PPD symptoms (β = 0.79, p = 0.04). The variables country HDI, mean/median age, vaginal delivery status, and parity showed no association with the effect.

A symmetrical, mountain-like Doi plot with an LFK index between -1 and 1 suggested no asymmetry, indicating a minimal likelihood of publishing bias (Figure 5).

Discussion

Based on a systematic literature search and subsequent meta-analysis of 15 studies, covering 4,788 postpartum women from 10 countries, we observed that the prevalence of PPD symptoms was high (31%) regardless of country HDI, compared to pre-pandemic data (14%).[26]

There are numerous known risk factors for PPD. Reviews indicate that a history of depression (any and/or during pregnancy), low socioeconomic status, and a lack of support are the greatest contributing factors.[27,28]

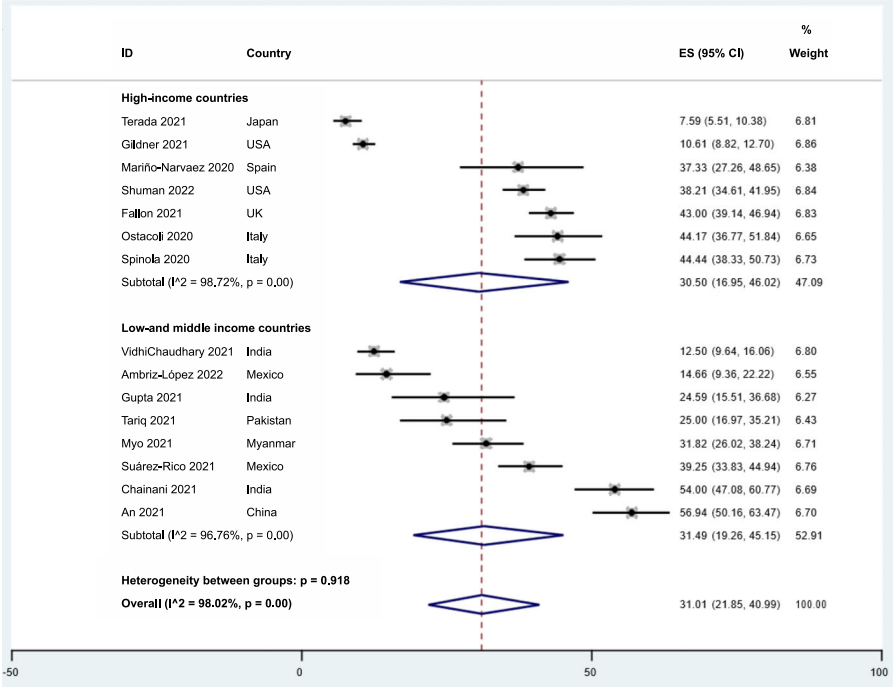

Figure 2 Forest plot of prevalence of PPD symptoms in studies conducted in HIC and in LMIC during the coronavirus disease 2019 (COVID-19) pandemic. HIC = high-income countries; LMIC = low- and middle-income countries; PPD = postpartum depression.

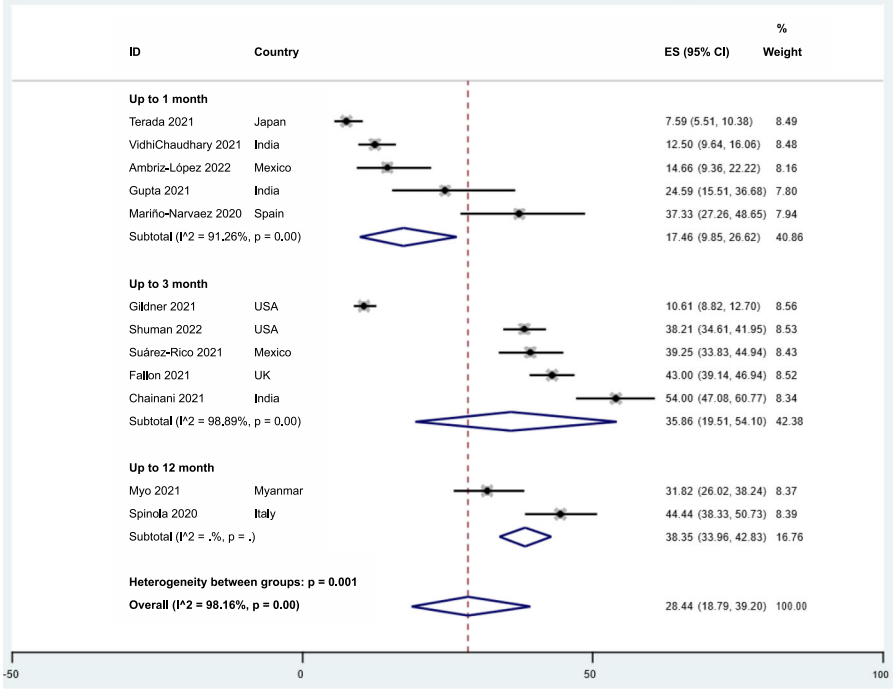

Figure 3 Forest plot of prevalence of PPD symptoms in studies evaluating the postpartum period up to 1 month, up to 3 months, and up to 12 months during the coronavirus disease 2019 (COVID-19) pandemic. PPD = postpartum depression.

These risk factors seem to be consistent across different countries. For instance, low socioeconomic status, prior mental health issues, poor relationships with partners, family, and friends, and unfavorable reproductive events were all identified as key categories of risk in a review of the determinants of common perinatal mental health

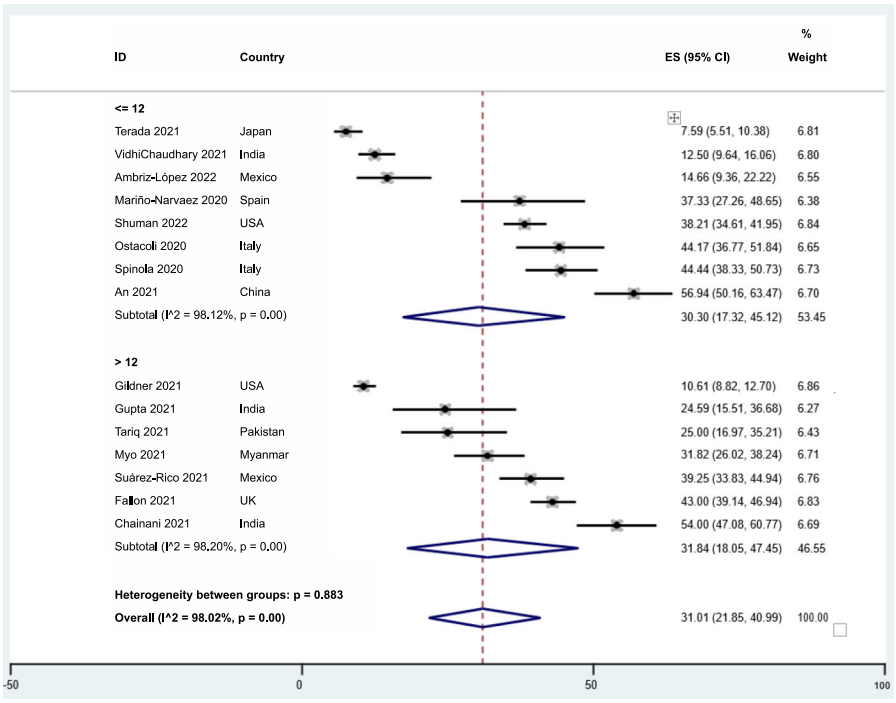

Figure 4 Forest plot of prevalence of PPD symptoms in studies evaluating the Edinburgh Postnatal Depression Scale (EPDS) cutoff ≤ 12 or > 12 during the coronavirus disease 2019 (COVID-19) pandemic. PPD = postpartum depression.

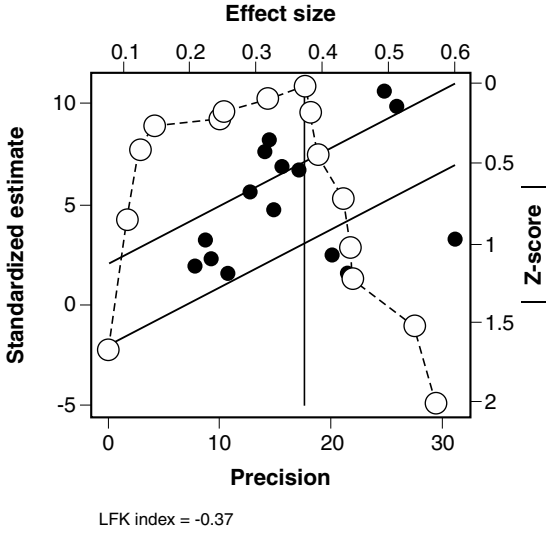

Figure 5 Doi plot with an LFK index indicating a low chance of publishing bias. LFK = Luis Furuya-Kanamori index.

disorders in LMIC.[29] One of the possible protective factors for mental health during the COVID-19 pandemic was being male.[30]

Before the pandemic, according to a meta-analysis by Liu et al.,[26] the pooled prevalence of PPD symptoms in all included studies was estimated to be 14%; a subgroup analysis, revealed that the prevalence of PPD symptoms in LMIC (15%) was significantly higher than that in HIC (12%).

In another study, also carried out during the pre-pandemic period, the prevalence of depression in men and women tended to be higher in countries with medium HDI (29.2%) in contrast to those with very high (9.8%), high (19.2%), or low (11.5%) HDI. Regarding gender differences, women exhibited a higher prevalence of depression (14.4%) compared to men (11.5%) across the 30 countries included in the study.[31]

Before the pandemic, there may have been disparities in the prevalence of PPD symptoms between HIC and LMIC. However, although there are more vulnerabilities in relation to socioeconomic determinants in LMIC compared to HIC (which can increase the symptoms of PPD), COVID-19 appears to contribute to equalizing these factors and making these groups equally susceptible.

In addition to the overall and subgroup analyses by country HDI, we conducted another subgroup analysis to determine the prevalence of PPD symptoms based on the postpartum period examined. Studies that analyzed women up to 1 month after childbirth found a lower prevalence of PPD symptoms (17.46% (95%CI 9.85-26.62]) than those that observed them up to 1 year after childbirth (38.35% [95%CI 33.96-42.83]). Gao et al.[32] found that the prevalence of PPD symptoms was higher (32.3% [95%CI 24.8-40.8]) in women at $>$ 6 weeks after delivery, whereas the prevalence was lower (21.7% [95% CI 16.5-28.1]) in the first 6 weeks of the postpartum period.

It bears stressing that, in comparison to the pre-pandemic period, during the COVID-19 pandemic new mothers experienced more difficult and complex environmental conditions. As time passes after delivery, mothers and their newborns must perform certain activities outside the home. The COVID-19 pandemic may have increased the prevalence of postpartum psychological disorders because of the tension between outdoor requirements and lockdown measures.[33]

In our meta-regression, breastfeeding had a direct association with the prevalence of PPD symptoms, which is unusual. Previous research has noted an association between breastfeeding and a reduced risk of PPD symptoms.[34] However, a cross-sectional study conducted with 3,253 postnatal women from five countries, designed to elucidate the associations between breastfeeding intentions and breastfeeding practices and PPD symptoms considering COVID-19-related factors, found that women who had no breastfeeding intention but actually breastfed had greater odds (odds ratio [OR]: 1.75) of having PPD than women who intended to breastfeed and actually breastfed (OR: 1.00). These findings emphasize the necessity of counseling women about their breastfeeding intentions. Tailored support is needed to ensure that breastfeeding demands are satisfied while also caring for maternal mental health during and after the COVID-19 pandemic.[35] We should point out that our result is based on an ecological connection determined using aggregated data. Because of the possibility of an ecological fallacy, the women who reported depression symptoms were not always those who breastfed. We should also note that we were unable to investigate differences according to the intention to breastfeed or whether breastfeeding was exclusive.

The high prevalence of PPD symptoms during the COVID-19 pandemic may have several different causes. Among these, we can highlight the direct action of the virus on the central nervous system, the traumatic experiences associated with infection or death of loved ones, the stress induced by changes in routine due to social distancing measures, or impacts on economic aspects, work routine, or affective relationships. Another possible cause is the disruption in health care for several chronic diseases due to the reallocation of funds for the pandemic response.[36]

The most popular instrument to assess PPD symptoms is the EPDS.[37] Two EPDS cutoff points are most commonly used in the literature: $\geqslant$ 10 points and $\geqslant$ 13 points.[38] It is important to emphasize that the EPDS is a screening test; therefore, it does not provide a diagnosis of depression. From a clinical perspective, the EPDS may be administered to help identify women who would benefit from in-depth psychiatric evaluation and ensuing follow-up.[39] In our study, the selected articles used different EPDS cutoff points. Only two articles were not included in the systematic review with a meta-analysis because they did not use the EPDS to assess PPD symptoms, despite fulfilling all other inclusion criteria. This confirms that the EPDS is indeed the most commonly used scale to assess PPD symptoms.

COVID-19 pandemic response strategies may have delayed access to health care for pregnant women during certain periods, particularly due to social distancing policies. Nguyen et al.[40] suggested that delays in antenatal care during the COVID-19 pandemic have adversely affected the quality of life and psychological well-being of pregnant women in Vietnam. Introducing measures such as routine screening for mental health issues during antenatal visits to identify women at risk of PPD and promoting family and social support for pregnant women – either in-person or through virtual platforms – to alleviate feelings of isolation may help mitigate symptoms of PPD.

To address the needs of the general population during the pandemic, it is worthwhile to consider introducing online or smartphone-based psychoeducation tools to promote mental wellness.[41] Additionally, implementing psychological interventions such as cognitive behavioral therapy (CBT) could be beneficial. The importance of CBT in treating psychiatric symptoms during COVID-19 lies in its adaptability to a wide range of mental health issues,[41] its accessibility through telemedicine interventions, its cost-effectiveness,[42] and its established efficacy in treating specific symptoms often associated with depression, such as insomnia.[43] These factors contribute to the role of CBT as an essential component of pandemic mental health initiatives.

The World Health Organization (WHO) proclaimed the end of the Public Health Emergency of International Concern on May 5, 2023; however, this does not mean that COVID-19 is no longer a health hazard. The disease's global spread is still being referred to as a pandemic. This suggests that it is time for countries to transition from ''emergency mode'' to management of COVID-19 as is done for other infectious diseases.[44] Although the peak of the pandemic has passed, its influence will be significant and long-lasting. The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus, the causative agent of COVID-19, is still killing one person every 3 minutes, while many survivors are suffering from the incapacitating effects of long COVID, which can leave them debilitated for months.[45]

Our comparison of the prevalence of PPD symptoms between countries with different HDIs during the pandemic allows us to evaluate how large-scale events affect maternal mental health in different contexts. It also allows us to compare our findings with those of previous studies, helping to identify trends and changes in prevalence over time.

During the COVID-19 pandemic, a steady flow of synthesis research has been published on a wide variety

of topics. While the need to disseminate information to the medical community and general public was paramount, concerns have been raised regarding scientific rigor in these published reports. Overall, their quality fell short of what is expected for systematic reviews.[46]

Although other reviews have already been published on the topic, new studies are constantly being carried out and published as the pandemic progresses. Our systematic review can provide an up-to-date, higher-quality analysis of this evidence, including recent studies that may not have been included in previous reviews.

The major strength of this investigation is that, to maximize data uniformity across selected studies, only articles with a specific study design (only cross-sectional studies can evaluate prevalence data) using a specific scale to assess PPD symptoms (EPDS) were eligible. Furthermore, our work included a substantial number of articles evaluating the prevalence of PPD symptoms in the COVID-19 pandemic. Consequently, because it was a meta-analysis, the results were more accurate than those of a single study would have been.

The main limitation was that different EPDS cutoffs were used to evaluate PPD symptoms among the included studies. Due to the high heterogeneity among the selected studies, the prevalence of PPD would be expected to vary according to region. However, this is not what we found in our study. This highlights the need for a contextualized approach to comprehending and addressing maternal mental health, tracking not only cultural and socioeconomic nuances, but also factors such as access to mental health resources and the diverse perceptions of mental health that influence the experience of depression in varied ways.

Finally, in a meta-analysis, the overall prevalence is weighted by the inverse of the variance, so larger studies carry more weight but may not necessarily represent larger populations.

Depression is caused by a complex interaction of individual, societal, and emotional stressors and vulnerabilities, and is one of the leading causes of disability globally. The prevalence of PPD symptoms and PPD risk factors must be regularly tracked around the world to assess, discuss, and recommend more assertive steps that may be implemented to address this condition based on the particular characteristics of each region or country.

It should also be noted that 70% of the global health workforce is made up of women, a number that increases to 90% when accounting for social care workers.[47] Therefore, the global decline in the number of healthy women affects the quality and quantity of health care workers, thus limiting access to health care. Prioritizing women's health is essential to improving global public health indicators and accelerating recovery from the COVID-19 pandemic.

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Author contributions

MV: Conceptualization, Methodology, Data curation, Funding acquisition, Writing – original draft, Writing – review & editing.
FR: Methodology, Formal analysis, Writing – review & editing.
IV: Investigation.
FM: Investigation.
MGC: Writing – review & editing.
AEN: Writing – review & editing.
DM: Conceptualization, Methodology, Funding acquisition, Writing – review & editing.
All authors have read and approved of the final version to be published.

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