

## CLINICAL ARTICLE

## Obstetrics

# Risk factors for anxiety and depression among pregnant women during COVID-19 pandemic—Results of a web-based multinational cross-sectional study

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#### Abstract

**Objective:** To assess risk factors for anxiety and depression among pregnant women during the COVID-19 pandemic using Mind-COVID, a prospective cross-sectional study that compares outcomes in middle-income economies and high-income economies.

**Methods:** A total of 7102 pregnant women from 12 high-income economies and nine middle-income economies were included. The web-based survey used two standardized instruments, General Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9).

**Result:** Pregnant women in high-income economies reported higher PHQ-9 (0.18 standard deviation [SD],  $P < 0.001$ ) and GAD-7 (0.08 SD,  $P = 0.005$ ) scores than those living in middle-income economies. Multivariate regression analysis showed that increasing PHQ-9 and GAD-7 scales were associated with mental health problems during pregnancy and the need for psychiatric treatment before pregnancy. PHQ-9 was associated with a feeling of burden related to restrictions in social distancing, and access to leisure activities. GAD-7 scores were associated with a pregnancy-related complication, fear of adverse outcomes in children related to COVID-19, and feeling of burden related to finances.

**Conclusions:** According to this study, the imposed public health measures and hospital restrictions have left pregnant women more vulnerable during these difficult times. Adequate partner and family support during pregnancy and childbirth can be one of the most important protective factors against anxiety and depression, regardless of national economic status.

#### KEYWORDS

anxiety, coronavirus disease 2019, cross-sectional studies, depression, economic status, mental health, patient health questionnaire, pregnant women

## 1 | INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection and the coronavirus disease-19 (COVID-19) have caused a major disruption to medical services, governments, and societies worldwide.<sup>1</sup> There is evidence on how pandemics including the current one have a significant affect on mental health, resulting in anxiety, depression, and high-stress levels.<sup>2</sup>

There is sufficient evidence demonstrating that SARS-CoV-2 infection is associated with an increased risk of adverse maternal and perinatal outcomes, and there are also reported cases of vertical transmission.<sup>3-5</sup> Hence pregnant women are particularly concerned

about their well-being and the safety of their unborn child, which has been reflected in studies reporting significantly higher rates of depressive symptoms after the declaration of the COVID-19 pandemic.<sup>6-10</sup> Infectious epidemics have been shown to cause anxiety in pregnant women because of unmet needs and expectations of women during prenatal, intrapartum, and postnatal care.<sup>4,5</sup> Although several countries have assessed maternal mental health during the pandemic, no study has been reported so far that assesses and compares maternal mental health between countries, continents, or geographical regions.

The objectives of this study were to assess risk factors for anxiety and depression among pregnant women during the

COVID-19 pandemic, compare differences in anxiety and depression scores between pregnant women in middle-income economies and high-income economies, and evaluate the relation between the pandemic status (number of infected patients, number of reported deaths), imposed/implemented restrictions, and maternal mental health.

## 2 | MATERIAL AND METHODS

### 2.1 | Study protocol

We report the results of a prospective cross-sectional study with the use of a web-based survey. The STROBE and Cherries guidelines were used to ensure appropriate reporting.<sup>11</sup> The study was performed in accordance with the Helsinki Declaration 2013. Approval for the study was obtained from the Centre of Postgraduate Medical Education Research Ethics Committee (Ref. No. 56/PB/2020) in Warsaw, Poland, and the Ethics Committee of each participating hospital in other regions, where applicable. Details of the study protocol have been previously published [3 The study was registered in [ClinicalTrials.gov](https://clinicaltrials.gov) (NCT04377412). The survey was conducted using the Research and Electronic Data Capture (REDCap) tool hosted at

the Foundation for the Saint Sofia Specialist Hospital in Warsaw, Poland<sup>12</sup> (Appendix S1; Full survey in English).

### 2.2 | Recruitment

Recruitment took place from 1 May 2020 to 28 February 2021 but did not start simultaneously in all regions (Table 1). Inclusion criteria were declaration of being pregnant, being able to complete the survey in the available languages (English, French, Spanish, Chinese, Polish, German, Russian, Italian, Ukrainian, Czech, Swedish, Albanian, Hebrew, Arabic, Malaysian, and Norwegian), completion of screening questions, and provision of informed consent for participation. Exclusion criteria were: not providing online informed consent for participation or not clicking the submit button at the end of the survey, and not answering all the General Anxiety Disorder-7 (GAD-7)<sup>13</sup> and Patient Health Questionnaire-9 (PHQ-9) scale<sup>14</sup> questions. Women were recruited in 21 regions and countries through a dedicated webpage ([www.pregmind.org](http://www.pregmind.org)) and social media (Facebook, Instagram). The webpage link with the description of the survey was posted in open and closed groups and fora dedicated to pregnancy. Medical staff provided pregnant women with flyers with information about the study, the

TABLE 1 Recruitment calendar

Country/Region	Start date	Time of recruitment in days	Number of respondents
High-income economies (N = 6134)			
Czech Republic	1 May 2020	303	1488
Spain	18 July 2020	225	566
United States	3 December 2020	87	11
France	20 May 2020	284	66
Germany	1 May 2020	303	12
Israel	1 May 2020	303	524
Hong Kong SAR, China	22 May 2020	282	397
Italy	2 May 2020	302	72
Norway	13 July 2020	230	146
Poland	1 May 2020	303	811
Sweden	5 June 2020	268	27
Taiwan	26 May 2020	278	2014
Middle-income economies (N = 1700)			
Albania	3 May 2020	301	96
Argentina	7 September 2020	205	198
Malaysia	23 October 2020	128	560
Mexico	14 July 2020	229	524
Peru	16 July 2020	227	131
Russian Federation	1 May 2020	303	7
Thailand	20 May 2020	284	22
Honduras	4 September 2020	208	82
Ukraine	1 May 2020	303	80

TABLE 2 Explanatory variables

Question	Distractors <sup>a</sup>	Variable name
Demographic		
Age, year		Age
Education	1 None 2 Elementary education 3 Secondary education 4 <b>Higher education</b>	Higher education
Where do you currently live?	1 A rural area (population of less than a 1000) 2 A small population center (population 1000–29 999) 3 A medium population center (population 30 000–99 999) 4 <b>A large population center (population 100 000–499 999)</b> 5 A very large population (population over 500 000)	Residence place large cities
Relationship status	1 <b>Married</b> 2 <b>In a relationship</b> 3 Single 4 Widowed	In relationship
How you feel about your household's income nowadays?	1 <b>Living comfortably on present income</b> 2 <b>Coping on present income</b> 3 Finding it difficult on present income 4 Finding it very difficult on present income	Sufficient income
Feeling supported		
Do you feel supported by your partner during this pregnancy?	<b>YES</b> NO	Partner support
Do you feel supported by other family members or friends during this pregnancy?	<b>YES</b> NO	Family support
Medical issue		
Is this your first pregnancy?	<b>YES—primiparous</b> NO—multiparous	Primiparous
Have you been told by your doctor or midwife that your pregnancy is a high-risk one?	<b>YES</b> NO	High risk pregnancy
Do you have any pregnancy-related conditions or problems during your current pregnancy?	<b>YES, if any answer 1–15</b> NO—answer 16 1 Pregnancy hypertension 2 HELLP syndrome 3 Pre-eclampsia 4 Obstetric cholestasis 5 Gestational diabetes mellitus 6 Fetal structural abnormalities 7 Fetus affected by genetic syndromes 8 Hyperemesis gravidarum 9 Threatened preterm birth 10 Threatened miscarriage 11 Acute fatty liver syndrome 12 Anemia during pregnancy treated with iron supplementation 13 Polyhydramnios 14 Oligohydramnios 15 Fetal growth restriction 16 I do not have any pregnancy-related health issues in this pregnancy	Pregnancy-related conditions
Before pregnancy have you ever sought any mental health support?	<b>YES</b> NO	Mental health problems before pregnancy
Before pregnancy have you had any psychiatric treatment?	<b>YES, if any answer 1–3</b> 1 Yes, pharmacologic 2 Yes, psychotherapy 3 Yes, psychotherapy and pharmacologic 4 NO	Psychiatric treatment before pregnancy

TABLE 2 (Continued)

Question	Distractors <sup>a</sup>	Variable name
During this pregnancy have you sought any mental health support?	YES NO	Mental health problems during pregnancy
During this pregnancy have you received/are you receiving any psychiatric treatment?	YES, if any answer 1-3 1 Yes, pharmacologic 2 Yes, psychotherapy 3 Yes, psychotherapy and pharmacologic 4 NO	Psychiatric treatment during pregnancy
COVID-19		
Have you been infected with the new coronavirus (known as COVID-19) before pregnancy?	YES NO	COVID-19 before pregnancy
Have you been infected with COVID-19 during this pregnancy?	YES NO	COVID-19 during pregnancy
Fear of a pandemic		
How would you rate your level of fear that you or the people close to you will become infected with COVID-19?	SCALE 1-100	COVID-19 fear people infected
How much are you concerned about your unborn child's safety due to the COVID-19 pandemic?	SCALE 1-100	COVID-19 child's safety
How much are you concerned about your family members getting sick and have the adverse effects of the COVID-19?	SCALE 1-100	COVID-19 fear family adverse outcomes
How much are you concerned about you getting sick and having the adverse effects of the COVID-19?	SCALE 1-100	COVID-19 fear you getting sick
How much do you fear that the COVID-19 pandemic will result in restrictions related to your childbirth (presence of accompanying person/s at hospital etc.)	SCALE 1-100	COVID-19 fear childbirth
How much do you fear that your baby will become ill during/after delivery and will have adverse outcomes due to the COVID-19?	SCALE 1-100	COVID-19 child adverse outcomes
How much do you fear that your partner will not be able to be present during the delivery?	SCALE 1-100	COVID-19 no partner during the delivery
Feeling of burden		
How much do you feel restricted due to social distancing recommended or implemented during the COVID-19 pandemic?	SCALE 1-100	COVID-19 distancing
How burdened do you feel by the current COVID-19 pandemic in regard to your or your family members' possibility to work and earn money (i.e. has it changed because of the pandemic)?	SCALE 1-100	COVID-19 burdened work
How burdened do you feel by the current COVID-19 pandemic in regard to your favorite leisure activities (i.e. has it changed because of the pandemic)?	SCALE 1-100	COVID-19 burdened leisure
How burdened do you feel by the current COVID-19 pandemic in regard to the provision of childcare—closed schools, kindergartens, nurseries, etc. (i.e. has it changed because of the pandemic)?	SCALE 1-100	COVID-19 burdened childcare

(Continues)

TABLE 2 (Continued)

Question	Distractors <sup>a</sup>	Variable name
How burdened do you feel by the current COVID-19 pandemic in regard to how it has affected your household's financial situation?	SCALE 1-100	COVID-19 burdened financial situation
How much do you feel burdened by restrictions imposed on labor and delivery as a result of the COVID-19 pandemic (presence of accompanying person/s at hospital etc.)?	SCALE 1-100	COVID-19 restrictions delivery
Which is your number one source of information about COVID-19 pandemic and the new coronavirus?	<b>1 Social media</b> 2 Internet published statistics 3 Medical research papers 4 Medical provider, general practitioner or midwife that I attend 5 Family or friends 6 Newspaper 7 TV	COVID-19 information from social media
COVID-19 situation		
Government Response Index (Oxford COVID-19 Government Response Tracker)	<b>Scale 1-100</b>	Government response index
Economic support index (Oxford COVID-19 Government Response Tracker)	<b>Scale 1-100</b>	Economic support index
Stringency index (Oxford COVID-19 Government Response Tracker)	<b>Scale 1-100</b>	Stringency index
Containment health index (Oxford COVID-19 Government Response Tracker)	<b>Scale 1-100</b>	Containment health index
Confirmed COVID-19 cases	<b>cases per 1000 inhabitants</b>	Confirmed cases
Confirmed COVID-19 deaths	<b>cases per 1000 inhabitants</b>	Confirmed deaths

<sup>a</sup>Reference values are shown in bold type.

website address, and a QR code to the survey during their visits to medical facilities.

### 2.3 | Data

The survey consisted of 60 questions: general demography, pregnancy health history, mental health history, socioeconomic factors, perception of fear, burden and restrictions related to the COVID-19 pandemic, GAD-7,<sup>13</sup> and PHQ-9<sup>14</sup> questionnaires. The list of all explanatory variables from the survey is presented in Table 2. According to the World Bank's Data, the collected survey results were grouped into middle-income economies and high-income economies<sup>15</sup> (Table 1). The analysis included six variables generated from the Oxford COVID-19 Government Response Tracker. These were used to correlate the results and declaration of burden and fear regarding different aspects of everyday life with the actual stringency measures and pandemic state (numbers of new cases and deaths). All the above variables were matched with the date and place of each survey completion.

### 2.4 | Statistical analysis

Descriptive statistics for middle-income economies and high-income economies were presented as mean ( $\pm$  standard deviation

[SD]) for continuous variables and number (percentage) for categorical variables. For the comparisons, we report *P* values based on F-test for continuous variables and based on  $\chi^2$  test for proportions. Both tests were adjusted for the clustering effects of the economies.

The main variables of interest, PHQ-9, and GAD-7 are composite variables, scales composed of aggregating responses from several items. Instead of using a simple sum of the scores, both scales were scaled using IRT-MG latent variable modeling with alignment optimization.<sup>16</sup> There are two main advantages of this method. First, it ensures the maximum possible comparability of the scales controlling for different behaviors of the item in different groups. Second, the procedure transforms a composite variable so that it results in a normally distributed indicator. In our analysis, both outcome variables were standardized to have mean of 0 and SD of 1 for the whole data set. Alignment optimization is one of the most effective scaling methods in cross-cultural studies and has been successfully applied to many studies, including analysis of anxiety and depressive symptoms, parenting knowledge, or well-being. The scaling of the outcome variables was performed using MPlus version 8 software with default settings.<sup>17</sup>

We used a two-stage approach based on a multivariate regression approach to investigate the relation between PHQ-9 and GAD-7 scales and a set of explanatory variables. In the first step, we used an adaptive lasso approach for multivariate regression. All

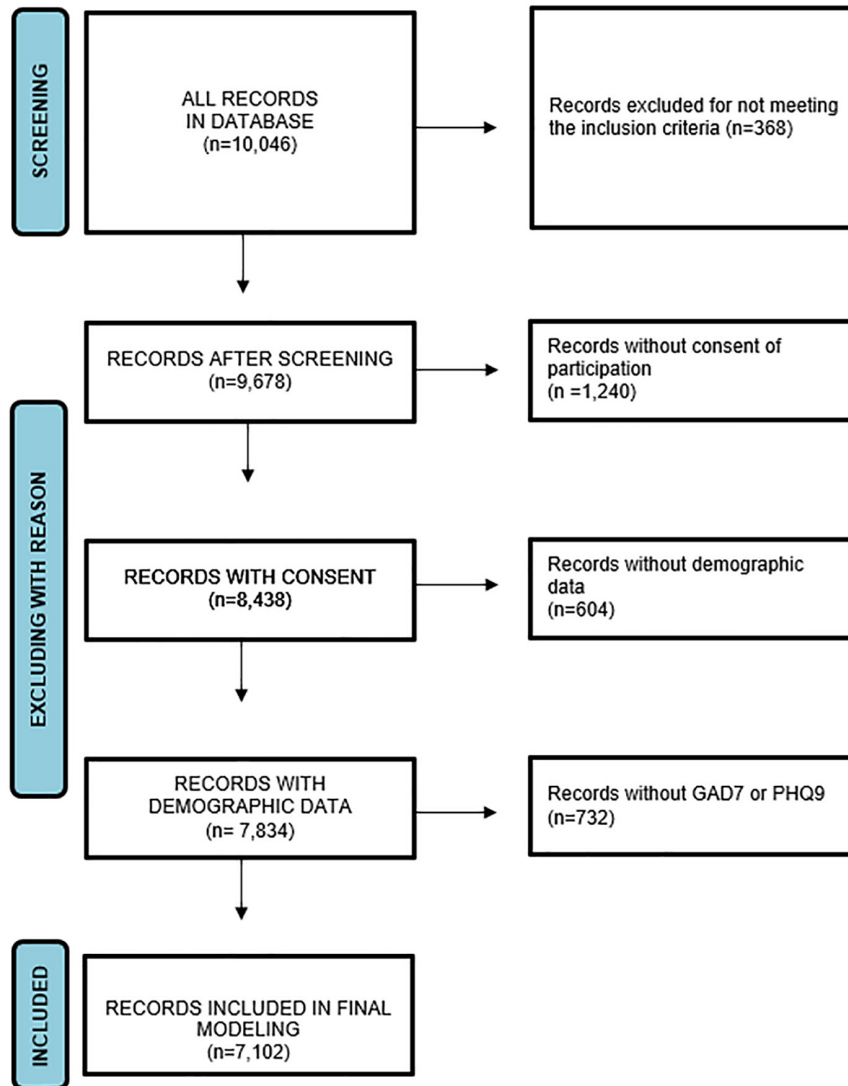


FIGURE 1 Recruitment and screened records.

potential predictors were included in the model and the procedure excluded the variables with zero (or close to zero) contribution for predicting outcomes. This stage allowed us to reduce the number of initial variables, excluding ones that were not relevant for PHQ-9 and GAD-7 scales. The procedure was performed separately for middle-income economies and high-income economies. In the second step, we kept all the significant parameters in the prediction models either in middle-income economies or high-income economies. This resulted in a different set of predictors, each for PHQ-9 and GAD-7, but after modeling each scale, the sets of predictors for middle-income economies and high-income economies became the same.

In the second stage, an ordinary linear square multivariate regression was performed separately for PHQ-9 and GAD-7 and separately for middle-income economies and high-income economies. Standardized coefficients were reported on a graph together with 95% confidence intervals (CI) for those coefficients. Additionally, we tested whether coefficients were statistically different among

middle-income economies and high-income economies at  $P = 0.95$  and  $P = 0.90$ , respectively, indicating differences by adding asterisks to the names of variables in the graphs.

The two-step procedure (sometimes described as post-lasso estimation) was shown to be more effective than one-step procedures both for variable selection and for estimation of unbiased parameters in the presence of a large set of predictors.<sup>18</sup> The two-step estimation was performed using STATA 17 statistical software (StatCorp, College Station, TX, USA) using default routines for lasso estimation and an ordinary linear square estimation with adjustment for clustering effects of the countries/economies.<sup>19</sup>

### 3 | RESULTS

A total of 10046 unique participants responded to the survey website. Among the initial participants, 368 did not meet inclusion criteria and 1240 women did not consent to participate in the study (participation

TABLE 3 Demographic data of women participating in the study<sup>a</sup>

	ALL		Middle Income		High Income		P value
Age, year	31.91	5.06	29.57	6.20	32.55	4.50	0.005
Body mass index <sup>b</sup>	23.69	4.67	25.23	5.26	23.29	4.42	0.001
Education							
None	28	0.36	18	1.06	10	0.16	<0.001
Elementary education	141	1.80	86	5.06	55	0.90	
Secondary education	1936	24.71	752	44.24	1184	19.30	
Higher education	5729	73.13	844	49.65	4885	79.64	
Where do you currently live?							
A rural area (population of less than a 1000)	616	7.86	246	14.47	370	6.03	<0.001
A small population centre (population between 1000 and 29 999)	1354	17.28	349	20.53	1005	16.38	
A medium population centre (population between 30 000 and 99 999)	1502	19.17	453	26.65	1049	17.10	
A large population centre (population between 100 000 and 499 999)	2031	25.93	339	19.94	1692	27.58	
A very large population (population over 500 000)	2331	29.75	313	18.41	2018	32.90	
Relationship status:							
Married	5897	75.27	1105	65.00	4792	78.12	<0.001
In a relationship	1655	21.13	453	26.65	1202	19.60	
Single	273	3.48	136	8.00	137	2.23	
Widowed	9	0.11	6	0.35	3	0.05	
How you feel about your household's income nowadays?							
Living comfortably on present income	3336	42.58	463	27.24	2873	46.84	<0.001
Coping on present income	3564	45.49	824	48.47	2740	44.67	
Finding it difficult on present income	739	9.43	336	19.76	403	6.57	
Finding it very difficult on present income	195	2.49	77	4.53	118	1.92	
The number of people living in household	3.26	1.62	4.09	2.11	3.03	1.37	0.011
Which of these descriptions applies to what you have been doing just before finding out you got pregnant?							
In paid work (or away temporarily) (employee, self-employed, working for your family business)	6131	78.99	1025	60.29	5106	84.23	<0.001
In education (not paid for by employer) even if on vacation	197	2.54	97	5.71	100	1.65	
Unemployed and actively looking for a job	200	2.58	103	6.06	97	1.60	
Unemployed, wanting a job but not actively looking for a job	123	1.58	51	3.00	72	1.19	
Permanently sick or disabled	18	0.23	10	0.59	8	0.13	
In community or military service	37	0.48	7	0.41	30	0.49	
Doing housework, looking after children or other persons	1056	13.60	407	23.94	649	10.71	



TABLE 3 (Continued)

	ALL		Middle Income		High Income		P value
Which of these descriptions applies to your current employment situation?							
In paid work (or away temporarily) (employee, self-employed, working for your family business)	5449	70.20	775	45.59	4674	77.10	<0.001
In education (not paid for by employer) even if on vacation	159	2.05	73	4.29	86	1.42	
Unemployed and actively looking for a job	150	1.93	86	5.06	64	1.06	
Unemployed, wanting a job but not actively looking for a job	312	4.02	118	6.94	194	3.20	
Permanently sick or disabled	102	1.31	22	1.29	80	1.32	
In community or military service	33	0.43	7	0.41	26	0.43	
Doing housework, looking after children or other persons	1557	20.06	619	36.41	938	15.47	
Do you feel supported by your partner during this pregnancy?	7497	95.70	1557	91.59	5940	96.84	0.066
Do you feel supported by other family members or friends during this pregnancy?	7532	96.15	1629	95.82	5903	96.23	0.837

<sup>a</sup>Data are presented as mean and standard deviation.

<sup>b</sup>Body mass index is calculated as weight in kilograms divided by the square of height in meters.

rate 84%). In all, 604 participants did not complete the demographic questionnaire. The final study population was 7834, including 6134 women from 12 high-income economies and 1700 women from nine middle-income economies, including 7102, who completed the GAD-7 or PHQ-9 questionnaires (completion rate 90%) (Figure 1).

There were statistically significant differences in education, residence, relationship status, declared income, and number of people living in the household between middle-income economies and high-income economies. Respectively, 1287 (75.71%) and 5613 (92.51%) declared to be living comfortably or coping on present income ( $P < 0.001$ ). Women in high-income economies were older (32.5 versus 29.5 years,  $P = 0.005$ ), had higher education (4885 [79.64%] versus 884 [49.65%],  $P < 0.001$ ), lived in very large and large agglomerations (3650 [60.48%] versus 652 [38.35%],  $P < 0.001$ ) in comparison to women in middle-income economies (Table 3). In all, 453 (26.65%) in middle-income economies versus 1202 (19.60%) in high-income economies declared being in a relationship but not being married ( $P < 0.001$ ). As for the mean number of people living in a household, this was three in high-income economies and four in middle-income economies ( $P = 0.011$ ). The rates of declared partner and family support exceeded 90% in both groups.

Regarding demography and obstetric history there were significant differences in maternal body mass index, number of previous cesarean sections, parity, proportion of high-risk pregnancies, and multiple pregnancies between middle-income economies and high-income economies (Table 4).

The proportions of women declaring mental health problems and in need of treatments before and during pregnancy were the same

in both groups (Table 5). There were also no statistical differences between SARS-CoV-2 infection rates between the two groups.

The analysis of the six variables generated from the Oxford COVID-19 Government Response Tracker showed statistical differences between middle-income economies and high-income economies in the containment and health index (Table 6).

Analysis of attitudes towards the pandemic and the related restrictions showed that women in both middle-income economies and high-income economies expressed similar sources of fear and burden regarding the pandemic. The mean declared values of fear regarding restrictions related to childbirth and feeling burdened by restriction imposed on labour and delivery because of the COVID-19 pandemic (presence of accompanying persons at hospital etc.) were 70.56 and 65.42, respectively for the total study population. There were no statistical differences between middle-income economies and high-income economies. The mean value of concern about family members getting sick and having adverse effects of COVID-19 was 70.67, but it was significantly higher in middle-income economies (76.82 versus 69.00,  $P < 0.001$ ). The mean value of declared fear that the baby will become ill during/after delivery and will have adverse outcomes due to COVID-19 was 70.19 but was significantly higher in middle-income economies (78.70 versus 67.88,  $P = 0.011$ ). In general, women in middle-income economies declared significantly higher mean values of fear and burden regarding the pandemic than women in high-income economies (7 out of 13 questions; Table 7).

Women in high-income economies presented higher PHQ-9 (0.18 SD,  $P < 0.001$ ) and GAD-7 (0.08 SD,  $P = 0.005$ ) scores than those living in middle-income economies. Results did not change significantly after

TABLE 4 Obstetric history of women participating in the study<sup>a</sup>

	All		Middle Income		High Income		P value
Primiparous	3973	52.04	757	45.74	3216	53.78	0.138
How many vaginal deliveries have you had?	1.97	0.91	2.12	1.23	1.92	0.78	0.469
How many cesarean sections have you had?	1.34	0.59	1.48	0.67	1.30	0.56	0.032
How many times have you been pregnant? (including this pregnancy)	2.50	1.25	2.85	1.33	2.39	1.20	0.014
Cesarean rate	0.42	0.17	0.43	0.18	0.41	0.16	0.553
How many pregnancies have you lost before 22 weeks?							
1	2273	62.12	593	66.18	1680	60.80	0.132
2	949	25.94	205	22.88	744	26.93	
3	306	8.36	68	7.59	238	8.61	
>3	131	3.58	30	3.35	101	3.66	
Do you have any pre-pregnancy chronic conditions?							
Pre-pregnancy hypertension	174	2.22	58	3.41	116	1.89	0.324
Pre-pregnancy diabetes mellitus type 1 + 2	121	1.54	70	4.12	51	0.83	<0.001
Hypothyroidism or Hashimoto disease	541	6.91	68	4.00	473	7.71	0.258
Hyperthyroidism or Graves-Basedow disease	105	1.34	9	0.53	96	1.57	0.001
Systemic lupus erythematosus, polyarthritis rheumatoid or other rheumatic diseases	118	1.51	63	3.71	55	0.90	0.074
Chronic anemia	99	1.26	19	1.12	80	1.30	0.743
Other	605	7.72	112	6.59	493	8.04	0.519
Do you have any pregnancy-related conditions or problems during your current pregnancy?							
Pregnancy hypertension	235	3.00	67	3.94	168	2.74	0.394
HELLP syndrome	143	1.83	33	1.94	110	1.79	0.884
Diabetes mellitus	489	6.24	183	10.76	306	4.99	0.199
Hyperemesis	181	2.31	32	1.88	149	2.43	0.597
Threatened preterm birth	235	3.00	79	4.65	156	2.54	0.102
Threatened miscarriage	254	3.24	89	5.24	165	2.69	0.076
Anemia	448	5.72	117	6.88	331	5.40	0.576
Polyhydramnios	40	0.51	11	0.65	29	0.47	0.600
Oligohydramnios	41	0.52	16	0.94	25	0.41	0.010
FGR	74	0.94	30	1.76	44	0.72	0.001
Other	648	8.27	226	13.29	422	6.88	0.096
I do not have any pregnancy-related health issues in this pregnancy	5766	73.60	1065	62.65	4701	76.64	0.021
Have you been told by your doctor or midwife that your pregnancy is a high-risk one?	1483	19.43	651	39.38	832	13.92	<0.001
Did you get infertility treatment before this pregnancy?	950	12.44	217	13.12	733	12.26	0.810
Is this pregnancy a result of fertility treatment?	658	8.62	109	6.59	549	9.18	0.151
How many babies are you carrying?							
1	7373	96.61	1552	93.89	5821	97.36	<0.001
2	233	3.05	85	5.14	148	2.48	
3	26	0.34	16	0.97	10	0.17	

<sup>a</sup>Data are presented as mean and standard deviation.

controlling for socioeconomic variables; both indicators were higher in high-income economies (PHQ-9: 0.21 SD,  $P < 0.001$  and GAD-7: 0.11 SD,  $P < 0.001$ ; Figure 2). There was a significant correlation between the GAD-7 and PHQ-9 scale (0.7613;  $P < 0.001$ ) (Figure 3).

In the total study population, multivariate regression analysis showed that increasing the PHQ-9 scale in pregnant women during the COVID-19 pandemic was contributed by mental health problems, psychiatric treatment during and before pregnancy, feeling of

TABLE 5 Mental health and views on the COVID-19 pandemic<sup>a</sup>

	All		Middle Income		High Income		P value
Before pregnancy have you ever sought any mental health support?	1437	19.00	312	19.22	1125	18.94	0.971
Before pregnancy have you had any psychiatric treatment?							
Yes, pharmacologic	181	2.39	27	1.66	154	2.59	0.274
Yes, psychotherapy	349	4.61	61	3.76	288	4.85	
Yes, psychotherapy and pharmacologic	261	3.45	38	2.34	223	3.75	
No	6773	89.54	1498	92.24	5275	88.80	
During this pregnancy have you sought any mental health support?	563	7.45	146	9.00	417	7.02	0.460
During this pregnancy have you received/are you receiving any psychiatric treatment?							
Yes, pharmacologic	72	0.95	20	1.23	52	0.88	0.729
Yes, psychotherapy	186	2.46	40	2.47	146	2.46	
Yes, psychotherapy and pharmacologic	34	0.45	8	0.49	26	0.44	
No	7266	96.14	1553	95.81	5713	96.23	
Have you been infected with the new coronavirus (known as COVID-19) before pregnancy?	160	2.18	80	5.09	80	1.39	0.117
Have you been infected with COVID-19 during this pregnancy?	287	3.92	91	5.79	196	3.41	0.501
Which of the following imposed restrictions resulting from the COVID-19 pandemic have burdened you the most?							
None	1878	25.65	396	25.19	1482	25.77	<0.001
I have to give up on my leisure activities	1481	20.22	203	12.91	1278	22.22	
I have to give up on social meetings	2237	30.55	304	19.34	1933	33.61	
I have to work from home	352	4.81	115	7.32	237	4.12	
I cannot work at all	505	6.90	246	15.65	259	4.50	
I cannot leave the house at all	870	11.88	308	19.59	562	9.77	
How do you view your country's policies related to the COVID-19 pandemic? Which statement best describes your view/feeling/fear?							
They are sufficient and I feel they are aimed at protecting me and my unborn child	3671	50.18	725	46.24	2946	51.25	0.008
The restrictions are not sufficient enough fear for myself and my unborn child	961	13.14	300	19.13	661	11.50	
I feel the restrictions such as labour without an accompanying person are harmful to me and my child	1153	15.76	129	8.23	1024	17.81	
I fear that I will have to have a cesarean section if I have suspected/confirmed COVID-19 infection	131	1.79	40	2.55	91	1.58	
I fear that if I have suspected/confirmed COVID-19 infection I will be separated from my child	1251	17.10	312	19.90	939	16.34	
I fear that if I have suspected/confirmed COVID-19 infection I will not be allowed to breastfeed	149	2.04	62	3.95	87	1.51	
Which is your number one source of information about COVID-19 pandemic and the new coronavirus?							
Social media	2079	28.42	607	38.71	1472	25.61	<0.001
Internet published statistics	1075	14.70	132	8.42	943	16.41	
Medical research papers	502	6.86	123	7.84	379	6.59	
Medical provider, general practitioner or midwife that I attend	436	5.96	109	6.95	327	5.69	
Family or friends	137	1.87	50	3.19	87	1.51	
Newspaper	509	6.96	33	2.10	476	8.28	
Television	2577	35.23	514	32.78	2063	35.90	

<sup>a</sup>Data are presented as mean and standard deviation.

TABLE 6 Oxford COVID-19 Government Response Tracker (OxCGRT) data from regions participating in the study<sup>a</sup>

Government response index	All		Middle income		High income		P value
	Mean	SD	Mean	SD	Mean	SD	
Government response index	57.94	14.89	69.47	6.47	54.74	14.99	0.054
Economic support index	61.16	22.27	71.45	14.69	58.31	23.16	0.175
Stringency index	57.61	22.60	74.89	9.21	52.82	22.87	0.057
Health and containment index	57.49	14.92	69.19	6.67	54.25	14.95	0.049
Confirmed cases per 1000	9.22	15.52	7.39	6.84	9.74	17.16	0.715
Confirmed deaths per 1000	0.23	0.36	0.39	0.43	0.18	0.32	0.385

<sup>a</sup>Data are presented as mean and standard deviation.

burden related to restrictions in social distancing, and access to leisure activities (Figure 4).

In high-income economies, increasing PHQ-9 scale in pregnant women during the COVID-19 pandemic was contributed by having mental health problems before pregnancy, feeling of burden related to financial restrictions, and fear for child's safety and adverse outcomes. Feeling of burden related to financial restrictions had a significantly higher effect on the PHQ-9 scale in high-income economies than in middle-income economies ( $P < 0.05$ ) (Figure 4).

In middle-income economies, PHQ-9 scores were affected by living in a large city, fear of childbirth-related restrictions and burden related to childcare. Fear of childbirth had a significantly higher effect on the PHQ-9 scale in middle-income economies than in high-income economies ( $P < 0.1$ ) (Figure 4).

Low PHQ-9 scores in pregnant women during the COVID-19 pandemic were significantly associated with having a good financial situation, and support from a partner and family (Tables 8 and 9). Higher maternal age resulted in lower PHQ-9 scores in middle-income economies, whereas a good financial situation had a significantly lower effect on the PHQ-9 scale in middle-income economies than in high-income economies ( $P < 0.1$ ) (Figure 4).

In the total study population, multivariate regression analysis demonstrated that GAD-7 scores were increased among women with a pregnancy-related complication, mental health problems during pregnancy, the need for psychiatric treatment before pregnancy, fear of adverse outcomes in children related to COVID-19, and feeling of burden related to finances. Fear of adverse outcomes in children had a significantly different effect on the GAD-7 scale in high-income economies and middle-income economies ( $P < 0.1$ ). Additionally, in high-income economies, GAD-7 scores were higher among women with higher education, mental health problems before pregnancy, fear for child safety, and burden related to social distancing and leisure. Child safety had a significantly different effect on the GAD-7 scale in high-income economies and middle-income economies ( $P < 0.05$ ). GAD-7 scores among women in middle-income economies were higher because of fear of childbirth restrictions (Figure 5).

In both middle-income economies and high-income economies, factors associated with reducing GAD-7 scores were comfortable financial status and support from a partner and family members. Higher maternal age was related to decreased GAD-7 scores in middle-income economies (Tables 10 and 11).

No correlation was found between the six analyzed Oxford COVID-19 Government Response Tracker variables and the GAD-7 and PHQ-9 scores. Confirmed COVID-19 cases and related deaths per 1000 inhabitants had no effect on the PHQ-9 and GAD-7 scales.

## 4 | DISCUSSION

WHO has expressed concerns regarding very restrictive government responses. Studies confirm that these government responses have significantly impacted mental health outcomes.<sup>20</sup> Although the containment and health index, defined as a composite measure of school closures, workplace closures, travel bans, testing policy, contact tracing, face coverings, and vaccine policy, was statistically higher in middle-income economies than high-income economies, a multivariate analysis did not confirm its impact on maternal mental health. This is in accordance with the previously published ineffectiveness of Oxford COVID-19 Government Response Tracker variables in explaining differences between studied economical regions.<sup>21</sup>

Our study confirms the previous finding of a stronger relation between mental health and the feelings related to burdens experienced, rather than the actual level of imposed restrictions. Satisfaction with government reactions and fear appraisal play an important role in the perception of the efficacy of restrictions. A perinatal cohort study revealed that general information on COVID-19 safe behaviors did not meet their particular needs and exacerbated the risk of psychological and psychosocial distress.<sup>22</sup>

The preventive protocols implemented in hospitals and birth centres have left women vulnerable.<sup>23,24</sup> In our study, women from middle-income economies had significantly higher levels of anxiety and depression due to concerns related to childbirth policies. Perhaps this was related to the higher containment and health index in middle-income economies. Previous studies regarding childbirth expectations were mainly conducted in high-income economic regions. An Italian survey showed that only 5.3% of women declared that they were afraid of giving birth during the COVID-19 pandemic. It was reported that the delivery experience was as expected in 50.8% of cases and better than expected in 36.2%.<sup>25</sup> WHO emphasizes that all pregnant women have the right to a safe and positive childbirth experience during the pandemic, irrespective of whether

TABLE 7 Self-assessed levels of fear and burden regarding restrictions in high-income and middle-income regions<sup>a</sup>

	All		Middle income		High income		P value
<b>How would you rate your level of fear that you or the people close to you will become infected with COVID-19?</b>	<b>59.58</b>	<b>25.63</b>	<b>65.12</b>	<b>25.28</b>	<b>58.08</b>	<b>25.53</b>	<b>0.002</b>
How much are you concerned about your unborn child's safety due to the COVID-19 pandemic?	67.36	25.81	75.80	22.24	65.07	26.24	<0.001
How much are you concerned about your family members getting sick and having the adverse effects of the COVID-19?	70.67	23.66	76.82	21.30	69.00	23.99	<0.001
How much are you concerned about you getting sick and having the adverse effects of the COVID-19?	66.91	25.82	74.65	23.29	64.81	26.07	0.002
How much do you fear that the COVID-19 pandemic will result in restrictions related to your childbirth (presence of accompanying person/s at hospital etc.)	70.56	26.27	71.84	25.54	70.22	26.45	0.730
How much do you fear that your baby will become ill during/after delivery and will have adverse outcomes due to the COVID-19?	70.19	26.90	78.70	22.73	67.88	27.48	0.011
How much do you fear that your partner will not be able to be present during the delivery?	69.76	28.86	66.72	30.98	70.59	28.21	0.408
How much do you feel restricted due to social distancing recommended or implemented during the COVID-19 pandemic?	59.86	26.25	63.85	25.88	58.77	26.25	0.400
How burdened do you feel by the current COVID-19 pandemic in regard to your or your family members' possibility to work and earn money (i.e. has it changed because of the pandemic)?	47.82	31.65	64.28	26.52	43.36	31.45	0.001
How burdened do you feel by the current COVID-19 pandemic in regard to your favorite leisure activities (i.e. has it changed because of the pandemic)?	58.51	26.45	59.23	27.23	58.31	26.24	0.864
How burdened do you feel by the current COVID-19 pandemic in regard to the provision of childcare - closed schools, kindergartens, nurseries, etc. (i.e. has it changed because of the pandemic)?	46.94	34.37	56.06	32.18	44.47	34.53	0.116
How burdened do you feel by the current COVID-19 pandemic in regard to how it has affected your household's financial situation?	44.67	30.98	64.08	27.21	39.41	29.82	<0.001
How much do you feel burdened by restrictions imposed on labor and delivery as a result of the COVID-19 pandemic (presence of accompanying person/s at hospital etc.)?	65.42	27.70	70.10	26.21	64.16	27.95	0.257

<sup>a</sup>Data are presented as mean and standard deviation.

they have confirmed SARS-CoV-2 infection. This includes all prenatal, intrapartum, and postpartum maternal and neonatal care services, including psychological health services.<sup>6</sup>

Partner and family support were the strongest protective factor for both anxiety and depression regardless of regional economic status. This confirms that social relationships provide a general sense of

self-worth, psychological well-being, as well as access to resources during stressful times.<sup>26</sup>

Previous studies have described a wide range of general risk factors of antenatal depression and anxiety including psychological status, history of maternal mental illness, a chronic mental illness, and a chronic somatic illness.<sup>27-29</sup> Our findings are consistent with studies

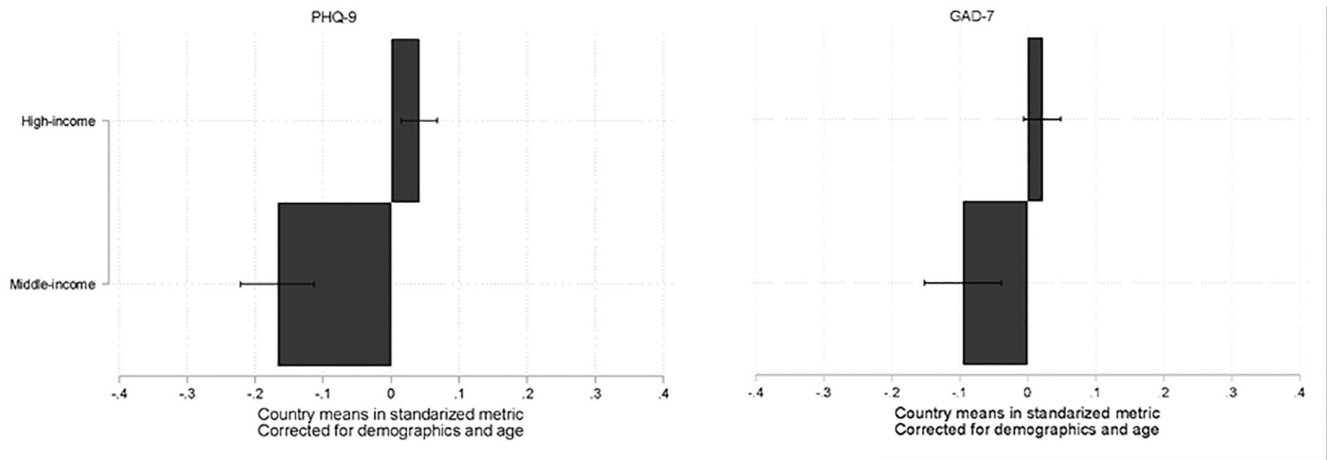


FIGURE 2 PHQ-9 and GAD-7 results corrected for demographics and age in high-income and middle-income regions.

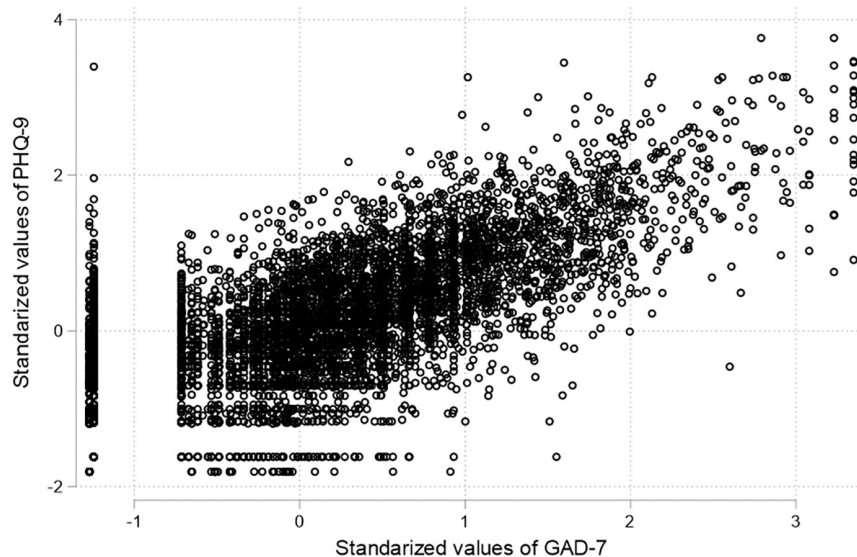


FIGURE 3 Correlations between scales PHQ-9 and GAD-7 (0.7613).

associating higher anxiety levels with a history of psychological disorders. Additionally, during the pandemic risk factors include fear of vertical transmission of SARS-CoV-2.

In middle-income economies specifically, women felt more burdened about the effect of the pandemic on their household's financial situation. One in four women declared not living comfortably or coping on their present income. For them the greatest potential burden of the imposed restrictions was not being able to leave the house for work.<sup>30</sup> Financial challenges, fear of loss of employment, and reduced salary are important risk factors affecting family stability and sense of security.<sup>29</sup>

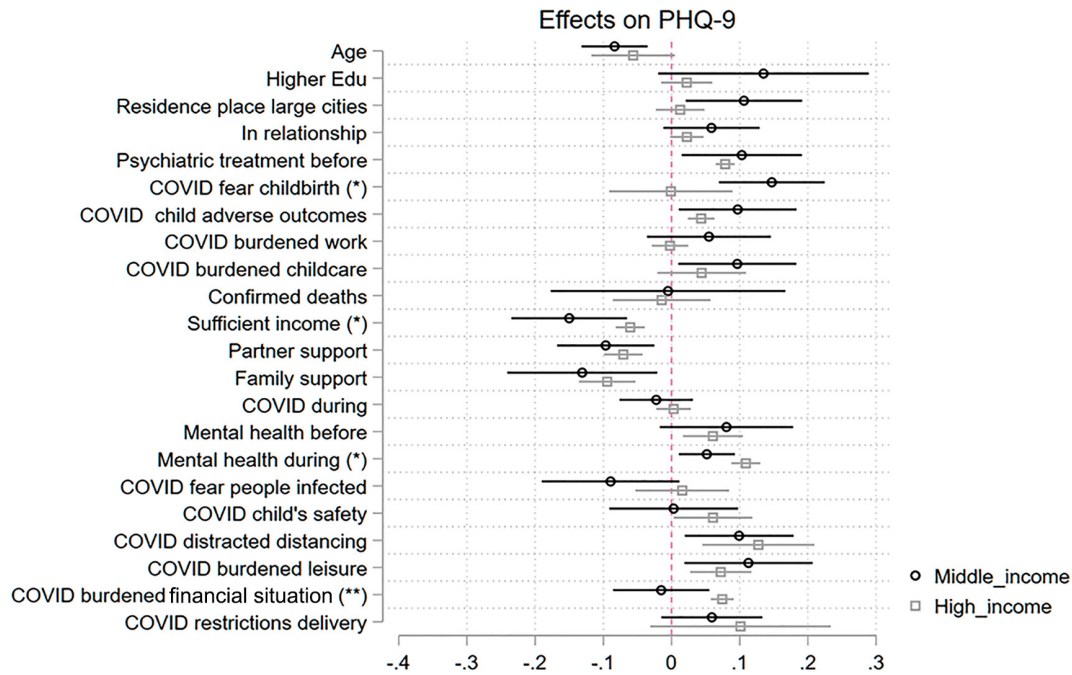
Mental health was not affected by the severity of the pandemic but by the feeling of being burdened related to public health measures imposed by the government. The primary issue is how the government responds and communicates to the general public the imposed public health measures to tackle the pandemic effectively and in a timely fashion. Hospital

level restrictions have left pregnant women more vulnerable during these difficult times. Settings with very strict hospital measures including no visitation and no accompanying person for the delivery should provide additional support from healthcare workers to compensate the lack of support from the partner and family, especially during childbirth. The latter is the most important protective factor against anxiety and depression regardless of regional economic status.

The Oxford COVID-19 Government Response Tracker variables were ineffective in discerning the differences between the studied regions. In future research, a different model for comparing public and healthcare measures should be used. The GAD-7 and PHQ-9 scales were found useful in assessing depression and anxiety syndromes. They are both short scales that can be used as online tools for self-assessment.

The main strength of our study is that it presents data from 21 regions collected in 16 different languages, so allowing comparison





**FIGURE 4** Comparison of multivariate regression of variables affecting the results of the PHQ-9 scale. Footnote: \*\* difference statistically significant at  $P = 0.05$  and \*difference statistically significant at  $P = 0.1$ .

**TABLE 8** Multivariate regression of variables affecting the results of the PHQ-9 scale in middle-income regions<sup>a</sup>

	Coefficient	SE	t	$P >  t $	95% CI
Age	-0.08	0.02	-3.98	0.004	-0.13 -0.04
Higher education	0.14	0.07	2.01	0.079	-0.02 0.29
Residence place large cities	0.11	0.04	2.87	0.021	0.02 0.19
In relationship	0.06	0.03	1.92	0.092	-0.01 0.13
Psychiatric treatment before pregnancy	0.10	0.04	2.7	0.027	0.02 0.19
COVID-19 fear childbirth	0.15	0.03	4.37	0.002	0.07 0.23
COVID-19 child adverse outcomes	0.10	0.04	2.59	0.032	0.01 0.18
COVID-19 burdened work	0.06	0.04	1.39	0.201	-0.04 0.15
COVID-19 burdened childcare	0.10	0.04	2.57	0.033	0.01 0.18
Confirmed deaths	-0.01	0.08	-0.07	0.947	-0.18 0.17
Sufficient income	-0.15	0.04	-4.09	0.004	-0.24 -0.07
Partner support	-0.10	0.03	-3.12	0.014	-0.17 -0.03
Family support	-0.13	0.05	-2.75	0.025	-0.24 -0.02
COVID-19 during pregnancy	-0.02	0.02	-0.96	0.364	-0.08 0.03
Mental health problems before pregnancy	0.08	0.04	1.9	0.094	-0.02 0.18
Mental health problems during pregnancy	0.05	0.02	2.9	0.020	0.01 0.09
COVID-19 fear people infected	-0.09	0.04	-2.04	0.076	-0.19 0.01
COVID-19 child's safety	0.00	0.04	0.08	0.941	-0.09 0.10
COVID-19 distancing	0.10	0.04	2.87	0.021	0.02 0.18
COVID-19 burdened leisure	0.11	0.04	2.77	0.024	0.02 0.21
COVID-19 burdened financial situation	-0.02	0.03	-0.49	0.634	-0.09 0.06
COVID-19 restrictions delivery	0.06	0.03	1.84	0.103	-0.02 0.13
Constant	-0.20	0.10	-2.09	0.071	-0.43 0.02

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; SE, standard error.

TABLE 9 Multivariate regression of variables affecting the results of the PHQ-9 scale in high-income regions

	Coefficient	SE	t	P >  t	95% CI	
Age	-0.06	0.03	-2.07	0.068	-0.12	0.01
Higher education	0.02	0.02	1.34	0.212	-0.02	0.06
Residence place large cities	0.01	0.02	0.8	0.442	-0.02	0.05
In relationship	0.02	0.01	2.07	0.068	-0.00	0.05
Psychiatric treatment before pregnancy	0.08	0.01	12.78	<0.001	0.07	0.09
COVID-19 fear childbirth	-0.00	0.04	-0.03	0.981	-0.09	0.09
COVID-19 child adverse outcomes	0.04	0.01	5.03	0.001	0.02	0.06
COVID-19 burdened work	-0.00	0.01	-0.19	0.856	-0.03	0.03
COVID-19 burdened childcare	0.04	0.03	1.53	0.160	-0.02	0.11
Confirmed deaths	-0.01	0.03	-0.46	0.660	-0.09	0.06
Sufficient income	-0.06	0.01	-6.4	<0.001	-0.08	-0.04
Partner support	-0.07	0.01	-5.63	<0.001	-0.10	-0.04
Family support	-0.09	0.02	-5.13	0.001	-0.14	-0.05
COVID-19 during pregnancy	0.00	0.01	0.27	0.793	-0.02	0.03
Mental health problems before pregnancy	0.06	0.02	3.11	0.012	0.02	0.11
Mental health problems during pregnancy	0.11	0.01	11.57	<0.001	0.09	0.13
COVID-19 fear people infected	0.02	0.03	0.52	0.617	-0.05	0.08
COVID-19 child's safety	0.06	0.03	2.38	0.041	0.00	0.12
COVID-19 distancing	0.13	0.04	3.51	0.007	0.05	0.21
COVID-19 burdened leisure	0.07	0.02	3.64	0.005	0.03	0.12
COVID-19 burdened financial situation	0.07	0.01	9.94	<0.001	0.06	0.09
COVID-19 restrictions delivery	0.10	0.06	1.73	0.118	-0.03	0.23
Constant	0.09	0.06	1.54	0.158	-0.04	0.21

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; SE, standard error.

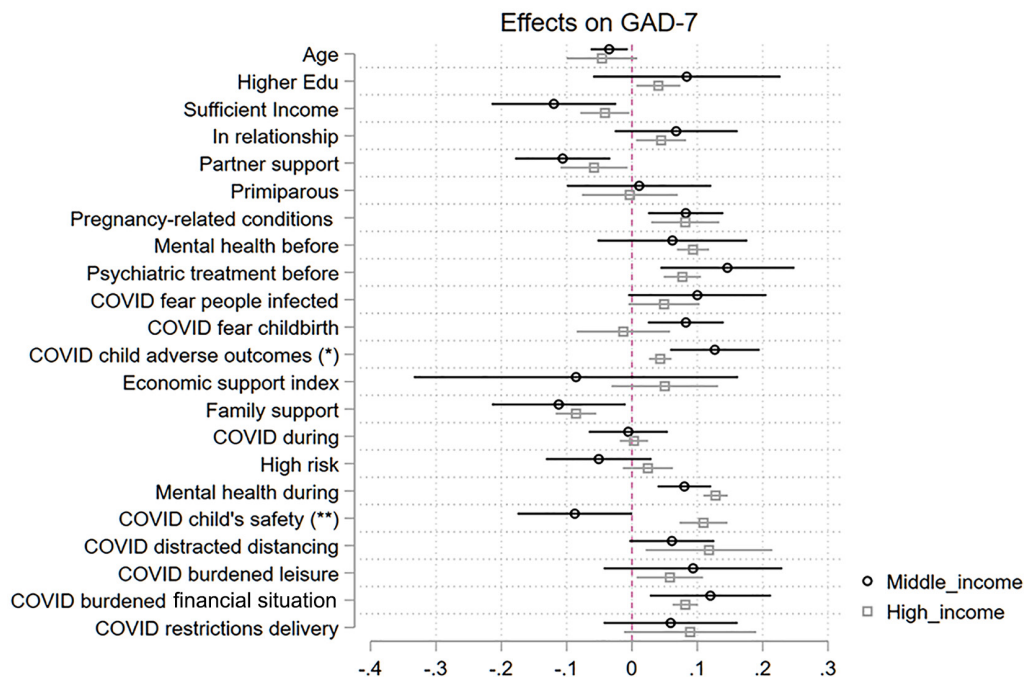


FIGURE 5 Comparison of multivariate regression of variables affecting the results of the GAD-7 scale. Footnote: \*\* difference statistically significant at  $P = 0.05$  and \* difference statistically significant at  $P = 0.1$ .



TABLE 10 Multivariate regression of variables affecting the results of the GAD-7 scale in high-income regions

	Coefficient	SE	t	P >  t	95% CI	
Age	-0.05	0.03	-1.87	0.088	-0.10	0.01
Higher education	0.04	0.02	2.64	0.023	0.01	0.07
Sufficient income	-0.04	0.02	-2.41	0.035	-0.08	-0.00
In relationship	0.05	0.02	2.56	0.026	0.01	0.08
Partner support	-0.06	0.02	-2.49	0.030	-0.11	-0.01
Primiparous	-0.00	0.03	-0.1	0.924	-0.08	0.07
Pregnancy-related conditions	0.08	0.02	3.44	0.006	0.03	0.13
Mental health problems before pregnancy	0.09	0.01	8.32	<0.001	0.07	0.12
Psychiatric treatment before pregnancy	0.08	0.01	5.93	<0.001	0.05	0.11
COVID-19 fear family adverse outcomes	0.05	0.03	1.98	0.073	-0.01	0.10
COVID-19 fear childbirth	-0.01	0.03	-0.41	0.691	-0.09	0.06
COVID-19 child adverse outcomes	0.04	0.01	5.51	<0.001	0.03	0.06
Economic support index	0.05	0.04	1.35	0.204	-0.03	0.13
Family support	-0.09	0.01	-6.06	<0.001	-0.12	-0.06
COVID-19 during pregnancy	0.00	0.01	0.31	0.763	-0.02	0.03
High-risk pregnancy	0.02	0.02	1.4	0.190	-0.01	0.06
Mental health problems during pregnancy	0.13	0.01	15.12	<0.001	0.11	0.15
COVID-19 child's safety	0.11	0.02	6.54	<0.001	0.07	0.15
COVID-19 distancing	0.12	0.04	2.68	0.022	0.02	0.22
COVID-19 burdened leisure	0.06	0.02	2.51	0.029	0.01	0.11
COVID-19 burdened financial situation	0.08	0.01	9.19	<0.001	0.06	0.10
COVID-19 restrictions delivery	0.09	0.05	1.94	0.079	-0.01	0.19
Constant	0.09	0.04	2.28	0.044	0.00	0.18

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; SE, standard error.

between middle-income economies and high-income economies. To our knowledge this is the first study to be as inclusive as possible, having a global picture of the mental health issues related to the COVID-19 pandemic. The strength of the study was that we targeted an unselected population of pregnant women and collected comprehensive demographic and medical history data. Another strength of the study is that it uses modern statistical tools that provide robust variable selection and unbiased estimation of parameters without threat of overfitting.

Although, the most used tools for the assessment of anxiety and depression are the State-Trait Anxiety Inventory and Edinburgh Postnatal Depression Scale, for this study we have chosen the GAD-7 and PHQ-9 because they are user-friendly self-assessment tools that can be completed online without the guidance of medical personnel.

A major limitation is that the online approach for data collection has limited participation of women in low-income regions and with a low socioeconomic status. A convenience sampling method was used because it is a proven, efficient, cost-effective method of

recruitment for a web-based survey.<sup>3</sup> Study promotion via the internet and social media, and fliers and QR codes distributed in healthcare facilities, yielded different rates of recruitment across the studied regions. In consequence, the number of recruited women was higher in high-income economies than middle-income economies. Although the number of cases in middle-income economies was sufficient for statistical comparisons with high-income economies, the results must be interpreted with caution. Differences in recruitment numbers between regions resulted in an under-represented sample of pregnant women from middle-income regions, which compromises the similarity of the results. A more homogeneous patient sample could result in finding risk factors with statistical difference between middle-income and high-income countries. This is a methodologic bias that cannot be compensated fully by the robust statistical methods applied in the study. Further, web-based survey is prone to several other types of biases.<sup>3</sup> Response-bias carries a risk that pregnant women are particularly worried about the COVID-19 pandemic and are more likely to respond to the advertisement of a survey assessing mental health

TABLE 11 Multivariate regression of variables affecting the results of the GAD-7 scale in middle-income regions

	Coefficient	SE	t	P >  t	95% CI	
Age	-0.04	0.01	-2.85	0.022	-0.06	-0.01
Higher education	0.08	0.06	1.35	0.215	-0.06	0.23
Sufficient income	-0.12	0.04	-2.89	0.020	-0.22	-0.02
In relationship	0.07	0.04	1.66	0.136	-0.03	0.16
Partner support	-0.11	0.03	-3.36	0.010	-0.18	-0.03
Primiparous	0.01	0.05	0.23	0.824	-0.10	0.12
Pregnancy-related conditions	0.08	0.03	3.3	0.011	0.03	0.14
Mental health problems before pregnancy	0.06	0.05	1.24	0.249	-0.05	0.18
Psychiatric treatment before pregnancy	0.15	0.04	3.29	0.011	0.04	0.25
COVID-19 fear family adverse outcomes	0.10	0.05	2.18	0.061	-0.01	0.21
COVID-19 fear childbirth	0.08	0.03	3.29	0.011	0.03	0.14
COVID-19 child adverse outcomes	0.13	0.03	4.28	0.003	0.06	0.20
Economic support index	-0.09	0.11	-0.8	0.449	-0.33	0.16
Family support	-0.11	0.04	-2.53	0.035	-0.21	-0.01
COVID-19 during pregnancy	-0.01	0.03	-0.22	0.834	-0.07	0.06
High-risk pregnancy	-0.05	0.04	-1.45	0.185	-0.13	0.03
Mental health problems during pregnancy	0.08	0.02	4.52	0.002	0.04	0.12
COVID-19 child's safety	-0.09	0.04	-2.3	0.050	-0.18	0.00
COVID-19 distancing	0.06	0.03	2.17	0.062	-0.00	0.13
COVID-19 burdened leisure	0.09	0.06	1.58	0.153	-0.04	0.23
COVID-19 burdened financial situation	0.12	0.04	2.99	0.017	0.03	0.21
COVID-19 restrictions delivery	0.06	0.04	1.33	0.219	-0.04	0.16
Constant	-0.16	0.10	-1.6	0.148	-0.38	0.07

Abbreviations: CI, confidence interval; COVID-19, coronavirus disease 2019; SE, standard error.

related to the COVID-19 pandemic. This was accounted for by collecting background information regarding mental health problems and previous treatments. There were no differences in the rate of mental health problems declared in the studied groups. There were also initial concerns that the survey would reach more women of a higher socioeconomic status and from larger agglomerations, which was true for high-income economies. For this reason, we corrected for these demographic variables when analyzing the results of the PHQ-9 and GAD-7 scales. Lastly, we have decided to report these results first, though some recruiting regions have not reached the recruitment target, as we feel strongly about informing our community of the negative impact of the ongoing pandemic on maternal perinatal mental health.

In conclusion, according to this study, the imposed public health measures and hospital restrictions have left pregnant women more vulnerable during these difficult times. Adequate partner and family support during pregnancy and childbirth can be one of the most important protective factors against anxiety and depression, regardless of national economic status (high-income or middle-income economies). However, more studies with robust methodology involving

pregnant women in middle-income economies are needed. A more homogeneous sample among countries with different socioeconomic levels can help to identify the risk factors that are related to anxiety and depression in pregnant women in different global economies.

#### AUTHOR CONTRIBUTIONS

AK and LCP are the principal investigators of this study; they conceived the study with input from DS, SF, AP, SK, MR, and RJM-P. The survey questionnaire was translated by AK, PC, SF, FP, LJS, OMYR, HYV, SLY, and LCP. AK and DS coordinated data acquisition and data management. AK, DS, GA, MB-Z, DB, TB-S, PC, T-YC, BC, AE, SF, RGM, MMG, SH, SK, AM-A, RJM-P, FP, MR, OMYR, LJS, MGS, SS, HT, SV, HYV, SLY, and LCP organized and performed the data collection. Data were cleaned and prepared by DS. AK and AP verified the underlying data. Statistical analyses and data visualization were performed by AP. AK, DS, AP, and LCP analyzed the results and wrote the manuscript. All authors were responsible for reviewing and editing the manuscript. All authors had full access to all the data in the study and approved the final version of this manuscript.

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## CONFLICT OF INTERESTS

All authors declare no competing interests.

## DATA AVAILABILITY STATEMENT

Research data are not shared.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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## APPENDIX A

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