



## Research paper

# Trends in prevalence of depression and anxiety symptoms and effects of sociodemographic variables before and after the first wave of COVID-19 in Qatar

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## ABSTRACT

**Background:** Prevalence trends from Arabic speaking countries on psychiatric symptoms before and after the first wave of the COVID-19 pandemic are lacking. We estimated the point prevalence and change in depression and anxiety symptoms scores in relation to sociodemographic variables following the resolution of the first wave in Qatar compared with before the pandemic.

**Methods:** We conducted a trend analysis using repeated nationally representative cross-sectional surveys spanning 2017, 2018, 2020/2021 and using the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) to assess depressive and anxiety symptoms. Negative binomial regression was used to model changes in these symptoms in relation sociodemographics and survey year.

**Results:** The two-week prevalence of depressive symptoms ( $\geq 10$  on the PHQ-9) was 6.6% in 2017 and 6.5% in 2020/2021 ( $p = 0.986$ ). The two-week prevalence of anxiety symptoms ( $\geq 10$  on the GAD-7) was 3.6% in 2018 and 5.1% in 2020/2021 ( $p = 0.062$ ). The data for 2020/21 showed a 35.1% and 29.2% decrease in depression and anxiety symptoms scores compared to pre-pandemic years (2017/2018) after adjusting for sociodemographic factors.

**Limitations:** Screening tools rather than structured interviews were used to assess depressive and anxiety symptoms

**Conclusions:** The prevalence of depression and anxiety after the first COVID wave did not differ significantly to pre-pandemic estimates. The end of the first wave of the pandemic weakened the associations of these symptoms with traditional sociodemographic risk factors. The 2020/21 depression and anxiety symptoms scores remained high for Qataris and Arabs, suggesting that these cultural groups may benefit most from public mental health interventions.

## 1. Introduction

The first case of novel coronavirus disease (COVID-19) was reported in Wuhan, China, in December 2019 (Holshue et al., 2020). Previous coronavirus epidemics have included Severe Acute Respiratory

Syndrome in 2003 and Middle East Respiratory Syndrome in 2012 (Roy et al., 2020). The World Health Organization (WHO) declared COVID-19 a pandemic in March 2020. Since then the pandemic has comprised waves of infection partly reflecting new variants with the time course and impact varying geographically. At the time of writing it has been

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responsible for over 433 million infections and nearly 6 million deaths worldwide (Worldometer, 2022). Global efforts to control the pandemic have included self-isolation, quarantine, travel restrictions, and strict lockdown measures. As such, the pandemic has disrupted the daily lives of millions of people (Arafa et al., 2021; Choi et al., 2020; Ettman et al., 2020).

The pandemic's impact in terms of rates of infection, mortality, and social disruption has varied between countries and over time. Consequently, a comprehensive picture of the pandemic's impact on mental health requires studies in different countries and at different time points as the pandemic unfolds.

### 1.1. Depression and anxiety symptoms during the first wave of COVID-19 pandemic

Many existing studies of mental health during the pandemic are cross-sectional, employ convenience samples and report the prevalence of self-reported psychiatric symptoms (i.e. psychological distress). A systematic review of 65 longitudinal studies, mostly from Europe and North America, with data collected before and during the first wave of the pandemic, showed increasing levels of psychiatric symptoms peaking in the early months of the pandemic (March/April 2020) before reducing to pre-pandemic levels by mid-2020 (May/July) (Robinson et al., 2021). Increases in depressive and other mood symptoms tended to be larger and showed smaller reductions over time compared to measures of anxiety and general mental health (Robinson et al., 2021).

To date, there is paucity of representative national data on the impact of the pandemic on symptoms of depression and anxiety from the Arabic speaking world. This reflects a lack of pre-pandemic (baseline) mental health data plus most pandemic studies being convenience samples that cannot provide prevalence estimates due to selection bias. Furthermore, most pandemic studies were conducted early in the pandemic with a paucity of research from the end of the first wave of COVID-19 onwards. These include studies conducted in April and/or May 2020 in Saudi Arabia (Alkhamees et al., 2020), Kuwait (Burhamah et al., 2020), the United Arab Emirates (Pilia et al., 2021), and a multisite study spanning eight Arab countries (Shuwiekh et al., 2020).

Qatar reported its first case of COVID-19 in late February 2020 (Ministry of Public Health, 2020). A first wave of infection was seen from April to August 2020 (Worldometer, 2020). Subsequently, new infections remained at a low level until a smaller second wave of infection occurred from February to June 2021 with a third Omicron wave extending from December 2021 to February 2022. Qatar has employed lockdowns, strict quarantine regulations and travel restrictions (varying over time depending on pandemic risk) to reduce the spread of the virus (Wadoo et al., 2020). Given that 85% of Qatar's population are expatriate workers (Worldpopulation Review, 2020) travel restrictions have affected most of the population.

### 1.2. The current study

Given the paucity of representative mental health studies from the Arab world, and the focus of international data on the early months of the pandemic, we conducted a cross-sectional study to estimate the prevalence of depression and anxiety symptoms in a representative sample of adults living in Qatar between December 2020 and January 2021. This corresponded to several months after the first COVID-19 wave had resolved in Qatar and represented a time when lockdown measures had loosened, but before the second wave had started.

Using this data, we aimed to compare prevalence of depression and anxiety symptoms at the end of the first wave of the pandemic to pre-pandemic population-based data, previously reported by the first author, on the prevalence of depressive symptoms in 2017 (Khaled, 2019) and anxiety symptoms in 2018 (Khaled and Zolezzi, 2021) in Qatar that used the same methodology (i.e. identical scales, cut-offs, sample design and survey mode).

Based on existing studies (Ettman et al., 2020; Pierce et al., 2020; Robinson et al., 2021), we hypothesized that the prevalence of depressive and anxiety symptoms would have returned to pre-pandemic levels. By investigating the prevalence of these symptoms following the resolution of the first wave of the pandemic in a Middle East setting we intended to add to existing representative general population studies from western countries (Robinson et al., 2021). In addition, by reporting cross-sectional data from December 2020/January 2021 we would extend knowledge of the trajectory of psychological morbidity associated with the pandemic given that previous studies focused on rates of affective symptoms in spring and summer 2020 (Robinson et al., 2021). We also aimed to contribute trend data and estimate changes in depression and anxiety symptom scores in relation to sociodemographic variables addressing questions of whether changes in these symptoms were more pronounced in some segments of society than others after the first wave of the pandemic compared to before COVID-19 pandemic.

## 2. Methods

### 2.1. Pre-pandemic and pandemic sample design and participants

All three samples came from a larger national cellphone frame with the same inclusion/exclusion criteria and were sampled using similar probability-based sampling procedures. Briefly, working with local cellphone providers, we employed probability-based, stratified, and list-assisted sampling procedure (Casady, 1993) to select a nationally representative sample of Arabic and English speaking adults (18 years or older) residing in Qatar at the time of data collection. Numbers in service, non-business numbers, and numbers belonging to one person only defined eligibility, while out of service numbers, business numbers, or numbers belonging to or shared by multiple persons defined ineligibility. The overall response rate of each sample adjusted for eligibility of respondents were 53.8%, 52.4%, 44.4%, respectively. Details about sampling procedures, phone interview outcomes, and response rate calculations for all three samples have been published elsewhere (Khaled, 2019; Khaled et al., 2021; Khaled and Zolezzi, 2021).

### 2.2. Procedures

Pandemic data collection took place from 15 December 2020 through 25 January 2021. The Arabic and English versions of the questionnaire were programmed and administered by trained researchers at the Social and Economic Survey Research Institute (SESRI) at Qatar University. The researchers conducted the phone interviews using a remote distributed Computer Assisted Telephone Interviewing (CATI) system (Kelly, 2008) and entered participants' responses directly into Blaise survey management software (Blaise, 2021). The average interview length was approximately 25 minutes. Standardized coding procedure was applied for different dialing outcomes and for calculation of response rates as per international guidelines (AAPOR, 2009).

### 2.3. Ethics

The study protocol was approved by Qatar University Institutional Review Board (QU-IRB 264- E/13, QU-IRB 1338 EA/20) and Hamad Medical Corporation (MRC05-089) in accordance with standard research protocols and HIPAA. Verbal consent was obtained from each respondent before proceeding with the phone interviews.

### 2.4. Translation

We used the officially translated versions of the PHQ-9 and GAD-7 in Arabic, which were developed by the MAPI research institute using internationally accepted translation methodology (Acquadro et al., 2012). These were readily available from the following website ([www.phqscreener.com](http://www.phqscreener.com)). In translating the rest of the questionnaire, our

team of bilingual researchers followed the process of translation and adaptation of instruments as per the WHO guidelines (World Health Organization, 2016).

## 2.5. Measures

### 2.5.1. Symptoms of depression

We used the nine-item Patient Health Questionnaire (PHQ-9) as our main measure of depression. The PHQ-9 is a brief screening tool for Major Depressive Episode (MDE) within the past two weeks used globally in both clinical and general population samples (Gelaye et al., 2014). The PHQ-9 assesses the frequency of the nine symptom criteria of MDE in the DSM-5 (American Psychiatric Association, 2013) by using a four-point response option for measuring severity of each symptom: 0 = “not at all,” 1 = “several days,” 2 = “more than half the days,” and 3 = “nearly every day.” A total score with a range from 0 to 27 can be computed for each respondent. The PHQ-9 has been validated for screening for depression in the general population (Kroenke et al., 2009; Löwe et al., 2005; Martin et al., 2006; Rancans et al., 2018). In Arabic speaking populations, the PHQ-9 has been validated in outpatients with a sensitivity and specificity for diagnosing MDE using a cutoff of 10 of 77% and 46%, respectively (Sawaya et al., 2016). A cutoff of  $\geq 10$  was used in our analysis of the pre-pandemic (Khaled, 2019) and pandemic data to dichotomize participants into moderate-to-severe levels of depression versus mild levels or no symptoms of depression.

### 2.5.2. Symptoms of generalized anxiety

The GAD-7 is a brief and validated screening measure for Generalized Anxiety Disorder (GAD) symptoms used in both clinical and community samples (Spitzer et al., 2006). The GAD-7 captures the frequency of the seven symptom criteria for GAD in the DSM-5 over the past two weeks with the same four-point rating options for each symptom as the PHQ-9 (Roehr, 2013). Cutoff scores of 5, 10, and 15 indicate mild, moderate and severe GAD symptoms, respectively (Kroenke et al., 2007, 2010). Previous studies have shown that the GAD-7 exhibits good psychometric properties (Kertz et al., 2012; Löwe et al., 2008) and acceptable sensitivity, but low specificity (Kertz et al., 2012; Spitzer et al., 2006). A cutoff of  $\geq 10$  was used in our analysis of the pre-pandemic (Khaled and Zolezzi, 2021) and pandemic data to dichotomize participants into moderate-to-severe levels of anxiety versus mild levels or no symptoms of anxiety.

### 2.5.3. Sociodemographic variables and culture

Standard sociodemographic information (age, gender, nationality, education, marital and employment status) were collected at all three times points (2017, 2018, 2020/2021). Qatari versus non-Qatari distinction was based on the question of whether the respondent was a Qatari national. We also assessed cultural affiliation or ethnicity based on questions in relation to nationality (country of origin) and language chosen to complete the interview (Arabic versus English). We defined two cultural groups based on these variables (Arab versus non-Arab) to account for cultural differences in depression and anxiety symptoms between the mainstream culture of Qatar (Arabic) versus other cultures.

## 2.6. Statistical analysis

We cleaned and merged data for all three years using common variables available across all datasets including main sociodemographics (2017, 2018, 2020/2021), PHQ-9 data from 2017 and 2020/2021 and GAD-7 data from 2018 and 2020/2021. We created a time variable to indicate the year of data collection. We conducted all our analysis in Stata version 16 (StataCorp, 2019). We “svyset” our dataset to allow us to incorporate complex survey design information including sample weights into our analysis taking into account the sample designs of different survey year. We explored our sample characteristics using percentages and corresponding 95% confidence intervals (CIs). We used

the Rao-Scott adjusted chi-square test (Rao and Scott, 1981) of proportions to compare the two-week prevalence of depression (2017 versus 2020/2021) and anxiety (2018 versus 2020/2021) pre- and post-first pandemic wave. The Rao-Scott adjusted chi-square test of proportions was also used to compare the distribution of sociodemographics across all three survey years.

As our main dependent variables (PHQ-9 and GAD-7) were over-dispersed (variance larger than the mean) count data, and because we were interested in modeling rate of change in depressive and anxiety symptoms score from pre- to post-first pandemic wave time points, we fitted univariable and multivariable negative binomial regression models to identify associations between survey year, sociodemographics, and our main dependent variables. In the univariable models, we entered survey year alone and estimated the unadjusted incidence rate ratio (IRR) with corresponding 95% CIs for symptoms scores of depression and anxiety. In the multivariable models, we simultaneously estimated IRRs with 95% CIs and robust SEs from the exponentiated coefficients of associations between survey year, all sociodemographic variables, and our dependent variables.

To evaluate changes in the effect of sociodemographics on depression and anxiety scores before and after the first wave of the pandemic, we computed average marginal effects (AMEs) or first differences in the margins or predicted rate of change in each dependent variable by each level or category of the independent variables. These marginal effects were calculated as post-model estimation from the negative binomial models that included two-way interactions between each sociodemographic variable and survey year. To test for interaction effects in the natural metric of the dependent variables (Mize, 2019), we also conducted a test of the second difference ( $\Delta$ AMEs) evaluating the equality of the differences in the AMEs across levels of each sociodemographic variable (Berry et al., 2010; Long and Freese, 2014).

For all our analysis, statistical significance was defined at an alpha level of 0.05.

## 3. Results

### 3.1. Pre-pandemic & Pandemic Samples

A total of 6064 complete observations were collected for the three time points i.e. 2017 ( $N = 2423$ ), 2018 ( $N = 2640$ ), and 2020/2021 ( $N = 1001$ ). These were participants who completed the entire phone interview and responded to all items on the PHQ-9 (2017 and 2020/2021) or the GAD-7 (2018 and 2020/2021) or both (2020/2021). Sociodemographic characteristics of participants by year and overall are shown in Table 1. Approximately, 90.2% of our total sample ( $N = 6064$ ) were non-Qataris, 79.1% were males, 76.4% were married, and 83.1% were employed (Table 1). However, the pandemic (2020/2021) and pre-pandemic (2017 and 2018) samples significantly differed in the distribution of all main sociodemographic variables as shown in Table 1.

### 3.2. Pre-pandemic & Pandemic Prevalence of depression and anxiety

The two-week prevalence of depression symptoms as defined by a score of 10 or higher on the PHQ-9 was 6.6% (95% CIs: 5.4–7.9) in 2017 and 6.5% (95% CIs: 5.1–8.4%) in 2020/2021, respectively [Rao-Scott chi-square (1, 3353) = 0.0003,  $p = 0.986$ ].

The two-week prevalence of anxiety symptoms as defined by a score of 10 or higher on the GAD-7 was 3.6% (95% CIs: 2.8–4.5) in 2018 and 5.1% (95% CIs: 3.8–6.9) in 2020/2021, respectively [Rao-Scott chi-square (1, 3557) = 3.4811,  $p = 0.062$ ].

In summary, the prevalence of both depression and anxiety post-first COVID wave were not significantly different to the estimates seen prior to the pandemic.

**Table 1**  
Sample characteristics.

Variable	Year									$\chi^2$	Total		
	2017			2018			2019				P-value	N	%
	n	%	95% CI	n	%	95% CI	n	%	95% CI				
Gender													
Male	1706	80.6	(78.7–82.5)	1936	82.3	(80.6–83.8)	678	66.7	(63.5–69.7)	<0.0001	4320	79.1	(77.9–80.2)
Female	717	19.4	(17.5–21.3)	704	17.7	(16.2–19.4)	323	33.3	(30.3–36.5)				
Age													
18–29	671	22.8	(20.6–25.2)	739	29.6	(27.4–32.0)	197	23.0	(20.1–26.1)	<0.0001	1607	25.6	(24.2–27.1)
30–39	823	38.1	(35.4–40.9)	803	36.6	(34.2–39.1)	368	37.1	(34.0–40.4)				
40+	845	39.1	(36.3–41.9)	893	33.7	(31.4–36.1)	415	39.9	(36.8–43.2)				
Marital status													
Ever married	1833	80.9	(78.8–82.8)	1918	72.9	(70.7–75.0)	774	74.0	(70.8–76.9)	<0.0001	4525	76.4	(75.1–77.7)
Never married	586	19.1	(17.2–21.2)	718	27.1	(25.0–29.3)	224	26.0	(23.1–29.2)				
Nationality													
Qatari	744	7.9	(7.2–8.7)	750	7.9	(7.3–8.6)	170	19.6	(17.0–22.4)	<0.0001	1664	9.8	(9.2–10.5)
Non-Qatari	1680	92.1	(91.3–92.8)	1891	92.1	(91.4–92.7)	831	80.4	(77.6–83.0)				
Ethnicity													
Non-Arab	1178	74.3	(72.3–76.2)	1285	74.2	(72.5–75.9)	411	44.7	(41.4–48.0)	<0.0001	2874	69.5	(68.2–70.7)
Arab	1230	25.7	(23.8–27.7)	1350	25.8	(24.1–27.5)	588	55.3	(52.0–58.6)				
Education													
No prep/primary/secondary	1333	64.4	(61.9–66.8)	1528	65.9	(63.7–68.1)	329	36.3	(33.1–39.6)	<0.0001	3190	60.5	(59.0–62.0)
Diploma/undergrad/prof	1078	35.6	(33.2–38.1)	1107	34.1	(31.9–36.3)	670	63.7	(60.4–66.9)				
Employment status													
Employed	1055	74.2	(71.4–76.9)	2145	88.9	(87.6–90.1)	761	75.9	(73.0–78.5)	<0.0001	3961	83.1	(81.9–84.2)
Unemployed	432	25.8	(23.1–28.6)	494	11.1	(9.9–12.4)	238	24.1	(21.5–27.0)				

Abbreviations. CI is 95% confidence intervals.  $\chi^2$  is the Rao-Scott adjusted chi-square test of proportions. Note. All estimates were weighted to account for survey sampling design.

**3.3. Pandemic/pre-pandemic sociodemographic associations with depressive symptoms**

Table 2 presents estimates of the associations between sample year and depressive symptoms before (Model A) and after adjusting for main sociodemographic variables (Model B). The pandemic year (2020/2021) was associated with an 8.1% decrease in depressive symptoms score compared to pre-pandemic year (2017) (IRR = 0.92,  $p = 0.151$ ). After adjusting for all sociodemographic variables, the pandemic year was associated with 35.1% decrease in depressive symptoms score compared to pre-pandemic year (IRR = 0.65,  $p < 0.0001$ ). Compared to the youngest age group (18–29 years), older age groups (30–39 years and 40+ years) were associated with 19.1% (IRR = 0.81,  $p = 0.013$ ) and 40.4% (IRR = 0.59,  $p < 0.0001$ ) decrease in depressive symptoms score, respectively. Females were associated with a 29.4% increase in depressive symptoms score compared to males (IRR = 1.29,  $p < 0.0001$ ). Holding other variables constant, Arab ethnicity was associated with an 85.4% increase in depressive symptoms score compared to non-Arab ethnicity (IRR = 1.85,  $p < 0.0001$ ). Not completing secondary school was associated with 15.8% increase in depressive symptoms score compared to completing secondary education or higher (IRR = 1.16,  $p < 0.0001$ ). Unmarried status (IRR = 1.01,  $p = 0.923$ ), Qatari nationality (IRR = 1.07,  $p = 0.321$ ) and unemployment (IRR = 0.945,  $p = 0.428$ ) were not significantly associated with depressive symptoms.

**3.4. Interaction of sociodemographic and pandemic/pre-pandemic year effects on depressive symptoms**

The AMEs and  $\Delta$ AMEs for sociodemographic variables and depressive symptoms during pandemic and pre-pandemic years are shown in

Table 3. In general, AMEs over most levels of the sociodemographic variables for depressive symptoms significantly changed over the pandemic relative to pre-pandemic years. The only exceptions were Qatari nationals (AMEs =  $-0.380$ ,  $p = 0.273$ ) and people in the youngest age (18–29 years) group (AMEs =  $-0.504$ ,  $p = 0.337$ ). However, the  $\Delta$ AMEs for most sociodemographic variables and depressive symptoms were not statistically significant over the pandemic relative to pre-pandemic year except for nationality ( $\Delta$ AMEs = 0.273,  $p = 0.007$ ), mostly due to decrease in the average score of depressive symptoms for non-Qataris. A visual of the statistically significant interactive effects of nationality and survey year are shown in Fig. 1.

**3.5. Pandemic/pre-pandemic & sociodemographic associations with anxiety symptoms**

Table 2 also presents estimates of the associations between sample year and anxiety symptoms before (Model C) and after adjusting for main sociodemographic variables (Model D). The pandemic year (2020/2021) was associated with a 7.2% decrease in anxiety symptoms score compared to pre-pandemic year (2018) (IRR = 0.93,  $p = 0.226$ ). After adjusting for all sociodemographic variables, the pandemic year was associated with 29.2% decrease in anxiety symptoms score compared to pre-pandemic year (IRR = 0.71,  $p < 0.0001$ ). Compared to the youngest age group (18–29 years), older age groups (30–39 years and 40+ years) were associated with 20.0% (IRR = 0.80,  $p = 0.006$ ) and 29.0% (IRR = 0.71,  $p < 0.0001$ ) decrease in anxiety symptoms score, respectively. Females were associated with a 59.0% increase in anxiety symptoms score compared to males (IRR = 1.59,  $p < 0.0001$ ). Holding other variables constant, Arab ethnicity was associated with a 62.3% increase in anxiety symptoms score compared to non-Arab ethnicity (IRR = 1.62,  $p$

**Table 2**  
Negative binomial regression models of PHQ-9 and GAD-7 by survey year and socio-demographics.

Variables	Ref.	PHQ-9						GAD-7					
		Model A			Model B			Model C			Model D		
		IRR	95% CI	P-value	IRR	95% CI	P-value	IRR	95% CI	P-value	IRR	95% CI	P-value
Year													
2020/2021	2017/2018	0.92	(0.82–1.03)	0.151	0.65	(0.58–0.73)	<0.0001	0.93	(0.82–1.05)	0.226	0.71	(0.62–0.80)	<0.0001
Gender													
Female	Male	–	–	–	1.29	(1.14–1.47)	<0.0001	–	–	–	1.59	(1.38–1.83)	<0.0001
Age group													
30–38	18–29	–	–	–	0.81	(0.68–0.95)	0.013	–	–	–	0.80	(0.69–0.94)	0.006
40+	18–29	–	–	–	0.60	(0.50–0.71)	<0.0001	–	–	–	0.71	(0.60–0.84)	<0.0001
Marital status													
Never Married	Ever married	–	–	–	1.01	(0.85–1.20)	0.923	–	–	–	0.95	(0.82–1.10)	0.491
Nationality													
Qatari	Non-Qatari	–	–	–	1.07	(0.94–1.21)	0.321	–	–	–	1.08	(0.94–1.24)	0.283
Ethnicity													
Arab	Non-Arab	–	–	–	1.85	(1.61–2.14)	<0.0001	–	–	–	1.62	(1.43–1.84)	<0.0001
Education													
Preparatory, primary, or secondary education	Post-secondary or higher education	–	–	–	1.16	(1.01–1.32)	0.030	–	–	–	1.14	(1.01–1.28)	0.036
Employment status													
Unemployed	Employed	–	–	–	0.95	(0.82–1.09)	0.428	–	–	–	1.03	(0.89–1.19)	0.716

Ref. is reference category. CI is 95% confidence intervals. IRR is incidence Rate Ratio. PHQ-9 is Patient Health Questionnaire. GAD-7 is Generalized Anxiety Disorder Questionnaire.

< 0.0001). Not completing secondary school was associated with 13.8% increase in anxiety symptoms score compared to completing secondary education or higher (IRR = 1.14, *p* = 0.036). Unmarried status (IRR = 0.95, *p* = 0.491), Qatari nationality (IRR = 1.08, *p* = 0.283) and unemployment (IRR = 1.03, *p* = 0.716) were not significantly associated with anxiety symptoms score.

### 3.6. Interaction of sociodemographic and pandemic/pre-pandemic year effects on anxiety symptoms

The AMEs and ΔAMEs for sociodemographic variables and anxiety symptoms during pandemic and pre-pandemic years are shown in Table 4. In general, AMEs over most levels of sociodemographic variables for anxiety symptoms significantly decreased over the pandemic relative to pre-pandemic years. The only exceptions were Arabs (AMEs = −0.048, *p* = 0.837) and people in the youngest age (18–29 years) group (AMEs = −0.335, *p* = 0.374). However, the ΔAMEs for most sociodemographic variables and anxiety symptoms were not statistically significant over the pandemic relative to pre-pandemic years except for ethnicity (ΔAMEs = 1.051, *p* < 0.0001), which was mostly due to decrease in the average score of anxiety symptoms for non-Arabs at the end of the first wave of the pandemic compared to before pandemic. A visual of the statistically significant interactive effects of ethnicity and survey year are shown in Fig. 2.

## 4. Discussion

In this study, we have highlighted prevalence trends of depression and anxiety symptoms before and after the first wave of the pandemic using repeated nationally representative cross-sectional surveys

spanning 2017, 2018, 2020/2021. To our knowledge, this is the first study in the Middle East that has used trend analysis of the same assessment tools, the PHQ-9 and GAD-7, at the population level pre- and post-first wave of the COVID-19 pandemic. Both of these instruments are valid and reliable multi-items measures of depression and anxiety symptoms in the Arabic language (AlHadi et al., 2017; Sawaya et al., 2016). Furthermore, our study adds to the existing literature on change in depression and anxiety symptoms scores before and after first wave of COVID-19 pandemic. Unlike, most studies, the timing of our comparisons allowed the examination of depressive or anxiety symptoms several months after the end of the first wave of the pandemic.

Our main findings were that the two-week prevalence estimates of depression and anxiety symptoms, as defined by a score of 10 or higher on the PHQ-9 and GAD-7, in the general population in Qatar in December 2020/January 2021 (i.e. some months after the end of the first wave of COVID-19) were not significantly different from estimates before the pandemic. Furthermore, our results showed that the depression and anxiety symptoms scores decreased relative to pre-pandemic levels as did the average marginal effects of traditional sociodemographic risk factors on depression and anxiety symptoms including female gender, never married status, unemployment, and lower education. In other words, the pandemic had a ‘levelling’ effect reducing the associations of traditional sociodemographic risk factors with depressive and anxiety symptoms. The only exception was the effects of being younger (18–29 years of age) on depression and anxiety symptoms, for which the change in these symptoms were not significantly different at the end of the first wave of the pandemic relative to before the pandemic (survey years 2017 and 2018). Additionally, the effects of Qatari nationality on depression symptom scores were similar post-first pandemic wave (2020/2021) relative to pre-pandemic year (2017),

**Table 3**

Margins, Average Marginal Effects (AMEs), & Average Marginal Effects Differences ( $\Delta$ AMEs) of depressive symptoms score for two-way interactions between sociodemographic variables and pandemic/pre-pandemic year.

Interaction type	Variable level	Pandemic year (2020/2021) Margins (SE)	Pre-pandemic year (2017) Margins (SE)	AMEs (SE)	p-Value	$\Delta$ AMEs (SE)	p-Value
Gender $\times$ Year	Female	3.267 (0.23)	4.845 (0.27)	-1.577 (0.36)	<0.0001	-0.506 (0.45)	0.266
	Male	2.559 (0.15)	3.631 (0.17)	-1.071 (0.23)	<0.0001		
Age $\times$ Year	Group 1 18–29 years	4.121 (0.42)	4.624 (0.31)	-0.504 (0.53)	0.337	-0.971 (0.67) <sup>a</sup>	0.150
	Group 2 30–39 years	2.924 (0.25)	4.399 (0.24)	-1.475 (0.35)	<0.0001	-0.917 (0.63) <sup>b</sup>	0.144
	Group 3 40+ years	2.006 (0.15)	3.427 (0.22)	-1.421 (0.27)	<0.0001	0.054 (0.45) <sup>c</sup>	0.903
	Marital status $\times$ Year	Never married	2.757 (0.32)	4.333 (0.29)	-1.575 (0.43)	<0.0001	-0.468 (0.54)
	Ever married	2.876 (0.17)	3.983 (0.16)	-1.108 (0.24)	<0.0001		
Nationality $\times$ Year	Qatari	3.336 (0.29)	3.716 (0.19)	-0.380 (0.35)	0.273	1.187 (0.44)	0.007
	Non-Qatari	2.632 (0.14)	4.199 (0.18)	-1.57 (0.23)	<0.0001		
Ethnicity $\times$ Year	Arab	3.489 (0.17)	4.979 (0.21)	-1.490 (0.27)	<0.0001	-0.405 (0.41)	0.325
	Non-Arab	1.746 (0.17)	2.831 (0.21)	-1.086 (0.27)	<0.0001		
Education $\times$ Year	Secondary or lower	3.093 (0.23)	4.422 (0.29)	-1.330 (0.37)	<0.0001	-0.132 (0.46)	0.776
	Post-secondary or higher	2.667 (0.16)	3.865 (0.16)	-1.198 (0.23)	<0.0001		
Unemployment $\times$ Year	Unemployed	2.865 (0.23)	3.635 (0.25)	-0.770 (0.34)	0.025	0.665 (0.46)	0.144
	Employed	2.828 (0.16)	4.263 (0.18)	-1.435 (0.25)	<0.0001		

<sup>a</sup> Differences in Average Marginal Effects between age groups 1 & 2.

<sup>b</sup> Differences in Average Marginal Effects between age groups 1 & 3.

<sup>c</sup> Differences in Average Marginal Effects between age groups 2 & 3.

while the effects of Arab ethnicity on anxiety symptom scores were similar post-first pandemic wave (2020/2021) relative to pre-pandemic year (2018). Furthermore, there were two significant interactions (i.e. evidence of inequality of the  $\Delta$ AMEs between groups pre-/post-first pandemic wave): 1) by nationality and survey year for change in depression symptoms score and 2) by ethnicity and survey year for the change in anxiety symptoms score. These were mostly due to the statistically significant decrease in the score of depressive symptoms for non-Qataris (Fig. 1) and significant decrease in the score of anxiety symptoms among non-Arabs (Fig. 2) post-first pandemic wave relative to pre-pandemic years. These interactions show the importance of cultural factors in influencing the prevalence of affective symptoms. One possible explanation is that loosening of travel restrictions and other-related public health measures post-first pandemic wave may had the largest beneficial psychological effects on non-Qatari expatriates of non-Arab ethnicity.

In our study, the end of first wave of the pandemic year (2020/2021) was associated with 35.1% and 29.2% decrease in depression and anxiety symptoms scores compared to pre-pandemic years (2017/2018) after adjusting for all sociodemographic covariates. This finding is consistent with the results of earlier studies from Europe and the US which showed that symptoms of depression and/or anxiety in the general population peaked early in the first wave and then started to fall (Ettman et al., 2020; Pierce et al., 2020) returning to pre-pandemic levels by the middle of 2020 (Robinson et al., 2021). Additionally, the same sociodemographic variables were independently and significantly associated with higher IRRs of depression and anxiety symptoms, namely: participants 18–29 years of age relative to other age groups (30–39 years and 40+ years), females relative to males, Arabs relative to non-Arabs, and those who did not complete post-secondary or higher

education. Marital status (never married versus ever married), employment status (unemployed versus employed), and nationality (Qatari versus non-Qatari) were not independently associated with IRRs of depression or anxiety symptoms scores in our models.

There is a strong research literature that shows that psychological problems are more prevalent among the unemployed than the employed (Paul and Moser, 2009). However, unemployment was not an independent variable associated with either depression or anxiety symptoms in the negative binomial regression models (Table 2). This may partly reflect the positive economic situation in Qatar, which is characterized by high employment partly due to large infrastructure projects being undertaken to prepare for the 2022 World Cup.

Female gender repeatedly emerges as being associated with depression and anxiety symptoms in pandemic studies (Kunzler et al., 2021). This is despite the fact that fatality rate of COVID-19 is higher for men than for women (Bwire, 2020). This apparent increased risk in women can be partly explained by the fact that prevalence rates for depressive (Gutiérrez-Rojas et al., 2020) and anxiety disorders (Bandelow and Michaelis, 2015) are twice as high in women as men prior to the pandemic. In fact, our IRRs of 1.29 for depression and 1.59 for anxiety symptoms (Table 2 Models B and D) suggests that this gender imbalance remains the same irrespective of survey year and the COVID-19 pandemic.

While holding other variables including survey year constant, Arab ethnicity emerged as an independent risk factor for depression and anxiety symptoms as evident from the IRRs estimates from our models in Table 2 (Model B and Model D). Studies conducted pre-pandemic in Qatar revealed Arab ethnicity as a risk factor for both depression and anxiety (Khaled, 2019; Khaled and Zolezzi, 2021). This pre-existing relationship appears to have persisted over the pandemic especially

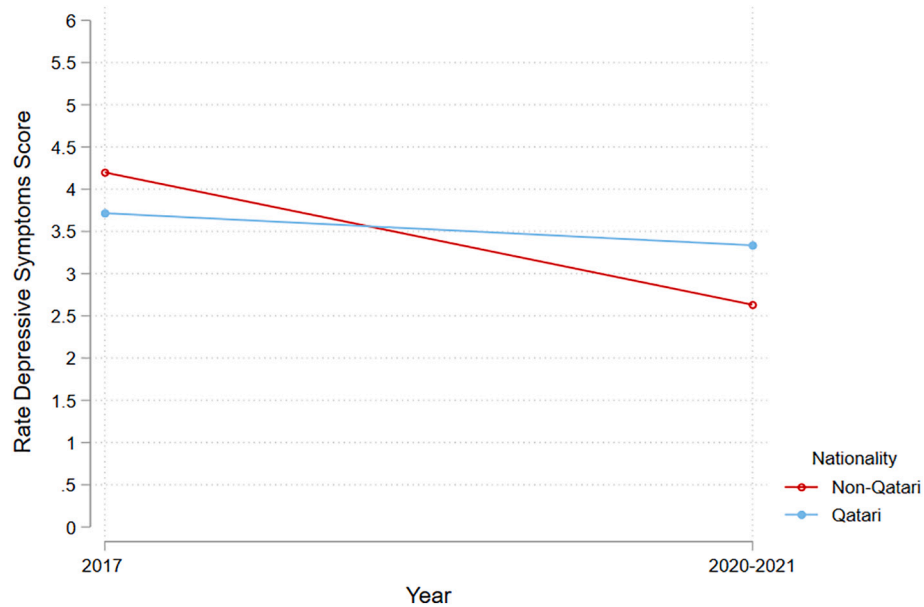


Fig. 1. Predicted rate of depressive symptoms score by nationality Pre- and Post- first wave of COVID-19 pandemic.

Table 4

Margins, average marginal effects, & average marginal effects differences of anxiety symptoms score for two-way interactions between sociodemographic variables and pandemic/pre-pandemic year.

Interaction type	Variable level	Pandemic year (2020/2021) Margins (SE)	Pre-pandemic year (2017) Margins (SE)	Average marginal effects (SE)	p-Value	Differences in average marginal effects (SE)	p-Value
Gender × year	Female	2.387 (0.24)	3.662 (0.25)	-1.235 (0.35)	<0.0001	-0.692 (0.38)	0.069
	Male	1.614 (0.13)	2.157 (0.08)	-0.543 (0.15)	<0.0001		
Age × year	Group 1 18–29 years	2.516 (0.33)	2.851 (0.19)	-0.335 (0.38)	0.374	-0.267 (0.45) <sup>a</sup>	0.558
	Group 2 30–39 years	1.849 (0.17)	2.451 (0.13)	-0.601 (0.22)	0.006	-0.693 (0.44) <sup>b</sup>	0.114
	Group 3 40+ years	1.331 (0.12)	2.359 (0.14)	-1.028 (0.19)	<0.0001	-0.426 (0.28) <sup>c</sup>	0.135
Marital status × year	Never married	1.814 (0.22)	2.558 (0.10)	-0.637 (0.28)	0.024	0.064 (0.35)	0.856
	Ever married	1.857 (0.15)	2.451 (0.18)	-0.701 (0.17)	<0.0001		
Nationality × year	Qatari	1.984 (0.21)	2.673 (0.16)	-0.689 (0.27)	0.010	0.006 (0.30)	0.984
	Non-Qatari	1.802 (0.13)	2.497 (0.09)	-0.695 (0.15)	<0.0001		
Ethnicity × year	Arab	2.873 (0.19)	2.921 (0.14)	-0.048 (0.23)	0.837	1.051 (0.29)	<0.0001
	Non-Arab	1.152 (0.15)	2.251 (0.11)	-1.099 (0.18)	<0.0001		
Education × year	Secondary or lower	1.979 (0.19)	2.565 (0.12)	-0.586 (0.22)	0.009	0.198 (0.29)	0.492
	Post-secondary or higher	1.700 (0.12)	2.484 (0.12)	-0.785 (0.17)	<0.0001		
Unemployment × year	Unemployed	1.911 (0.19)	2.492 (0.19)	-0.581 (0.27)	0.030	0.140 (0.32)	0.665
	Employed	1.816 (0.14)	2.536 (0.09)	-0.720 (0.17)	<0.0001		

<sup>a</sup> Differences in average marginal effects between age groups 1 & 2.

<sup>b</sup> Differences in average marginal effects between age groups 1 & 3.

<sup>c</sup> Differences in average marginal effects between age groups 2 & 3.

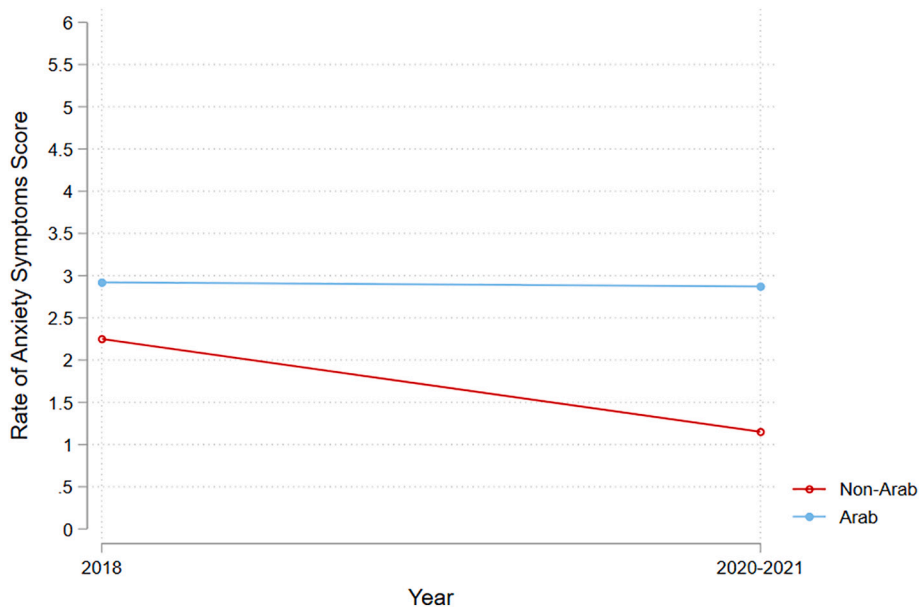


Fig. 2. Predicted rate of anxiety symptoms score by ethnicity Pre- and Post- first wave of COVID-19 pandemic.

for anxiety symptoms. In particular, while non-Arabs, on average, experienced a significant decrease in predicted rate of anxiety symptoms by 1.1 score points post-first pandemic wave compared to pre-pandemic (AMEs =  $-1.099$ ,  $p < 0.0001$ ), this was not the case for Arabs (AMEs =  $-0.048$ ,  $p = 0.837$ ). As shown in Table 4, this led to a statistically significant interaction in the effect of ethnicity on anxiety symptoms over the pandemic relative to pre-pandemic years ( $\Delta$ AMEs =  $1.051$ ,  $p < 0.0001$ ). It is possible that Arabs perceive themselves as more vulnerable to the impact of the pandemic as they belong to a specific geographic and cultural region. In contrast, non-Arab expatriate workers have ties not only to Qatar, but to their home countries. As a result, they may perceive greater flexibility regarding their future lives and careers irrespective of the impact of the pandemic on the Arab world. The potential higher risk of psychological distress in those of Arab ethnicity may also reflect more negative attitudes towards COVID-19 vaccination including lack of confidence in it conferring individual protection against illness or brining the pandemic to an end. Qatar's national COVID-19 vaccination program had recently started when our survey took place. However, at that time there was a high level of vaccine hesitancy in Qatar which was significantly more marked among Arab expatriates and Qatari nationals (Khaled et al., 2021). Another survey, conducted in Arabic, across 17 Arab speaking countries in January 2021 also revealed high levels of vaccine hesitancy (Qunaibi et al., 2021).

Contrary to ethnicity, nationality was not a significant risk factor for depression and anxiety symptoms with near-null IRRs estimates for that variable in our models (Table 2, Model B and Model D). However, as shown in Table 3, the decrease in depressive symptom score for non-Qataris (AMEs =  $-1.57$ ,  $p < 0.0001$ ) were significantly larger than that for Qataris (AMEs =  $-0.380$ ,  $p = 0.273$ ) at the end of the first wave of the pandemic compared to before the pandemic (2017) suggesting that the effects of nationality and pandemic on the rate of change in depression symptoms score were more pronounced for expatriates compared to nationals of Qatar ( $\Delta$ AMEs =  $1.187$ ,  $p = 0.007$ ).

The study has several strengths. First, it is a representative national survey; as far as we are aware it is the first representative national study of psychiatric morbidity from an Arabic speaking country since the COVID-19 pandemic was declared. Second, we assessed morbidity in December 2020 to January 2021 (several months after the first COVID-19 wave had resolved in Qatar) whereas most published studies from the Arabic speaking world have addressed morbidity during or soon after the first wave. Finally, we used identical methodology to assess anxiety

and depressive symptoms as pre-pandemic studies conducted in 2017 and 2018 in Qatar by the same research organization (Social and Economic Survey Research Institute, SESRI, Qatar University) allowing us to make a valid comparison to pre-pandemic prevalence estimates. Several caveats are necessary. Our measures of depression and anxiety were self-report. Although we used both scores above cut-offs ( $\geq 10$ ) on the PHQ-9 and GAD-7 and dimensional scores (range of 0–27 for PHQ-9 and range of 0–21 for GAD-7), these do not necessarily correlate with a formal diagnosis of MDD and GAD. Therefore, we cannot assume that all participants with anxiety and depression in our study require psychiatric treatment for a mental illness. Rather they are likely to benefit from a range of interventions including provision of self-help material, support groups and, for those with more severe problems, consultation with a health care professional, for example a family practitioner.

We report the point prevalence of anxiety and depressive symptoms and while we have examined trends in prevalence rate of these symptoms pre- and post-first pandemic wave, our data are still cross-sectional. Therefore, our findings should not be interpreted as changes in incidence of these symptoms over this time. We only report on symptoms of anxiety and depression, yet psychological distress can manifest in other ways, for example with post-traumatic stress disorder (PTSD) symptoms and substance misuse. PTSD symptoms have been reported to be common and persistent in some groups, for example front line health care workers, following other epidemics (Preti et al., 2020). A significant increase in substance use during the pandemic is unlikely in Qatar, due to strict control on the sale and consumption of alcohol, cultural taboos on substance use and strong legal penalties for illicit drug use. As for covariates, we only looked at the effects of sociodemographics on depression and anxiety symptoms as these were commonly assessed across all three surveys. This limited our ability to model other important relationships with our dependent variables such as physical health, religiosity, loneliness and other important factors that may also be associated with our sociodemographics.

In conclusion, we examined data from three national surveys carried out in Qatar in 2017, 2018, and 2020/2021 in order to compare the point prevalence of both depression and anxiety symptoms after the first COVID-19 wave to point prevalence assessed pre-pandemic. We found that the point prevalence of both moderate-to-severe depression and anxiety symptoms in December 2020–January 2021 (a point some months after the resolution of Qatar's first COVID-19 wave) were the same as pre-pandemic prevalence estimates for these symptoms from



2017 and 2018, respectively. However, the end of first wave of the pandemic year (2020/2021) was associated with 35.1% and 29.2% decrease in depression and anxiety symptoms scores compared to pre-pandemic years (2017/2018) after adjusting for all sociodemographic factors. This downward trend was evident for both types of symptoms in all age groups except for youngest age category (18–29 years), in both men and women, across high and low-education levels, ever married and never married, and employed and unemployed. However, the pandemic scores for depression and anxiety symptoms remained high for Qataris and Arabs, suggesting that these cultural groups may benefit most from public mental health interventions.

## Abbreviations

<b>COVID-19</b>	Coronavirus disease 2019
<b>GAD</b>	Generalized Anxiety Disorder
<b>MDE</b>	Major Depressive Episode
<b>PHQ-9</b>	Patient Health Questionnaire
<b>GAD-7</b>	Generalized Anxiety Disorder Questionnaire
<b>AMEs</b>	Average Marginal Effects
<b>WHO</b>	World Health Organization

## Author contribution

All authors met the four ICMJE criteria for authorship. All authors were involved in the design of the work or the acquisition, analysis, or interpretation of data. All authors contributed to writing and/or revising the article. Salma M. Khaled: Conceptualization, Supervision, Data curation, Formal analysis, Writing - original draft. Veena Davies: Conceptualization, Formal analysis, Writing of Original Draft, Review and Editing. Iman Amro: Conceptualization, Data curation, Writing of Original Draft, Review and Editing. Amal Ali: Data acquisition, analysis, interpretation. Peter Woodruff: Conceptualization, Supervision, Methodology, Writing of original draft, Review and Editing. Peter M. Haddad: Conceptualization, Supervision, Formal analysis, Writing of original draft, review and editing.

## Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request and pending additional ethical approval.

## Declaration of competing interest

Peter M. Haddad reports personal fees from Janssen, New Bridge Pharmaceuticals and Otsuka outside the submitted work.

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