



# Psychological Wellbeing and Associated Factors Among Ethnic Minorities During the COVID-19 Pandemic

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## Abstract

This study assessed the psychological wellbeing and its associated factors amongst ethnic minorities during the coronavirus disease 2019 (COVID-19) pandemic. A total of 310 Hong Kong South Asians aged 41.3 (SD 13.7) years completed an anonymous online survey between July 2020 and February 2021. The results showed an overall moderate level of stress and high levels of depression, anxiety and post-traumatic stress disorder (PTSD) symptoms amongst South Asian minorities. Multivariable regression analyses suggested that being single/divorced, following Hinduism or other non-Muslim religions, having lower perceived knowledge of COVID-19 and having worried about losing job were significant predictors of higher levels of depression, anxiety and/or stress; additionally, being male, having a low monthly household income, having worried about losing job and healthcare collapse were significant predictors of a higher level of PTSD symptoms. The findings suggest an urgent need to alleviate the psychological impacts of the COVID-19 pandemic on ethnic minorities, specifically for those most vulnerable to these impacts.

**Keywords** Psychological wellbeing · Depression · Anxiety · Post-traumatic stress · Ethnic minorities · COVID-19

## Introduction

The coronavirus disease 2019 (COVID-19) pandemic has affected the world in an unprecedented manner [1]. As of 26 October 2021, the world has recorded more than 244 million infected cases (> 3% of the total world population) and over 4.9 million deaths [2]. Hong Kong is moderately affected by the COVID-19 pandemic compared with other countries worldwide but has experienced four waves of infections. As of 26 October 2021, a total of 12,311 confirmed cases (< 0.5% of the total local population) and 213 deaths of COVID-19 have been recorded in Hong Kong [3].

To contain the spread of the virus, Hong Kong has implemented a series of public health measures such as the enactment of regulations to maintain social distancing by prohibiting group gatherings in public places and closing of non-essential premises. Whilst the effectiveness of the territory-wide vaccination programme is yet

to be determined, social distancing remained the first line of prevention and control measures [3]. Although these measures have shown promise in controlling the spread of COVID-19, they can also induce a wide range of psychosocial impacts on different populations [4–7]. A systematic review of studies conducted before June 2020 found a high prevalence of symptoms of anxiety (6–51%), depression (15–48%), post-traumatic stress disorder (PTSD) (7–54%), psychological distress (34–38%) and stress (8–82%) amongst the general population in eight countries including China, Spain, Italy, Iran, the United States, Turkey, Nepal and Denmark [8]. The review also summarised the risk factors for poorer mental health outcomes: female gender, aged 40 years or below, presence of chronic/psychiatric illness, unemployment, being a student and frequent exposure to news/social media regarding COVID-19 [8]. Additionally, online surveys from India during the early lockdown months of 2020 suggested that around 10–15% of the respondents reported moderate to severe levels of anxiety and depression; while 8–18% met the criteria for a probable diagnosis of PTSD [9–11]. Compared with the general population, ethnic minorities may experience increased psychological impacts of COVID-19 due

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to the potential interactions of cultural, behavioural and social factors such as health-seeking behaviours, intergenerational interactions, language barriers and lower socioeconomic status [12]. However, little is known about the psychological wellbeing and associated factors amongst ethnic minorities during the pandemic.

According to the Census and Statistics Department [13], the ethnic minority population living in Hong Kong has increased by more than 70% in the past decade and reached 584,383 in 2016. Most ethnic minorities (excluding foreign domestic helpers) are from South Asian countries, such as India (12.6%), Pakistan (6.9%) and Nepal (9.6%) [14]. However, South Asians may lack knowledge and not fully understand the health information, mostly in Chinese or English, which are widely available in Hong Kong [13, 15]. In a recent cross-sectional study, South Asians in Hong Kong reported a relatively low knowledge about COVID-19 and certain misconceptions regarding infection prevention, such as the mode of transmission and use of rubber gloves. Of note, majority of them (61.9%) were fearful of being infected [16]. With the vast majority of the population being ethnic Chinese in Hong Kong, racial discrimination, particularly against South Asians, is prevalent in many areas of life including medical services, employment and education [17, 18]. A previous local study on Pakistanis and Nepalese immigrants showed that perceived discrimination was positively associated with psychological distress [19]. These aforementioned pieces of evidence indicate that the potential interactions of cultural, behaviour and social factors may result in heightened psychological symptoms in South Asians.

Most of the research related to this outbreak focuses on examining the psychological impact on patients, health-care providers and general population [5–8]. Data on ethnic minorities and their psychological wellbeing during COVID-19 are scarce and equivocal [20, 21]. Therefore, the aim of this study was to examine the psychological wellbeing and its associated factors amongst South Asian ethnic minorities during the COVID-19 pandemic.

## Methods

We conducted a cross-sectional descriptive correlational study by using an anonymous online/telephone survey to collect data on psychological wellbeing amongst South Asian ethnic minorities between late July 2020 and mid-February 2021.

## Participants

A convenience sampling method was adopted in this study. We sought the support from the South Asian community centres and organisations that are located in districts with a high concentration of South Asians to circulate the online survey (in English only) to their members through the instant messaging application WhatsApp. South Asians who were (1) aged 18 years or older and (2) able to understand Hindi, Urdu, Nepali or English were included. We determined the sample size on the basis of a previous study, wherein the prevalence of depression amongst university students in Bangladesh as measured during the COVID-19 pandemic was 76.1% [22]. On the basis of this reference, at least 280 respondents were needed (confidence level = 95% and margin of error = 5%).

## Measures

The online survey collected self-reported information on socio-demographics (i.e. age, gender, place of birth, marital status, work status, education level, monthly household income and religion), COVID-19 perception and exposure, as well as psychological wellbeing (symptoms of depression, anxiety, stress and PTSD).

COVID-19 perception and exposure were assessed using 10 questions ad hoc developed by the research team with reference to previous studies [5]. Specifically, there were two questions on COVID-19 knowledge (How would you rate your knowledge level on COVID-19?; Where did you first learn about COVID-19?), one question on perceived worries (What are you worried about during COVID-19 outbreak?) and six questions on perceived COVID-19 exposure (for example, have you been diagnosed with COVID-19?). Symptoms of depression, anxiety and stress were assessed using the Depression, Anxiety, and Stress Scale (DASS-21). It consists of 21 items in three domains on a four-point rating scale (0–3). Each domain comprises seven items assessing symptoms of depression, anxiety, and stress. The scores in each domain are summed and then multiplied by two to give a final domain score. Higher scores indicate a higher level of psychological distress. The cut-off scores that indicate severe to highly severe depression, anxiety, and stress are > 20, > 14, and > 25, respectively [23]. The DASS-21 has been adopted in recent COVID-19 studies on general populations [5, 8] and demonstrated good validity and reliability among South Asians populations prior to the pandemic [24–26]. In this study, the Cronbach's alpha for the depression, anxiety and stress subscales were 0.89, 0.87 and 0.90, respectively.

Symptoms of PTSD were assessed using the Impact of Event Scale-Revised (IES-R). It consists of 22 items on a five-point rating scale (0–4). The total score ranges from 0 to 88, and a score of 33 or over indicates a probable diagnosis of PTSD [27]. The IES-R has been adopted in recent COVID-19 studies on different populations [5, 28], and demonstrated high internal consistency among Asian populations [28]. The IES-R received a Cronbach's alpha of 0.95 in this study.

## Data Collection

Data were collected via a self-administered online survey or phone interviews. An online survey portal was created using Survey Monkey, a secure and mobile device-based data collection tool. A brief study description, a consent form and the questionnaire were included in the online survey portal. Our partner ethnic minority associations helped to promote the study by circulating the link of the online survey to their members. Potential participants were asked to access the link to review the study description, provide informed consent and complete the survey. Respondents were reminded to seek medical care if they perceived severe or highly severe depression/anxiety/stress. Those who did not have Internet access or could not read English were offered to complete the survey through phone interviews by a South Asian research assistant. It turned out that a small percentage (4%) of the Nepalese participants were phone interviewed in Nepalese by a Nepalese research assistant who was a nursing doctoral student who worked part-time as a translator in non-governmental organisations. Participants did not receive any incentive for this study. Ethical approval was obtained from our institutional ethics committee prior to data collection.

## Statistical Analysis

IBM SPSS Statistics for Windows version 26.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Listwise deletion was used to account for missing data. Descriptive statistics, such as mean and standard deviation for continuous variables and proportions for categorical variables, were used to summarise the participants' characteristics and psychological outcome variables. Bivariate analyses by means of Pearson's correlation, Chi-square test, independent t-test and one-way ANOVA were used to examine the association between study outcomes and participants' characteristics. Factors with  $p < 0.25$  in bivariate analyses were selected to enter into multivariable linear regression models. The variance inflation factor (VIF) was computed to detect collinearity. Variables with  $VIF \geq 10$  were excluded from multivariable analysis. The statistical significance level was set at  $p < 0.05$  (two-sided).

## Results

### Participants' Characteristics

A total of 316 eligible participants completed the survey but six were excluded due to substantial amount of missing data (i.e. missing all items in the psychometric scales). The final sample included 310 participants with a mean age of 41.3 (SD 12.7) and the majority female (61.6%). Tables 1 and 2 summarise the socio-demographic and COVID-19-related characteristics of the study participants.

### Psychological Outcomes

Table 3 summarises the psychological outcomes of the study. The mean scores for DASS depression, anxiety, stress subscales and IES-R were 18.5 (SD 6.0), 17.8 (SD 5.5), 18.4 (SD 6.1) and 35.3 (SD 14.2), respectively. Based on the cut-off scores proposed by Lovibond and Lovibond [23], 27.4%, 47.7% and 16.7% of the participants reported severe or extremely severe depression, anxiety, and stress, respectively. On the other hand, almost half of them met the criteria (46.5%) for a probable diagnosis of PTSD. Notably, 61% of men (vs 38% of women) in our study met the criteria for a probable diagnosis of PTSD (Odds ratio 2.5; 95% CI 1.6 to 4.0).

### Multivariable Analyses of the Factors Associated with Psychological Outcomes

As demonstrated by the results of the multiple linear regressions, marital status, religion, perceived knowledge of COVID-19, having worried about losing job and travel ban were found to be significantly and independently associated with depression, anxiety and/or stress (Table 4). Specifically, those being single or divorced as compared to those being married or cohabiting were more likely to suffer from higher levels of depression ( $B = 2.754$ ;  $p = 0.014$ ) and stress ( $B = 2.322$ ;  $p = 0.037$ ); those following Hinduism or other religions as compared to those following Islam religion were more likely to report higher levels of depression ( $B = 4.992$ – $5.352$ ;  $p = 0.002$ – $0.005$ ), anxiety ( $B = 3.265$ – $3.434$ ;  $p = 0.030$ ), and stress ( $B = 5.149$ – $5.512$ ;  $p = 0.002$ ); those having average or below knowledge about COVID-19 as compared to those having good or very good knowledge was more likely to suffer from higher levels of anxiety ( $B = 2.058$ ;  $p = 0.002$ ) and stress ( $B = 2.049$ ;  $p = 0.004$ ); those expressed worry about losing job was more likely to suffer from a higher level of stress ( $B = 1.514$ ;  $p = 0.036$ ) than those without such worry. On the other hand, those expressed worry about travel ban was more likely to

**Table 1** Participants' socio-demographics characteristics (N=310)

	n (%) / M(SD)
Age (years) <sup>a</sup>	41.3 (13.7)
Duration of stay in Hong Kong (years) <sup>a</sup>	18.0 (12.1)
Gender	
Male	119 (38.4)
Female	191 (61.6)
Place of birth	
Pakistan	124 (40.0)
India	84 (27.1)
Nepal	56 (18.1)
Hong Kong	41 (13.2)
Others (Dubai/London/Mainland China/not reported)	5 (1.6)
Country of Origin	
Pakistan	136 (43.9)
India	100 (32.3)
Nepal	69 (22.3)
Others <sup>b</sup>	5 (1.6)
Marital status	
Married	245 (79.0)
Single	51 (16.5)
Cohabiting	2 (0.6)
Divorced	4 (1.3)
Widowed	8 (2.6)
Education level	
No school	24 (7.7)
Primary	56 (18.1)
Secondary	143 (46.1)
University	73 (23.5)
Master or above	13 (4.2)
Not reported	1 (0.3)
Number of children	
0	71 (22.9)
1	58 (18.7)
2	92 (29.7)
3	44 (14.2)
4 or above	44 (14.2)
Not reported	1 (0.3)
Work status	
Full time	133 (42.9)
Part time	36 (11.9)
Not working	134 (43.2)
Self-employed/freelancer	5 (1.6)
Not reported	2 (0.6)
Occupation	
Managers & administrators	9 (2.9)
Professionals	44 (14.2)
Clerical support workers	5 (1.6)
Service & sales workers	38 (12.3)
Manufacturing, construction, transportation	37 (11.9)
Elementary occupations	40 (12.9)
Not working (students/housewife/unemployed/ retired/on CSSA)	131 (42.3)
Not reported	6 (1.9)

**Table 1** (continued)

	n (%) / M(SD)
Monthly household income (USD)	
< 1250	74 (23.9)
1250–2500	141 (45.5)
2501–3750	68 (21.9)
3751–5000	16 (5.2)
> 5000	11 (3.5)
Religion	
Hinduism	99 (31.9)
Islam	136 (43.9)
Sikhism	20 (6.5)
Buddhism	37 (11.9)
Christianity	7 (2.3)
Others (Kirat, Jain, not mentioned)	4 (1.3)
No religion	7 (2.3)

Data marked with<sup>a</sup> are presented as mean (standard deviation); all others are presented as frequency (%)

CSSA Comprehensive social security assistance scheme

<sup>b</sup>Others included Hong Kong, Mainland China and half Pakistani half Filipino

report a lower level of anxiety ( $B = -2.138$ ;  $p = 0.004$ ) than those without such worry. The predictors in the models for depression, anxiety and stress collectively explained 16.7%, 12.4% and 15.6% of the total variance, respectively.

With regard to PTSD symptoms, those being male ( $B = 6.523$ ;  $p = 0.001$ ), having monthly household income < USD 1250 ( $B = 6.018$ ;  $p = 0.004$ ), expressed worry about losing job ( $B = 4.557$ ;  $p = 0.010$ ) and healthcare collapse ( $B = 6.754$ ;  $p < 0.001$ ) were independently associated with higher levels of PTSD symptoms. This model accounted for 23.8% of the total variance.

## Discussion

To our best knowledge, this is the first study that examined the psychological wellbeing of ethnic minorities in Hong Kong during the COVID-19 pandemic. Our findings suggested that South Asians in Hong Kong experienced moderate levels of stress and high levels of depression, anxiety and PTSD symptoms during the pandemic. Notably, around 14.5%, 31.6% and 3.2% of the participants experienced extremely severe levels of depression, anxiety and stress, respectively, and almost half of them met the criteria (46.5%) for a probable diagnosis of PTSD. In comparison to the findings of a similar local study by Tso and Park [29] conducted in the second wave of the COVID-19 outbreak, our sample reported slightly higher levels of depression and stress, as well as almost twice the level of anxiety. Furthermore, the levels of depression, anxiety and stress reported in our study are substantially higher than those reported by convenience samples of the general population in China [28], Iran [28],

Malaysia [28], the Philippines [28], Vietnam [28], Pakistan [28, 30], Nepal [31] and India [9, 10] during the pandemic. Likewise, the level of PTSD symptoms reported in our sample is higher than that reported by convenience samples of the general population in China [28], Iran [28], Malaysia [28], the Philippines [28], Vietnam [28], Pakistan [28, 30] and India [10, 11] during the pandemic. Taken together, ethnic minorities seem to be vulnerable to the adverse psychological impacts of the pandemic. This is a particularly worrying situation as the ongoing pandemic is likely to further widen the existing inequalities and exacerbate racial discrimination faced by ethnic minorities [32, 33].

The findings in this study suggest that a number of demographic and COVID-19-related factors were independently associated with psychological wellbeing amongst South Asian minorities. Being single or divorced predicted higher levels of depression and stress. Similar findings were reported in two Chinese studies conducted during the early COVID-19 outbreak [34, 35]. This highlights the importance of spousal support in the midst of the pandemic in collectivistic cultures such as those in Asia. Religion was found to be a common predictor of depression, anxiety and stress in the multivariable models in this study. Consistently, we found that those following Islam religion experienced significantly lower levels of depression, anxiety and stress than those following other religions. A growing body of research suggests that positive religious coping is a protective factor for mental health outcomes including depression and anxiety during stressful life events [36, 37]. Previous multi-faith studies showed that compared to others, Muslims were more likely to report greater use of positive religious coping

**Table 2** COVID-19-related characteristics

<i>Knowledge and Worries</i> (multiple choices questions, N = 310)	n (%)
Where did you first learn about COVID-19? <sup>a</sup>	
Family members	192 (61.9)
Friends, neighbors, and colleagues	189 (61.0)
Internet	179 (57.7)
Television	176 (56.8)
Newspapers and magazines	105 (33.9)
Healthcare workers	60 (19.4)
Brochures, posters and other printed materials	36 (11.6)
Radio	27 (8.7)
What are you worried about during COVID-19 outbreak? <sup>a</sup>	
Family members infected with COVID-19	224 (72.3)
Infected with COVID-19	201 (64.8)
Travel ban	186 (60.0)
Losing job	176 (56.8)
Being in quarantine	153 (49.4)
Healthcare collapse	122 (39.4)
Not enough masks	88 (28.4)
Others	
Kids' education <sup>b</sup>	9 (2.9)
How would you rate your knowledge level on COVID-19?	
Very poor	1 (0.3)
Poor	17 (5.5)
Average	143 (46.1)
Good	116 (37.4)
Very good	33 (10.6)
<i>COVID-19 Exposure</i> (Yes–no questions, N = 303)	
Have you been diagnosed with COVID-19?	
Yes	2 (0.6)
Have your family members been diagnosed with COVID-19?	
Yes	4 (1.3)
Have you been identified as having close contact with persons with COVID-19?	
Yes	3 (1.0)
Have your family members been identified as having close contact with persons with COVID-19?	
Yes	2 (0.6)
Do you work in environment with high risk of exposure to persons with COVID-19?	
Yes	13 (4.2)
Do your family members work in in environment with high risk of exposure to persons with COVID-19?	
Yes	9 (2.9)

<sup>a</sup>Multiple responses possible

<sup>b</sup>The most common answer from those who selected the “others” option

strategies such as reinterpreting the stressor as salutary and seeking God's love and care [37, 38]. This may partly explain the lower levels of depression, anxiety and stress amongst Muslims, as compared with others, in our study. The findings regarding marital status and religion imply that ethnic minorities who are single, divorced or non-Muslim are considered as a high-risk group that needs early psychological intervention.

Our finding of lower perceived knowledge of COVID-19 being an independent predictor of higher levels of anxiety and stress is contradictory to a similar study conducted amongst the Chinese general population during the early COVID-19 outbreak, where higher self-evaluated knowledge level was significantly associated with a higher level of anxiety [34]. Lei et al. [34] proposed that misconceptions about COVID-19 might have provoked anxiety in

**Table 3** Summary of the psychological outcomes of the study

	Mean (SD)	Median (IQR)	n (%)
<i>DASS-21</i> (N = 310)			
Depression	18.5 (6.0)	16 (14–22)	
Moderate (14–20)			225 (72.6)
Severe (21–27)			40 (12.9)
Extremely severe ( $\geq 28$ )			45 (14.5)
Anxiety	17.8 (5.5)	14 (14–20)	
Moderate (10–24)			162 (52.3)
Severe (15–19)			50 (16.1)
Extremely severe ( $\geq 20$ )			98 (31.6)
Stress	18.4 (6.1)	15 (14–22)	
Normal (0–14)			155 (50.0)
Mild (15–18)			50 (16.1)
Moderate (19–25)			53 (17.1)
Severe (26–33)			42 (13.5)
Extremely severe ( $\geq 34$ )			10 (3.2)
<i>IES-R</i> (N = 306)			
Probable diagnosis of PTSD	35.3 (14.2)	31 (22–44)	
No (0–32)			162 (52.3)
Yes ( $\geq 33$ )			144 (46.5)

*DASS* Depression, Anxiety, and Stress Scale, *IES-R* Impact of Event Scale—Revised, *PTSD* Post-traumatic stress disorder

the Chinese population. However, we cannot ascertain the association between actual knowledge level and psychological wellbeing due to the adoption of subjective evaluation questions, instead of objective assessment of knowledge, in both studies. Nevertheless, more than half of our participants perceived that their knowledge about COVID-19 was average, poor or very poor. This finding echoed the finding of a previous study that South Asian minorities achieved a mean knowledge score of 5.38/10 [16]. Since the initial outbreak of the pandemic, the Hong Kong government and some non-governmental organisations (NGOs) serving ethnic minorities have provided COVID-19-related information in their native languages. The low perceived knowledge of COVID-19 reported in our study might imply that this information was not well-received by ethnic minorities. Further studies are warranted to explore the perception of South Asian minorities towards these education materials. Regarding the information source, our study found that around 57% of our participants first learnt about COVID-19 via the Internet and television, which are the major sources of disseminating COVID-19-related information in Hong Kong. The most common information source amongst this group of South Asians was family members, followed by friends, neighbours and colleagues. As such, identifying culturally compatible role models to proactively disseminate COVID-19-related information to their peers appears

to be an effective approach. According to a previous study's findings, health ambassadors are well-suited to take up this role [39].

In the current study, gender and income levels were identified to be predictors of PTSD symptoms. Being male was a risk factor of higher levels of PTSD symptoms. This finding is contrary to a Chinese study conducted by Wang et al. [40] and an Indian study conducted by Varshney et al. [11] in which female gender was a significant predictor of higher PTSD symptoms in the early phase of the COVID-19 outbreak. This is also contrary to the vast majority of epidemiological literature that reported higher prevalence of mental illness in South Asian women [41]. Given that a high proportion of men presented with PTSD symptoms of clinical significance in our study (61%) and that existing support services for ethnic minorities in Hong Kong mostly targeted women, there is a pressing need to identify the cause and develop gender-specific initiatives to address PTSD symptoms in this vulnerable group. In addition, having a low monthly household income was also a risk factor of higher levels of PTSD symptoms in this study, which confirms the well-established link between income and mental health [42, 43]. With insecure jobs and limited financial reserves, low-income families inevitably face more financial burden in the global economic recession triggered by the pandemic [43]. The high financial burden might explain the inverse relationship between income and PTSD symptoms identified in our study. Thus, local authorities should develop measures to relieve the financial burden of low-income ethnic minorities during the pandemic.

Concerns about COVID-19 have been reported to associate with higher levels of depression, anxiety, stress and PTSD symptoms amongst the Chinese populations [29, 34, 40]. These studies either used a single item to measure the overall level of concern [29] or asked participants to report any worry about self or other family members contracting COVID-19 and the likelihood of survival if infected [34, 40]. In our study, worries about losing job and healthcare collapse remained significantly associated with depression and/or higher levels of PTSD symptoms in multivariable analysis. These findings might indicate that the major pandemic-related stressors faced by South Asian minorities were concerns about job insecurity and collapse of the healthcare system. These concerns could be exacerbated by the existing disparities in employment and engagement of the healthcare system between South Asian minorities and the general population in Hong Kong. More specifically, South Asians were found to be more likely to work in insecure jobs and less likely to engage in the healthcare system due to language, cultural and communication barriers [13, 44]. In this regard, the concerns about job insecurity and collapse of the healthcare system should be addressed when developing psychological interventions. Surprisingly, having

**Table 4** Multiple linear regression model for predicting depression, anxiety, stress and post-traumatic disorder symptoms

Variables	Depression			Anxiety			Stress			PTSDsymptoms					
	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$			
	Age		NE			NE			NE			-0.011	0.064	-0.011	
Gender (Ref: Female)															
Male		NE		0.335	0.748	0.029		NE			6.523	2.012	0.225**		
Place of Birth (Ref: Hong Kong or others)															
Pakistan	2.675	1.468	0.220	1.982	1.298	0.176	2.021	1.487	0.163				NM		
India	-0.597	1.297	-0.045	-0.724	1.151	-0.058	-0.616	1.293	-0.045				NM		
Nepal	0.269	1.483	0.017	-0.523	1.315	-0.036	-0.600	1.419	-0.038				NM		
Country (Ref: Nepal and others)															
Pakistan		NM			NM			NM			0.701	2.285	0.025		
India		NM			NM			NM			-2.991	2.311	-0.099		
Marital status (Ref: Single/divorced)															
Married/cohabiting	-2.754	1.117	-0.184*	-1.440	0.821	-0.105	-2.322	1.109	-0.154*		-2.485	2.082	-0.070		
Education level (Ref: University or above)															
Primary or below	1.827	1.144	0.134		NE			NE					NE		
Secondary	1.061	0.912	0.089		NE			NE					NE		
Number of children (Ref: 0)															
1	-1.462	1.245	-0.096		NE			-0.764	1.247	-0.049			NE		
2	-0.754	1.187	-0.058		NE			-0.621	1.178	-0.047			NE		
3	0.930	1.343	0.055		NE			0.898	1.332	0.052			NE		
4 or above	1.720	1.423	0.101					1.967	1.394	0.113					
Work status (Ref: Not working)															
Full time	-0.315	0.803	-0.026		NE			NE			0.627	2.081	0.022		
Part time	0.232	1.076	0.013		NE			NE			-3.084	2.496	-0.075		
Monthly income (Ref: < USD1250)															
USD1250–2500	-1.337	0.898	-0.111	-1.200	0.791	-0.108		NE					-0.212**		
> USD2500	-0.616	1.052	-0.048	0.926	0.896	-0.077		NE					-0.049		
Religion (Ref: Islam)															
Hinduism	5.352	1.679	0.418**	3.265	1.496	0.276*	5.149	1.637	0.395**				NE		
Others <sup>a</sup>	4.992	1.751	0.356**	3.434	1.572	0.266*	5.512	1.725	0.388**				NE		
Perceived knowledge (Ref: Very poor/ poor/average)	-1.299	0.752	-0.109	-2.058	0.646	-0.186**	-2.049	0.712	-0.168**				NE		
Good/very good															
Worried about having infected with COVID (Ref:No)		NE		0.352	0.753	0.030		NE					-0.311	2.248	-0.010
Worried about family members having infected with COVID-19 (Ref:No)		NE			NE			1.132	0.780	0.083			1.358	2.288	0.043
Worried about not enough masks (Ref:No)	0.968	0.831	0.073		NE			1.259	0.810	0.093			-3.493	1.776	-0.111
Worried about losing job (Ref:No)		NE			NE			1.514	0.732	0.125*			4.557	1.769	0.159*



Table 4 (continued)

Variables	Depression			Anxiety			Stress			PTSDsymptoms		
	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$	B	SE B	$\beta$
Worried about being in quarantine (Ref:No)		NE		0.556	0.683	0.050		NE		0.483	1.700	0.017
Worried about healthcare collapse (Ref:No)		NE			NE			NE		6.754	1.704	0.234***
Worried about travel ban (Ref:No)	-0.645	0.735	-0.053	-2.138	0.737	-0.190**	-0.607	0.749	-0.049	-3.300	1.867	-0.114
R <sup>2</sup>		0.167			0.124			0.156			0.238	
Adjusted R <sup>2</sup>		0.111			0.086			0.113			0.196	

B regression coefficient, NE not entered into linear regression analysis using variables with p-value < 0.25 in univariate analysis as candidate variables, NM not entered into regression model due to potential multicollinearity problem, PTSD Post-traumatic stress disorder, R<sup>2</sup> proportion of variance explained by multivariable regression model, SE standard error of the regression coefficient,  $\beta$  standardized coefficients

\*p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001

<sup>a</sup>Others included Sikhism, Buddhism, Christianity, no religion, Kirat, Jain, and not mentioned

worried about travel ban was identified as a protective factor of anxiety. Further research is needed to explore the link between such worry and anxiety.

This study is subjected to several limitations. Firstly, the cross-sectional study design precludes causality ascertainment. Secondly, the over-representation of participants with knowledge of English and Pakistani women compared with the demographic profile of South Asians reported in the latest census [13], compounded with the use of convenience and snowball sampling strategies, instead of random sampling, limited the generalisability of the findings to the entire South Asian population in Hong Kong. Thirdly, there is only a single time point; tracking of changes of study outcomes across the pandemic trajectory is not possible. Finally, the psychological outcomes were based on self-report, which may not necessarily align with clinical assessments.

## Conclusions

South Asian minorities in Hong Kong experienced moderate levels of stress and high levels of depression, anxiety and PTSD symptoms during the COVID-19 pandemic. In particular, being male, being single or divorced, having a low income, being non-Muslim, having a lower perceived knowledge about COVID-19 and having worried about losing job and healthcare collapse were significant predictors of more negative psychological outcomes. These findings imply an urgent need for culturally sensitive measures to mitigate the negative psychological impacts of the pandemic on ethnic minorities, especially targeting the higher risk groups. For example, culturally compatible role models such as health ambassadors [39] should be identified and trained to proactively disseminate COVID-19-related information to their peers. Recognising that mental health services targeting ethnic minorities are largely lacking in Hong Kong, the government or NGOs should establish mental health support services that are culturally sensitive to ethnic minorities. As the end of the pandemic is still out of sight, longitudinal studies are warranted to assess the long-term psychological impact of the pandemic on ethnic minorities and identify the most vulnerable groups for intervention.

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## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical Approval** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by Survey and Behavioural Research Committee of the Chinese University of Hong Kong (reference number: SBRE-19–808).

**Consent to Participate** Online consent was obtained from each participant prior to completing the study survey.

**Consent for Publication** Not applicable.

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