Mental distress during the COVID-19 pandemic: Its association with public perceptions toward government's pandemic responses and lifestyle changes

Juliet Honglei Chen[1,2] · Eilo Wing-yat Yu[3] · Xiaoyu Su[1,4] · Kwok Kit Tong[1] · Anise M. S. Wu[1,2]

Abstract

In order to propose better mental health interventions under the pandemic threat, the present study aimed to investigate whether depression and anxiety are associated to Chinese adults' perceptions of government's pandemic responses and the personal lifestyle changes imposed by those responses during the COVID-19 pandemic. We used a telephone survey with random sampling and obtained a probability community sample of 616 adults (39.1% men; $M_{age} = 41.7$, $SD_{age} = 16.3$) in Macao, China in April 2020. The prevalence of 8.8% probable depression and 12.0% probable anxiety was observed in this sample. Positive perceptions toward government's pandemic responses were found to be negatively associated with probable depression and probable anxiety (ORu = .36 and .41, $p < .05$). Three lifestyle-changing stressors (i.e., increased family conflict, friendship deterioration, and weight gain), were commonly reported (29.9, 27.5, and 43.0% respectively), and displayed positive associations with probable depression (ORu = 1.67 to 1.87, $p < .05$) and probable anxiety (ORu = 1.54 to 2.10, $p < .05$). Our findings suggest protective effects of perceived trust and satisfaction regarding government's pandemic responses against mental distress and the potential mental health threats from three pandemic-specific lifestyle-changing stressors. These findings can inform clinicians and policymakers to better prepare for the mental health impacts of the current and future pandemics.

Keywords Mental distress · Pandemic · Perception · Trust · Public satisfaction · Weight gain

Introduction

Ever since its outbreak in December 2019, Coronavirus Disease 2019 (COVID-19) has posed unprecedented challenges to humankinds' physical and mental health on a global scale. By the end of July, the total number of confirmed COVID-19 cases worldwide had mounted to 17,106,007 and resulted in 668,910 deaths (World Health Organization [WHO], 2020a). What is less visible from these numbers is how COVID-19 has afflicted people with regard to their mental health. Learning from past experience of similar public health crises, such as Severe Acute Respiratory Syndrome (SARS) and Ebola, the mental effects associated to epidemics and pandemics appear to be more intense, pervasive, and enduring than the merely physical effects of an infection (Cheng, 2004; Desclaux, Diop, Doyon, Hofman, & Au, 2017; Mak, Chu, Pan, Yiu, & Chan, 2009). Depression and anxiety are two commonly reported mental distress during pandemics (Taylor, 2019). Although still limited in number and scope, the evidence thus far has underscored the emergence of depression and anxiety with the progress of the ongoing COVID-19 pandemic in communities (e.g., E. P. H. Choi, Hui, & Wan, 2020; González-Sanguino et al., 2020; Qiu et al., 2020), and these effects are potentially long lasting (Wang et al., 2020b). These studies have also examined the correlates of mental distress during the COVID-19 pandemic, but most of them either explored sociodemographic correlates alone (e.g., Ahmed et al., 2020; Cao et al., 2020; Qiu et al., 2020) or focused on relatively general risk/protective factors (e.g., social media exposure; Gao et al., 2020). Further research on pandemic-specific factors are warranted to inform clinicians and policymakers to develop more tailored

✉ Anise M. S. Wu
anisewu@um.edu.mo

1 Department of Psychology, Faculty of Social Sciences, University of Macau, Macao, China

2 Centre for Cognitive and Brain Sciences, University of Macau, Macao, China

3 Department of Government and Public Administration, Faculty of Social Sciences, University of Macau, Macao, China

4 Department of Social Psychology, Zhouenlai School of Government, Nankai University, Tianjin, China

measures to manage the next stage of battling with the coronavirus and its influence, as well as enrich our collective knowledge to better prepare for future epidemics/pandemics. In the present study, we aimed to examine whether public perceptions of government's pandemic responses and their experiences with respect to pandemic-imposed lifestyle changes were associated with probable depression and anxiety among Chinese community-dwelling adults in Macao, China.

The first confirmed COVID-19 case in Macao was discovered on 22 January 2020, but Macao's response to the pandemic had begun by 1 January 2020 (Macao SAR Centre for Disease Control and Prevention, 2020b). On the community level, a series of preventative measures were taken, which included, but were not limited to, compulsory quarantine for people returning from abroad, the shutdown of nonessential services, the recommendation to work and study from home, and a city lockdown. More detailed personal protective measures were issued on a personal level, such as wearing a face mask in public, proper hand washing, and social distancing. In addition to these overall measures, the Macao government implemented the Guaranteed Mask Supply for Macao Residents Scheme, which ensured a sufficient supply and orderly distribution of face masks to every resident (Macao SAR Centre for Disease Control and Prevention, 2020a); this scheme also effectively averted the panic buying and shortage of personal protective equipment that was observed in other regions (e.g., Leung, Lam, & Cheng, 2020). Up to the end of July 2020, the Macao government had managed to contain the spread of the coronavirus to 46 confirmed cases (i.e., 44 imported, two import-related, and zero local infection) with zero mortality in Macao (Macao SAR Centre for Disease Control and Prevention, 2020b); the government's effective management of the disease is rather remarkable for a region with the highest population density in world.

Aside from effective government responses to the pandemic, a successful control of the infection may also rely on public perceptions towards these responses. During different types of crises, positive public perceptions toward government/institutions, including public trust and satisfaction, have been key factors that not only enhance the public compliance with precautionary measures (Blair, Morse, & Tsai, 2017; Nilima, Kaushik, Tiwary, & Pandey, 2020; Vinck, Pham, Bindu, Bedford, & Nilles, 2019), but also in their capacity to exert a protective effect against depression and anxiety (Bäuerle et al., 2020). In contrast, a lack of trust in government and/or its institutions has been found to be related to noncompliance with disease control interventions (Blair et al., 2017) and an elevated level of anxiety in the face of epidemics (Cheung & Tse, 2008; Hayllar, 2007). Therefore, we hypothesized a negative correlation between positive perceptions toward government's pandemic responses and probable depression/anxiety reported by Chinese community-dwelling adults during the COVID-19 pandemic in the present study.

Inevitably, some governmental regulations and guidance in response to COVID-19, such as community lockdown, working from home, and social distancing, have imposed restrictions on people's autonomy with respect to daily activities and even required lifestyle changes. Such restrictions may bring new stressors on both an interpersonal level, such as presenting challenges to one's social support system (e.g., family and friends) and on an intrapersonal level, in that one's physical health and self-image (e.g., weight gain) may be threatened, and such stressors have been shown to be associated with higher levels of depression and/or anxiety (H. Choi & Marks, 2008; Jorm et al., 2003; Lee, Jobe, & Mathis, 2020). Studies have revealed adverse outcomes of the COVID-19 pandemic on family relations, including deteriorated parent-child relationships after a one-month quarantine at home (Zheng, Li, Zhang, Jin, Li, Cao et al., 2020), an upsurge in incidents of domestic violence (Bradbury-Jones & Isham, 2020), and a spike in divorce rates (Y.-L. Liu, 2020). During the lockdown, lack of personal space and increased boredom at home (Wang, Zhang, Zhao, Zhang, & Jiang, 2020), together with financial stress caused by the coronavirus-burdened economy (Romano, 2020), are likely to be sources of increased family conflict. In the meantime, friendships are also challenged by a dramatic decrease in real-life interactions during the pandemic. In this study, we therefore examined how commonly the two interpersonal stressors (i.e., increased family conflict and friendship deterioration) were experienced during the pandemic among Chinese adults and whether they would be associated with probable depression and anxiety.

Weight gain is another noticeable phenomenon during the COVID-19 pandemic (Balzer, 2020) and was thus proposed as a potential intrapersonal-level stressor associated with depression and anxiety in the current study. On the one hand, the social distancing and stay-at-home orders tend to decrease individuals propensity to engage in physical activities and increase their tendency toward more sedentary activities, both of which contribute to a higher risk of weight gain (Rundle, Park, Herbstman, Kinsey, & Wang, 2020). On the other hand, as COVID-19 is highly contagious, with potentially fatal outcomes, the virus is also likely to induce the likelihood of stress, which can lead to greater consumption of foods high in sugar and fat, contributing to the development of obesity (Torres & Nowson, 2007). Weight gain, no matter how it occurs, has been found to be associated with elevated levels of depression and anxiety (Jorm et al., 2003). Moreover, depressive mood and anxiety may further lower one's social and physical activity levels and exacerbate the vicious cycle of obesity and distress (de Wit et al., 2010). In this study, we examined the extent to which Chinese adults experienced weight gain during the COVID-19 pandemic and whether this stressor was associated with probable depression and anxiety.

Methods

Respondents and Procedures

In April 2020, we conducted a telephone survey in Macao, China with a two-stage cluster random sampling method and acquired a probability sample of local Chinese. The inclusion criteria were both male and female local adult residents (18 years old or above), who were able to understand and speak either Cantonese or Mandarin Chinese. We first randomly selected households from the latest Macao phonebook in the first stage and then invited one adult, the one who mostly recently had his/her birthday among all the eligible respondents in the household (i.e., last-birthday rule; Gaziano, 2008), to take the survey in the second stage. Trained research assistants briefed the chosen respondents on the study aims and their rights as study participants. Only those who gave oral consent to participate in the study responded to the formal telephone survey, and no one received monetary incentives. An ethical approval for this study was obtained from the affiliated university of the corresponding author and the study was carried out in accordance with the 1964 Declaration of Helsinki and its later amendments.

Six hundred and sixteen respondents completed our telephone survey. According to the calculation method proposed by the American Association for Public Opinion Research (2016), the cooperation rate, which was the percentage of all cases interviewed versus all eligible respondents ever contacted, was 89.9%. This sample was comprised of 39.1% men (95% CI [35.2%, 43.0%]) and 60.9% women (95% CI [57.0%, 64.8%]) with an average age of 41.7 years ($SD =$ 16.3 years; range = 18 to 87 years). Most of the respondents had received education at the tertiary level (51.9%), followed by 25.6% at the senior level and 12.8% at the junior level. The majority of the respondents had a full- or part-time job (63.0%) whereas the rest were students (13.3%), retired (12.7%), homemakers (7.0%), unemployed (3.2%), or others (0.8%). None of them had prior infection by COVID-19, and 10 respondents (1.6%) reported having had a family member or friend infected.

Measures

Probable Depression and Anxiety

Two 7-item subscales from the Chinese version of the 21-item Depression Anxiety Stress Scale (DASS-21; Moussa, Lovibond, & Laube, 2001) were used to assess depressive (e.g., "I couldn't seem to experience any positive feeling at all.") and anxious symptoms (e.g., "I felt I was close to panic.") in the past week on a 4-point Likert scale, in which responses ranged from 0 = *did not apply to me at all* to 3 = *applied to me very much or most of the time*. The Cronbach's

alpha for depression and anxiety was .83 and .81, respectively. The total score of each subscale was multiplied by two to compute a composite score for depression and anxiety, which ranged from 0 to 42. A higher score indicated more symptoms of the corresponding mental distress. According to Moussa et al. (2001), a set of four cutoff points was utilized to categorize depression symptoms at mild ($\geq$ 10), moderate ($\geq$ 14), severe ($\geq$ 21), and extremely severe ($\geq$ 28) levels, and for anxiety symptoms at mild ($\geq$ 8), moderate ($\geq$ 10), severe ($\geq$ 15), and extremely severe ($\geq$ 20) levels. Consistent with previous studies (Chen, Tong, Wu, Lau, & Zhang, 2018; Wang et al., 2020a), the cutoff points for moderate levels were adopted for identifying probable cases with depression (i.e., $\geq$ 14; hereinafter *probable depression*) and anxiety (i.e., $\geq$ 10; hereinafter *probable anxiety*). Because the two DASS-21 subscales did not display a satisfactory discriminant validity in our study (i.e., both construct's average variance extracted [0.42 and 0.37] were smaller than their squared correlation [0.83] in the model; Fornell & Larcker, 1981), we also computed an "overall psychological distress" composite score by summing up the depression and anxiety scores as an additional reference score for comparison.

Positive Perceptions toward government's Pandemic Responses

In this study, positive perceptions towards government's reactions to the pandemic (hereinafter referred to as *perceptions toward government*) were used to measure one's trust and satisfaction regarding the local government's actions taken to combat the pandemic. This construct was measured by three items that were rated on a 5-point Likert scale, which ranged from 1 = *extremely unconfident/dissatisfied* to 5 = *extremely confident/satisfied*: (1) "How much confidence do you have that the local government can successfully combat the COVID-19 pandemic?" (2) "To what extent are you satisfied with the local government's policies against the pandemic?" and (3) "To what extent are you satisfied with the local government's performances against the pandemic?" Similar items and scaling methods were used in measuring related public perceptions towards authorities and/or governments in previous studies (e.g., Ryzin, 2004). The internal consistency of the three items was .80 in the present study. By averaging the three item scores, the composite score was computed for an overall perception, with a higher score indicating a more positive perception toward government's reactions.

Interpersonal and Intrapersonal Stressors during the Pandemic

The three stressors, which included increased family conflict, friendship deterioration, and weight gain, all of which were

deemed to be induced by the pandemic, were measured by three single-item scales: (1) "To what extent have your family conflicts increased due to the pandemic?" (2) "To what extent have your relationships with friends deteriorated due to the pandemic?" and (3) "To what extent have you gained weight due to the pandemic?" The respondents rated them on a 5-point Likert scale, which ranged from 1 = *not at all* to 5 = *a great deal*, and hence a higher score represented a greater degree of influence from the corresponding stressor.

Demographic Variables

Four general aspects of demographics were assessed, including gender, age, educational attainment, and working status (i.e., employed [full- or part-time], unemployed, retired, student, homemaker, and others). Respondents were also asked to report whether they and their family/friends had ever had COVID-19.

Statistical Analysis

After delineating the sample profiles and core constructs with descriptive statistics, we first explored the associations of depression/anxiety symptoms to the hypothesized correlates with Pearson's r for bivariate correlation in SPSS 25.0 (IBM, 2017). Subsequently, we tested the hypotheses regarding probable depression and anxiety by performing two sets of eight simple logistic regressions: first without and then controlling for gender, age, and education attainment. Finally, one multiple logistic regression was each performed to test the effects of all the proposed correlates together on probable depression and probable anxiety, respectively, after adjusting for gender, age, and education attainment. One additional multiple regression was conducted for depressive symptoms, anxiety symptoms, and overall psychological distress, respectively. All the regressions were conducted in Mplus 7.3 (Muthén & Muthén, 2012). The robust Maximum Likelihood (MLR), which does not assume multivariate normality and takes missing values into account, was chosen as the estimation method, albeit the cases with missing values at X-position were excluded from the model by default. In all these models, we treated (1) depression, anxiety, and overall psychological distress as dependent variables (binary form for logistic regression analyses while continuous form for multiple regression analyses), (2) perceptions towards government, increased family conflict, friendship deterioration, and weight gain as independent variables, and (3) gender, age, and educational attainment as controlling variables.

Results

The prevalence of probable depression was 8.8% (95% CI [6.6%, 11.0%]); specifically, 5.2% of the respondents were

considered to have moderate levels, 2.1% severe, and 1.5% extremely severe. The prevalence of probable anxiety was 12.0% (95% CI [9.4%, 14.6%]), which corresponds to 7.5% of respondents of moderate levels, 1.8% severe, 2.8% extremely severe. Men, compared to women, appeared to be more likely to suffer from both probable depression ($r_{pb} = -.10$, $p = .01$; 12.4% vs. 6.4%) and probable anxiety ($r_{pb} = -.09$, $p = .01$; 15.8% vs. 9.6%). Younger respondents were more vulnerable to probable anxiety ($r_{pb} = -.10$, $p = .01$) but not depression ($p > .05$). No significant association was observed between educational attainment and probable depression/anxiety ($p > .05$).

The majority of the respondents reported being satisfied or extremely satisfied with the government's pandemic-related policies (91.4%) and performance (92.4%), whereas 94.0% felt confident or extremely confident in the government's success in combating the pandemic. Regarding stressors that respondents reported experiencing at least to some extent (item score ≥ 2) during the pandemic, 29.9% reported an increase in family conflict, 27.5% friendship deterioration, and 43.0% weight gain. As shown in Table 1, a strong, positive correlation was observed between probable depression and probable anxiety ($\varphi = .57$, $p < .001$). The three stressors showed positive correlations with probable depression and probable anxiety ($r_{pb} = = .19$ to $.29$, $p < .001$), whereas perceptions toward government, which were favorable with respect to its response to the pandemic, was negatively correlated with probable depression and probable anxiety ($r_{pb} == - .17$ and $- .16$, $p < .001$).

The simple logistic regressions displayed similar results both with or without adjusting for gender, age, and education attainment (see Table 2). Those who perceived a higher level of positive perceptions toward government (ORu = 0.36 and 0.41, ORa = 0.40 and 0.50) were less likely to suffer from probable depression and probable anxiety. In contrast, those who reported a higher level of increase in family conflict (ORu = 1.86 and 2.10, ORa = 1.85 and 2.01), friendship deterioration (ORu = 1.87 and 1.66, ORa = 1.95 and 1.72), and weight gain (ORu = 1.67 and 1.54, ORa = 1.85 and 1.59) were more likely to be inflicted by probable depression and probable anxiety.

As shown in Table 3, after adjusting for differences in gender, age, and education attainment, multiple logistic regression results showed that the strongest correlate for probable depression was positive perceptions toward government (ORa = 0.38), followed by weight gain (ORa = 1.56), friendship deterioration (ORa = 1.49), and increased family conflict (ORa = 1.45), all of which explained 27.4% variance of probable depression. As for anxiety symptoms, positive perceptions toward government (ORa = 0.53) and increased family conflict (ORa = 1.77) appeared as the stronger factors, while and friendship deterioration (ORa = 1.38) and weight gain (ORa = 1.25) were weaker factors, especially with a marginal

Table 1 Descriptive statistics and bivariate correlations of core constructs ($N = 616$)

	M (SD)	1	2	3	4	5	6	7	8
1. Probable depression	0.09 (0.28)	1							
2. Probable anxiety	0.12 (0.33)	.57***	1						
3. Depressive symptoms	4.03 (6.27)	.81***	.65***	1					
4. Anxiety symptoms	3.26 (5.54)	.64***	.83***	.79***	1				
5. Psychological distress	7.29 (11.19)	.77***	.77***	.95***	.94***	1			
6. Perceptions toward government	4.26 (0.52)	−.17***	−.16***	−.25***	−.21***	−.24***	1		
7. Increased family conflict	1.46 (0.85)	.22***	.29***	.33***	.35***	.36***	−16***	1	
8. Friendship deterioration	1.45 (0.87)	.23***	.19***	.28***	.25***	.28***	−.05	.26***	1
9. Weight gain	1.77 (1.07)	.20***	.19***	.22***	.19***	.21***	.02	.34***	.29***

*** $p < .001$. The phi coefficient (φ) was reported for the correlation between the two dichotomous variables, probable depression and probable anxiety. Other correlations were calculated with Pearson's r or its special form, point biserial correlation (r_{pb})

significance ($p = .09$) for the weight gain. The overall explained variance of anxiety symptoms was 22.5%.

The linear relationship of depressive and anxiety symptoms and overall psychological distress with the hypothesized four IVs was also explored with three additional multiple regression analyses, controlling for gender, age, and educational attainment (see Table 4). The depressive and anxiety symptoms, corresponding to its converted DASS-21 subscale score, were treated as continuous variables in the models; while overall psychological distress, referring to the composite score of depression and anxiety symptoms, was also included in the model as a continuous variable. Similar to the multiple logistic regression results, we found a significant effect of perceptions toward government at a negative direction ($\beta = -0.20$, $p < .001$) and of increased family conflict, friendship deterioration, and weight gain at a positive direction ($\beta = 0.11$ to 0.23, $p = <.001$ to $.04$) on depressive symptoms, which explained 20.5% of the variance of depressive symptoms as a whole. Regarding anxiety symptoms, we found that the multiple regression model explained 19.9% of the variance of anxiety symptoms. Although a non-significant effect of weight gain was found ($\beta = 0.06$, $p = .20$), perceptions toward government displayed a negative correlation on anxiety symptoms ($\beta = -0.16$, $p = .007$); in contrast, both increased family conflict and friendship deterioration showed a positive association with anxiety symptoms ($\beta = 0.29$ and 0.13, $p = <.001$

and .03). Furthermore, the third multiple regression explained 22.2% of the variance of overall psychological distress and demonstrated a similar associative pattern as that of anxiety symptoms (i.e., a significant effect of all the other correlates except for weight gain [$p = .06$]).

Discussion

With a random sample of Chinese adults in Macao, the prevalence of probable depression (DASS-21 Depression ≥14) and probable anxiety (DASS-21 Anxiety ≥10) in April 2020 was 8.8 and 12.0%, respectively. These percentages are lower than those observed in mainland China during the early outbreak of the pandemic (DASS-21 Depression [≥ 14]: 16.5%, DASS-21 Anxiety [≥ 10]: 28.8%, in data collected during 31st Jan to 2nd February 2020; Wang, Pan, et al., 2020a) and also lower than those from a recent study conducted in Hong Kong (PHQ-9 Depression [≥ 10]: 19%, GAD Anxiety [≥ 10]: 14%, in data collected during 24th April to 3rd May 2020; Choi et al., 2020). The relatively lower prevalence of probable depression and anxiety was plausibly linked to the timing of our data collection (i.e., 11-20th April 2020), during which the pandemic seemed better under control locally with the incidences dropping to zero (from 8th April to 25th June 2020; Macao SAR Centre for Disease Control and Prevention,

Table 2 Simple logistic regressions of probable depression and probable anxiety

	Probable Depression		Probable anxiety	
	ORu [95% CI]	ORa [95% CI]	ORu [95% CI]	ORa [95% CI]
Perceptions toward government	0.36 [0.22, 0.59]*	0.40 [0.23, 0.67]*	0.41 [0.26, 0.65]*	0.50 [0.31, 0.81]*
Increased family conflict	1.86 [1.47, 2.37]*	1.85 [1.43, 2.40]*	2.10 [1.66, 2.64]*	2.01 [1.58, 2.56]*
Friendship deterioration	1.87 [1.48, 2.36]*	1.95 [1.48, 2.56]*	1.66 [1.34, 2.05]*	1.72 [1.36, 2.18]*
Weight gain	1.67 [1.36, 2.04]*	1.85 [1.47, 2.33]*	1.54 [1.29, 1.84]*	1.59 [1.31, 1.94]*

* $p < .05$. *ORu* odds ratio unadjusted. *ORa* odds ratio adjusted by gender, age, and education attainment

Table 3 Multiple logistic regression of probable depression and probable anxiety ($N = 542$)

	Probable Depression			Probable anxiety		
	B	p	ORa [95% CI]	B	p	ORa [95% CI]
Perceptions toward government	−0.97	.002	0.38 [0.21, 0.70]	−0.65	.02	0.53 [0.31, 0.90]
Increased family conflict	0.37	.04	1.45 [1.02, 2.05]	0.57	<.001	1.77 [1.32, 2.38]
Friendship deterioration	0.40	.02	1.49 [1.06, 2.10]	0.33	.04	1.38 [1.02, 1.88]
Weight gain	0.44	.004	1.56[1.15, 2.11]	0.23	.09	1.25 [0.97, 1.62]
	$R^2 = .274$			$R^2 = .225$		

ORa Odds ratio adjusted by gender, age, and education attainment

2020a). However, other studies have warned that there may be a delayed effect of pandemic-related mental distress at a desynchronized pace with the development of the pandemic (X. Liu et al., 2012; Taylor, 2019), and thus policymakers and mental health professionals are advised to take necessary precautions and interventions for a potential rise in depression and anxiety in Macao and other regions with a greater accumulated intensity.

The identified protective and risk factors for probable depression/anxiety cases (by logistic regression analyses) were more or less identical to those for the symptom severity of depression, anxiety, and overall psychological distress (by multiple regression analyses). The invariance of these findings across analyses indicates that the salient protective and risk factors remained the same for those who suffered from both types of psychological distress across the severity spectrum in our sample. We may further infer from these findings that our identified protective and risk factors can be applied to different levels of preventions among community-dwelling Chinese adults to intervene before mental effects occur, screening to identify mental distress in the earliest, and managing related distress after diagnosis. In the following, we will discuss each of these identified proactive and risk factors in detail.

Consistent with our hypothesis, we found that favorable perceptions toward the government's proactive response to the pandemic was negatively associated with both depression and anxiety. Similar patterns of negative associations have been observed between public perceptions of strong leadership by the government and worries or depression in a 58-country survey during the COVID-19 pandemic (Fetzer et al., 2020). The generally high public trust and satisfaction toward the government reported by the majority of our respondents (91.4–94.0%) appeared to be in line with the relatively lower prevalence of probable depression/anxiety in Macao when compared to neighboring regions. In addition, other studies have shown that the more confident and satisfied residents were with their government's leadership in combating the pandemic, the more likely they were to comply with those personal preventative measures advocated by the government (Nilima et al., 2020). Therefore, these perceptions may be the key to promising pandemic-related outcomes in terms of both physical and mental health. The pandemic experience of Macao suggests that effective government measures are conducive to earning public trust and satisfaction, while such positive perceptions are highly plausible to inspire more confidence in these measures along with individuals' willingness to sacrifice their short-term interests for mass cooperation with the government and in the meantime lowering their mental distress. In those countries/regions with low public trust in, or satisfaction with, the government, related stakeholders are advised to utilize this virtuous cycle: through responding more promptly and effectively to the fluctuations of the ongoing COVID-19 outbreaks and future epidemics/pandemics, they may establish more favorable public perceptions toward epidemic/pandemic-related measures, which may also lessen the mental burdens associated with pandemics.

Table 4 Multiple regression of depressive and anxiety symptoms ($N = 542$)

	Depressive symptoms		Anxiety symptoms		Psychological distress	
	β [95% CI]	p	β [95% CI]	p	β [95% CI]	p
Perceptions toward government	−0.20 [−0.31, −0.10]	<.001	−0.16 [−0.28, −0.05]	.007	−0.20 [−0.30, −0.09]	<.001
Increased family conflict	0.23 [0.11, 0.36]	<.001	0.29 [0.18, 0.41]	<.001	0.27 [0.16, 0.39]	<.001
Friendship deterioration	0.15 [0.03, 0.26]	.01	0.13 [0.02, 0.24]	.03	0.15 [0.03, 0.26]	.01
Weight gain	0.11 [0.01, 0.21]	.04	0.06 [−0.03, 0.16]	.20	0.09 [−0.004, 0.19]	.06
	$R^2 = .205$		$R^2 = .199$		$R^2 = .222$	

Gender, age, and education attainment were controlled for all the multiple regressions

When looking into the three lifestyle-changing stressors, we observed that a sizable proportion (29.9%, 27.5%, and 43.0%) of our respondents suffered to a certain extent from an increase in family conflict, deterioration in friendships, and weight gain, respectively, during the pandemic. As hypothesized, the former two interpersonal stressors were positively associated with probable depression/anxiety among Macao residents. In particular, the increased level of family conflict due to the pandemic reported by our Chinese respondents emerged as the most salient risk factor of their probable anxiety. For possible remedies, parents are advised to engage more in daily rituals that can improve family relationships and help to pass the time (World Health Organization [WHO], 2020b); government and related parties are recommended to be more alert to increased domestic violence during the pandemic and to collaborate with clinicians to provide therapeutic support (Bradbury-Jones & Isham, 2020; Campbell, 2020). Proper use of social media for online interaction and communication may be promoted, particularly in older adults (Armitage & Nellums, 2020), as a means to compensate for the lack of offline interpersonal contact. Weight gain also displayed a positive correlation with depression and anxiety symptoms, but it was a stronger risk factor for depression than for anxiety. The latter finding was consistent with previous studies (e.g., Rivenes, Harvey, & Mykletun, 2009; Strine et al., 2008). To cope with pandemic-related lifestyle changes, which involve but are not limited to the aforementioned three stressors, tailored guidelines are needed to coach individuals on how to prevent and deal with the emergence of potential problems due to the lack of personal space at home, how to maintain an effective social support system in the face of social distancing, and how to regulate diet and increase exercise levels indoors (Mackolil & Mackolil, 2020). Clinicians are recommended to consider these identified lifestyle-changing stressors during the early detection of and the intervention design for depression and anxiety. They may also design specialized trainings on emotional management through various online platforms to encourage citizens to enrich their knowledge and enhance their skills in performing daily activities to enhance mental health on their own and in the early identification of the potential need to seek professional help (Bavel et al., 2020; Taylor, 2019).

The present study is limited in several aspects. First, due to its cross-sectional design, we cannot trace changes in respondents' mental status over time and further test our hypotheses as the external environment changes, nor can we make causal inferences on the relations of the identified protective and risk factors to mental distress. The present study relies on subsequent studies with longitudinal or experimental designs for additional explorations, especially the plausible interaction between stressors and mental distress in a recursive loop. Second, self-constructed scales were used in this study to assess COVID-19 stressor variables because validated scales

were not available, while a satisfactory discriminant validity of DASS-21 depression and anxiety subscales was not obtained in our study. Subsequent studies with broader scopes may further examine these scales. Third, as Macao provides a macro environment of few COVID-19 infections, we encourage replication studies of our findings in regions with more COVID-19 infections, so that the robustness of these pandemic-related factors can be tested. In addition, the focus of this study was on pandemic-related factors related to government and lifestyle changes only and thus missed other general trait factors, such as personal adaptive coping strategies (Polizzi, Lynn, & Perry, 2020), which are worth further consideration together with our pandemic-specific factors. Therefore, future studies are encouraged to broaden the scope of protective and risk factors to delineate a more comprehensive picture of individuals' mental health under the conditions of a pandemic.

Conclusions

The present study made the first attempt to examine how one's perceptions toward the government's pandemic responses and lifestyle-changing stressors during the COVID-19 pandemic were associated with his/her probable depression and probable anxiety among Chinese residents with a probability community sample. Our findings suggest that perceived trust and satisfaction in the local government's actions and outcomes may be salient factors in one's mental disorder development during a public health crisis. Meanwhile, three lifestyle-changing stressors associated to the pandemic-related measures, namely increased family conflict, friendship deterioration, and weight gain, were identified as potential risk factors for an increased likelihood of both probable depression and probable anxiety in the face of the pandemic. Policymakers and health professionals may consider these three stressors when designing screening tools and prevention/intervention programs to mitigate the mental impact associated with the current, as well as future pandemics, and to help prepare for the potential rise of mental distress as the pandemic develops and for its prolonged aftermath effects.

Data Availability The dataset generated during and/or analyzed during the current study is available from the corresponding author on reasonable request.

Declarations

Ethics Approval This research was approved by Research Ethics Committee, Department of Psychology, University of Macau.

Conflict of Interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Ahmed, M. Z., Ahmed, O., Aibao, Z., Hanbin, S., Siyu, L., & Ahmad, A. (2020). Epidemic of COVID-19 in China and associated psychological problems. *Asian Journal of Psychiatry, 51*, 102092. https://doi.org/10.1016/j.ajp.2020.102092.

American Association for Public Opinion Research. (2016). Standard definitions: Final dispositions of case codes and outcome rates for surveys (9th ed.). Oakbrook Terrace, IL: AAPOR. Retrieved from https://www.aapor.org/Standards-Ethics/Standard-Definitions-(1).aspx. Accessed 1 December 2019.

Armitage, R., & Nellums, L. B. (2020). COVID-19 and the consequences of isolating the elderly. *The Lancet Public Health, 5*(5), e256. https://doi.org/10.1016/S2468-2667(20)30061-X.

Balzer, D. (2020). Packing on pounds during COVID-19 and how to turn it around. Retrieved from https://newsnetwork.mayoclinic.org/discussion/packing-on-pounds-during-covid-19-and-how-to-turn-it-around/. Accessed 10 July 2020.

Bäuerle, A., Teufel, M., Musche, V., Weismüller, B., Kohler, H., Hetkamp, M., … Skoda, E.-M. (2020). Increased generalized anxiety, depression and distress during the COVID-19 pandemic: A cross-sectional study in Germany. *Journal of Public Health*, fdaa106. https://doi.org/10.1093/pubmed/fdaa106.

Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., Kitayama, S., Mobbs, D., Napper, L. E., Packer, D. J., Pennycook, G., Peters, E., Petty, R. E., Rand, D. G., Reicher, S. D., Schnall, S., Shariff, A., Skitka, L. J., Smith, S. S., Sunstein, C. R., Tabri, N., Tucker, J. A., Linden, S., Lange, P., Weeden, K. A., Wohl, M. J. A., Zaki, J., Zion, S. R., & Willer, R. (2020). Using social and behavioural science to support COVID-19 pandemic response. *Nature Human Behaviour, 4*(5), 460–471. https://doi.org/10.1038/s41562-020-0884-z.

Blair, R. A., Morse, B. S., & Tsai, L. L. (2017). Public health and public trust: Survey evidence from the Ebola virus disease epidemic in Liberia. *Social Science & Medicine, 172*, 89–97. https://doi.org/10.1016/j.socscimed.2016.11.016.

Bradbury-Jones, C., & Isham, L. (2020). The pandemic paradox: The consequences of COVID-19 on domestic violence. *Journal of Clinical Nursing, 29*(13–14), 2047–2049. https://doi.org/10.1111/jocn.15296.

Campbell, A. M. (2020). An increasing risk of family violence during the Covid-19 pandemic: Strengthening community collaborations to save lives. *Forensic Science International: Reports, 2*, 100089. https://doi.org/10.1016/j.fsir.2020.100089.

Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Research, 287*, 112934. https://doi.org/10.1016/j.psychres.2020.112934.

Chen, J. H., Tong, K. K., Wu, A. M. S., Lau, J. T. F., & Zhang, M. X. (2018). The comorbidity of gambling disorder among Macao adult residents and the moderating role of resilience and life purpose. *International Journal of Environmental Research and Public Health, 15*(12), 2774. https://doi.org/10.3390/ijerph15122774.

Cheng, C. (2004). To be paranoid is the standard? Panic responses to SARS out-break in the Hong Kong special administrative region. *Asian Perspective, 28*(1), 67–89.

Cheung, C., & Tse, J. W. (2008). Institutional trust as a determinant of anxiety during the SARS crisis in Hong Kong. *Social Work in Public Health, 23*(5), 41–54. https://doi.org/10.1080/19371910802053224.

Choi, E. P. H., Hui, B. P. H., & Wan, E. Y. F. (2020). Depression and anxiety in Hong Kong during COVID-19. *International Journal of Environmental Research and Public Health, 17*(10), 3740. https://doi.org/10.3390/ijerph17103740.

Choi, H., & Marks, N. F. (2008). Marital conflict, depressive symptoms, and functional impairment. *Journal of Marriage and Family, 70*(2), 377–390. https://doi.org/10.1111/j.1741-3737.2008.00488.x.

de Wit, L. M., Fokkema, M., van Straten, A., Lamers, F., Cuijpers, P., & Penninx, B. W. J. H. (2010). Depressive and anxiety disorders and the association with obesity, physical, and social activities. *Depression and Anxiety, 27*(11), 1057–1065. https://doi.org/10.1002/da.20738.

Desclaux, A., Diop, M., Doyon, S., Hofman, M., & Au, S. (2017). Fear and containment: Contact follow-up and social effects in Senegal and Guinea. In: *The politics offear: Medecins sans Frontieres and the west African ebola epidemic* (pp. 210–234). New York: Oxford University Press.

Fetzer, T., Witte, M., Hensel, L., Jachimowicz, J. M., Haushofer, J., Ivchenko, A., … Yoeli, E. (2020). Global behaviors and perceptions in the COVID-19 pandemic. *Harvard Business School Working Paper*, 20–111.

Fornell, C. G., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.1177/002224378101800104.

Gao, J., Zheng, P., Jia, Y., Chen, H., Mao, Y., Chen, S., Wang, Y., Fu, H., & Dai, J. (2020). Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One, 15*(4), e0231924. https://doi.org/10.1371/journal.pone.0231924.

Gaziano, C. (2008). Last-birthday selection. In P. J. Lavrakas (Ed.), *Encyclopedia of survey research methods* (pp. 417–418). Thousand Oaks: SAGE Publications.

González-Sanguino, C., Ausín, B., Castellanos, M. Á., Saiz, J., López-Gómez, A., Ugidos, C., & Muñoz, M. (2020). Mental health consequences during the initial stage of the 2020 coronavirus pandemic (COVID-19) in Spain. *Brain, Behavior, and Immunity, 87*, 172–176. https://doi.org/10.1016/j.bbi.2020.05.040.

Hayllar, M. R. (2007). Governance and community engagement in managing SARS in Hong Kong. *Asian Journal of Political Science, 15*(1), 39–67. https://doi.org/10.1080/02185370701315582.

IBM Corp. (2017). IBM SPSS statistics, Version 25.0. Armonk, NY: IBM Corp.

Jorm, A. F., Korten, A. E., Christensen, H., Jacomb, P. A., Rodgers, B., & Parslow, R. A. (2003). Association of obesity with anxiety, depression and emotional well-being: A community survey. *Australian and New Zealand Journal of Public Health, 27*(4), 434–440. https://doi.org/10.1111/j.1467-842X.2003.tb00423.x.

Lee, S. A., Jobe, M. C., & Mathis, A. A. (2020). Mental health characteristics associated with dysfunctional coronavirus anxiety. *Psychological Medicine*, 1–2. https://doi.org/10.1017/S003329172000121X.

Leung, C. C., Lam, T. H., & Cheng, K. K. (2020). Mass masking in the COVID-19 epidemic: People need guidance. *The Lancet, 395*(10228), 945. https://doi.org/10.1016/S0140-6736(20)30520-1.

Liu, X., Kakade, M., Fuller, C. J., Fan, B., Fang, Y., Kong, J., Guan, Z., & Wu, P. (2012). Depression after exposure to stressful events: Lessons learned from the severe acute respiratory syndrome epidemic. *Comprehensive Psychiatry, 53*(1), 15–23. https://doi.org/10.1016/j.comppsych.2011.02.003.

Liu, Y.-L. (2020). Is Covid-19 changing our relationships? Retrieved from https://www.bbc.com/future/article/20200601-how-is-covid-19-is-affecting-relationships. Accessed 10 July 2020).

Macao SAR Centre for Disease Control and Prevention. (2020a). Special webpage against Epidemics: Guaranteed mask supply for Macao residents scheme. Retrieved from https://www.ssm.gov.mo/apps1/PreventCOVID-19/en.aspx#clg17311. Accessed 11 July 2020.

Macao SAR Centre for Disease Control and Prevention. (2020b). Special webpage against Epidemics: Statistics. Retrieved from https://www.ssm.gov.mo/apps1/PreventCOVID-19/en.aspx#clg17046. Accessed 15 July 2020.

Mackolil, J., & Mackolil, J. (2020). Addressing psychosocial problems associated with the COVID-19 lockdown. *Asian Journal of Psychiatry, 51*, 102156. https://doi.org/10.1016/j.ajp.2020.102156.

Mak, I. W. C., Chu, C. M., Pan, P. C., Yiu, M. G. C., & Chan, V. L. (2009). Long-term psychiatric morbidities among SARS survivors. *General Hospital Psychiatry, 31*(4), 318–326. https://doi.org/10.1016/j.genhosppsych.2009.03.001.

Moussa, M. T., Lovibond, P. F., Laube, R. (2001). Psychometric properties of a Chinese version of the short depression anxiety stress scales (DASS21). In *Report for New South Wales Transcultural Mental Health Centre*. Sydney, Australia: Cumberland hospital. Retrieved from http://www2.psy.unsw.edu.au/dass/Chinese/Chinese%20DASS21%20Paper.Pdf. Accessed 5 December 2018.

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide* (7th ed.). Los Angeles: Muthén & Muthén.

Nilima, N., Kaushik, S., Tiwary, B., & Pandey, P. K. (2020). Psychosocial factors associated with the nationwide lockdown in India during COVID- 19 pandemic. *Clinical Epidemiology and Global Health*, S2213398420301676 https://doi.org/10.1016/j.cegh.2020.06.010.

Polizzi, C., Lynn, S. J., & Perry, A. (2020). Stress and coping in the time of COVID-19: Pathways to resilience and recovery. *Clinical Neuropsychiatry, 17*(2), 59–62. https://doi.org/10.36131/CN20200204.

Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., & Xu, Y. (2020). A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: Implications and policy recommendations. *General Psychiatry, 33*(2), e100213. https://doi.org/10.1136/gpsych-2020-100213.

Rivenes, A. C., Harvey, S. B., & Mykletun, A. (2009). The relationship between abdominal fat, obesity, and common mental disorders: Results from the HUNT study. *Journal of Psychosomatic Research, 66*(4), 269–275. https://doi.org/10.1016/j.jpsychores.2008.07.012.

Romano, F. (2020). Could COVID-19 Lead to another great depression? Evidence from the USA and Australia. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3609548.

Rundle, A. G., Park, Y., Herbstman, J. B., Kinsey, E. W., & Wang, Y. C. (2020). COVID-19–related school closings and risk of weight gain among children. *Obesity, 28*(6), 1008–1009. https://doi.org/10.1002/oby.22813.

Ryzin, G. G. V. (2004). The measurement of overall citizen satisfaction. *Public Performance & Management Review, 27*(3), 9–28.

Strine, T. W., Mokdad, A. H., Dube, S. R., Balluz, L. S., Gonzalez, O., Berry, J. T., Manderscheid, R., & Kroenke, K. (2008). The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *General Hospital Psychiatry, 30*(2), 127–137. https://doi.org/10.1016/j.genhosppsych.2007.12.008.

Taylor, S. (2019). *The psychology of pandemics: Preparing for the next global outbreak of infectious disease*. Newsastle upon Tyne, UK: Cambridge Scholars Publishing.

Torres, S. J., & Nowson, C. A. (2007). Relationship between stress, eating behavior, and obesity. *Nutrition, 23*(11–12), 887–894. https://doi.org/10.1016/j.nut.2007.08.008.

Vinck, P., Pham, P. N., Bindu, K. K., Bedford, J., & Nilles, E. J. (2019). Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in north Kivu, DR Congo: A population-based survey. *The Lancet Infectious Diseases, 19*(5), 529–536. https://doi.org/10.1016/S1473-3099(19)30063-5.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020a). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health, 17*(5), 1729. https://doi.org/10.3390/ijerph17051729.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., Choo, F. N., Tran, B., Ho, R., Sharma, V. K., & Ho, C. (2020b). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, Behavior, and Immunity, 87*, 40–48. https://doi.org/10.1016/j.bbi.2020.04.028.

Wang, G., Zhang, Y., Zhao, J., Zhang, J., & Jiang, F. (2020). Mitigate the effects of home confinement on children during the COVID-19 outbreak. *The Lancet, 395*(10228), 945–947. https://doi.org/10.1016/S0140-6736(20)30547-X.

World Health Organization [WHO]. (2020a). *Coronavirus disease 2019 (COVID-19) situation report-193*. Retrieved from https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200731-covid-19-sitrep-193.pdf?sfvrsn=42a0221d_4. Access on 1 August 2020.

World Health Organization [WHO]. (2020b). *Mental health and psychosocial considerations during the COVID-19 outbreak*. Retrieved from https://www.who.int/publications-detail-redirect/WHO-2019-nCoV-MentalHealth-2020.1. Accessed 30 July 2020.

Zheng, Y., Li, J., Zhang, M., Jin, B., Li, X., Cao, et al. (2020). A survey of the psychological status of primary school students who were quarantined at home during the coronavirus disease 2019 epidemic in Hangzhou China. Retrieved from https://doi.org/10.1101/2020.05.28.20115311.