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Research paper

Prevalence, risk factors and clinical correlates of depression in quarantined population during the COVID-19 outbreak

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ABSTRACT

Background: The COVID-19 outbreak has brought tremendous psychological pressure to the general population, which may lead to depression. Therefore, this study aim to evaluate the prevalence and clinical correlates of depressive symptoms in the general population quarantined during the COVID-19 outbreak in Shenzhen.
Methods: 2237 quarantined general individuals participated in this cross-sectional study from February 14 to March 4, 2020, during their 14 days quarantine. They completed the Zung's Self-Rating Depression Scale (SDS) for depression, Zung's self-rating anxiety scale (SAS) for anxiety, the Pittsburgh Sleep Quality Index (PSQI) for sleep quality, and the Impact of Events Scale-Revised (IES-R) for post-traumatic stress symptoms (PTSS).
Results: The prevalence of depressive symptom was 6.21% in quarantined individuals. The depressed group were younger, less married and educated, and had higher SAS, PSQI, IES-R total scores (all $p < 0.05$), as well as more avoidance, intrusion and hyperarousal symptoms than the non-depressed group. Correlation analysis showed significant correlations between SDS score and the following parameters: age, marriage, education, SAS, PSQI, IES-R total and its three subscale scores (Bonferroni corrected all $p < 0.05$). Further multiple regression indicated that age, marriage, education, SAS, PSQI, IES-R total score, Avoidance and Hyperarousal factor were independent predictors of depressive symptom.
Limitations: This study adopted a cross-sectional design and used self-report questionnaires.
Conclusions: Our results suggest an elevated prevalence of depressive symptom in quarantined general individuals in Shenzhen. Some demographic and clinical variables were associated with depressive symptoms.

1. Introduction

Since the December of 2019, 2019 Novel Coronavirus Pneumonia (COVID-19) infection has broken out in China, resulting in more than 80,000 infections and more than 3000 deaths there, and a huge number of people have been quarantined. The rapid spread and high mortality of COVID-19 seriously threaten people's physical and mental health, and cause a series of mental diseases such as depression, post-traumatic stress disorder, anxiety, and panic disorder. According to previous studies, depression is one of the most common mental disorders triggered by emerging infectious disease (EID) (Mak et al., 2009). Recent studies have shown that during the COVID-19 outbreak, the depression rate in the general population ranges from 3.7%~48.3% (Ahmed et al., 2020; Gao et al., 2020; Lei et al., 2020; Tan et al., 2020; Wang et al., 2020a, 2020b; Zhang et al., 2020), and 6.46%~50.7% among medical workers in China(Chen et al., 2020; Chew et al., 2020; Liu et al., 2020b; Shen et al., 2020; Zhang et al., 2020).

The prevalence of depressive symptoms is high during the COVID-19 pandemic(Ahmed et al., 2020; Chen et al., 2020; Gao et al., 2020; Lei et al., 2020; Liu et al., 2020a; Wang et al., 2020a, 2020b). Without

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early intervention, these depressive symptoms may develop into long-term depression (Lee et al., 2019), which has been confirmed by previous studies, showing that the prevalence rate of depression during follow-up is about 15.6–40.4% (Lee et al., 2007; Mak et al., 2009). For example, Lee et al. found that one year after the end of SARS, the prevalence of depressive symptoms among survivors was 40.4% (Lee et al., 2007). Another study reported that 12 and 18 months after the MERS outbreak, the prevalence of depression among survivors was 26.9% and 17.3%, respectively (Lee et al., 2019). Mak et al. found that 15.6% of survivors suffered from depression 30 months after the SARS outbreak (Mak et al., 2009). In another 4-year follow-up study, the prevalence of depression among SARS survivors was 39.0% (Lam et al., 2009). Persistent depression may lead to severe cognitive impairment (Semkovska et al., 2019), severe social dysfunction (Tunvirachaisakul et al., 2018), poor life quality (Sharma et al., 2020; Ebert et al., 2018; Hofmann et al., 2017; Kwek et al., 2006), and even serious suicidal behavior (Ribeiro et al., 2018; Ernst et al., 2019). However, the progression of depressive symptoms during an outbreak can be prevented through early mental health services. Therefore, there is an urgent need for timely psychological assessment and appropriate intervention to prevent the development of depressive symptom (Liu et al., 2020a).

Several previous studies have found that quarantine during epidemics is a predictor of depressive symptoms (Bai et al., 2004; Hawryluck et al., 2004; Liu et al., 2012). However, these studies have focused on health workers and survivors. For example, a study in Toronto reported that the prevalence of depressive symptoms among quarantined individuals during SARS was 31.2% (Hawryluck et al., 2004), and their sample was a mixture of the general public and medical staff (Hull, 2005). However, three other studies failed to distinguish the prevalence of depression among subjects with or without quarantine. For example, a study in Taiwan reported that after SARS control, the prevalence of depressive symptoms in the general population was 3.7%, with mixed samples including subjects with or without quarantine experience (Ko et al., 2006). A previous study in Taiwan reported that the prevalence of depressive symptoms among medical staff during SARS was 11% (38/338), of which only 15% (6/38) had experienced quarantine (Bai et al., 2004). Another study from Beijing found that 3 years after the outbreak of SARS, the prevalence of moderate and severe depressive symptoms among medical workers was 14.0% (77/549) and 8.8% (48/549), respectively (Liu et al., 2012). Therefore, the prevalence of depressive symptoms among the quarantined general population is still inconsistent, probably due to the different sampling issues in these studies, which deserves further study.

Although several studies have investigated depression in the general population in China (Ahmed et al., 2020; Gao et al., 2020; Lei et al., 2020; Tan et al., 2020; Wang et al., 2020a, 2020b; Zhang et al., 2020), none of these studies focused on the general population who were quarantined for 14 days. To the best of our knowledge, there is no epidemiological data on depressive symptoms in the quarantined general population during the COVID-19 pandemic, and the prevalence and risk factors of depressive symptoms are unknown. Therefore, the purposes of this study were to investigate 1) the prevalence, risk factors and clinical correlates of depressive symptoms in quarantined general population in Shenzhen, China; and 2) the association between depressive symptoms and demographic or clinical characteristics. Through this study, we hoped to be able to identify the risk factors for depressive symptoms and provide appropriate management strategies and use practical interventions to improve depressive symptoms for the general population during the quarantine period.

2. Methods

2.1. Subjects

The data were collected by our epidemiological investigation team. People between the ages of 18 and 70 years who were staying in 14 days of quarantine period in Nanshan district of Shenzhen city, without clear diagnosis of COVID-19 infection, were invited to participate in this cross-sectional study. A total of 2726 subjects were screened. 373 children under 18 years old were excluded because the samples were concentrated on individuals over 18 years old. Also, 18 elderly people over 70 years old were excluded because of potential cognitive impairment. Further, 98 subjects were excluded because they refused to participate or submitted contradictory or careless answers on SAS or SDS. Finally, a total of 2237 subjects participated in our study. Among them, 681 subjects were between 18 and 30 years old, 1340 were between 31 and 50 years old, and 216 were between 51 and 70 years old. The response rate was 95.8%.

This study was approved by the Ethics Review Committee of Shenzhen Nanshan People's Hospital affiliated to Shenzhen University. All subjects gave signed, informed consent to participate in the study.

2.2. Procedures

The mental health assessment questionnaire was delivered to the subjects face to face by the epidemiological investigation team. Each subject completed a detailed questionnaire via Wechat to reduce the likelihood of exposure to contaminated subjects (Wechat is a widely used social media application in China) and provide general information and socio-demographic characteristics, including age, sex, marriage, education, smoking statue, drinking statue, and psychological status. The survey was conducted in their home, hotels and hospitals during their quarantine period of COVID-19 from February 14 to March 4, 2020. Each subject was provided with a free COVID-19 throat swab test provided by the epidemiological investigation team, but none of the subjects were positive for COVID-19 infection.

2.3. Measurements of clinical symptoms

2.3.1. Depression

Depressive symptoms were evaluated by Zung's Self-Rating Depression Scale (SDS). This scale consists of 20 items, of which 10 items indicate negative experience and 10 items indicate positive experience, with a 4-point Likert scale ranging from 1 (none, or little time) to 4 (most, or all times). In this study, the cut-off point for depressive symptoms was based on an index score of 50 (Jokelainen et al., 2019; Zung, 1965).

2.3.2. Anxiety

Anxiety symptoms were assessed by Zung's self-rating anxiety scale (SAS). This is a 20-item scale for assessing psychological and physical anxiety symptoms. Respondents scored each item based on how they felt over the past week, ranging from 1 (none or small) to 4 (most or all times) (Zung, 1971).

2.3.3. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI) is a self-rated scale that assesses sleep quality and interference over a month. It includes 19 items, which yields 7 factor scores. The sum of these seven factors is the total score (Backhaus et al., 2002; Buysse et al., 1989; Mollayeva et al., 2016).

2.3.4. Post-traumatic stress symptoms (PTSS)

The Chinese version of the Impact of Events Scale-Revised (IES-R) was used to assess post-traumatic stress symptoms (PTSS). IES-R contains 22 items with 5 points of Likert scale (0, not at all ~ 4, extremely). The IES-R Chinese version has a total score (from 0 to 88) and three subscales: hyperarousal, avoidance and intrusion. The internal consistency of the Chinese version of IES-R was 0.83–0.89(Wu and Chan, 2003).

2.4. Statistical analysis

We compared the demographic and clinical variables between people with or without depressive symptoms by using ANOVA for continuous variables, and chi-square test for categorical variables. Furthermore, binary logistic regression analysis was adopted to examine the related factors of depressive symptom. Then, we adopt Pearson or Spearman to explore the correlation between SDS score and demographic or clinical parameters. Bonferroni correction was performed to adjust for multiple tests ($a = 0.05/13 = 0.004$). Finally, multiple regression analysis was applied to explore the predictive variables associated with SDS score, including age, gender, marital status, education, smoking status, drinking statue, SAS score, PSQI score, IES-R total score, IES-R Avoidance factor, IES-R Intrusion factor, and IES-R Hyperarousal factor. Statistical analysis was performed using SPSS software (version 18). All p values were 2 tails, reaching a significant level of 0.05. Continuous data were expressed as mean ± SD.

3. Results

3.1. Prevalence of depressive symptom among individuals in quarantine

The prevalence rate of depressive symptoms among the quarantined population was 6.21% (139/2237), which is similar to the latest report of health workers in Nanjing (6.46%) (Shen et al., 2020) and Vietnamese outpatients (7.44%) (Nguyen et al., 2020), but higher than that of unquarantined general population in Chongqing (3.7%) (Tan et al., 2020) during the COVID-19 pandemic, and also higher than that of migrant workers in service industry in Shenzhen without COVID-19 pandemic and quarantine (2.5%) (Xu et al., 2016).

3.2. Demographic and clinical parameters

Table 1 summarizes the demographic and clinical parameters of the participants. Compared with the non-depressed group, the depressed group were younger, less educated, less married, as well as had higher SDS, SAS, PSQI, IES-R total and all three subscale scores (all $p < 0.001$). After controlling for age, gender, marriage and education as covariables, there were still significant differences in SDS score ($F = 1655.02$, $p < 0.001$), SAS score ($F = 500.64$, $p < 0.001$), PSQI score ($F = 249.95$, $p < 0.001$), IES-R total score ($F = 95.80$, $p < 0.001$), IES-R Avoidance factor ($F = 30.44$, $p < 0.001$), IES-R Intrusion factor ($F = 94.63$, $p < 0.001$) and IES-R Hyperarousal factor ($F = 150.88$, $p < 0.001$) between the two groups. Furthermore, significant difference in SDS score, SAS score, PSQI score, IES-R total score, IES-R Avoidance factor, IES-R Intrusion factor, as well as IES-R Hyperarousal symptoms factor passed the Bonferroni corrections (all Bonferroni corrected $p < 0.05$). In addition, binary logistic regression analysis revealed that gender (Wald $x^2 = 4.43$, OR = 0.599, df = 1, CI = 0.372–0.965, $p = 0.035$), education (Wald $x^2 = 13.58$, OR = 0.673, df = 1, CI = 0.545–0.831, $p < 0.001$), SAS score (Wald $x^2 = 150.13$, OR = 1.329, df = 1, CI = 1.270–1.391, $p < 0.001$), and PSQI score (Wald $x^2 = 24.14$, OR = 1.205, df = 1, CI = 1.119–1.299, $p < 0.001$) were associated with depressive symptoms.

3.3. Association between SDS scores and clinical variables in quarantined population

Pearson and Spearman correlation analysis indicated a significant association between SDS score and the following variables: age ($r = -0.133$, $p < 0.001$), marriage ($r = -0.108$, $p < 0.001$), education($r = -0.104$, $p < 0.001$), SAS score($r = 0.671$, $p < 0.001$), PSQI score ($r = 0.459$, $p < 0.001$), IES-R total score($r = 0.350$, $p < 0.001$), IES-R Avoidance factor ($r = 0.196$, $p < 0.001$), IES-R Intrusion factor ($r = 0.353$, $p < 0.001$), and IES-R Hyperarousal factor ($r = 0.432$, $p < 0.001$). Further, significant association between SDS score and age, marriage, education, SAS score, PSQI score, IES-R total score, IES-R Avoidance factor, IES-R Intrusion factor or IES-R Hyperarousal factor passed the Bonferroni corrections (all Bonferroni corrected $p < 0.05$). In addition, further multiple regression showed that age (beta = −0.091, $t = -5.077$, $p < 0.001$), marriage (beta = −0.059, $t = -3.451$, $p = 0.001$), education (beta = −0.111, $t = -6.867$, $p < 0.001$), SAS score (beta = 0.534, $t = 30.968$, $p < 0.001$), PSQI score (beta = 0.182, $t = 10.488$, $p < 0.001$), IES-R total score(beta = 0.105, $t = 6.315$, $p < 0.001$), IES-R Avoidance factor (beta = −0.041, $t = -2.040$, $p = 0.041$) and IES-R Hyperarousal factor (beta = 0.158, $t = 6.361$, $p < 0.001$) were still associated with SDS score.

Table 1
Social demography and clinical characteristics of people with depression and non-depression.

	Depressive group (n = 139)		Non-depressive group (n = 2098)		
	n	%	n	%	p
Gender					0.49
Male	85	61.2	1220	58.2	
Female	54	38.8	878	41.8	
Education					0.02*
≤9 years	27	19.4	255	12.2	
9–12 years	26	18.7	438	20.9	
12–15 years	40	28.8	508	24.2	
≥15 years	46	33.1	987	47.0	
Marital statue					0.04*
Single/divorced/ losing spouse	55	39.6	651	31.0	
Married	84	60.4	1447	69.0	
Smoking statue					0.61
Smoker	35	25.2	489	23.3	
Non-smoker	104	74.8	1609	76.7	
Drinking statue					0.17
Drinker	22	15.8	250	11.9	
Non-drinker	117	84.2	1848	88.1	
	Mean	SD	Mean	SD	p
Age	34.96	9.87	36.89	5.13	0.02*
Clinical assessments					
SDS total score	55.18	4.67	33.22	6.24	<0.01**
SAS total score	43.10	5.30	32.82	5.15	<0.01**
PSQI total score	6.45	3.79	3.14	2.28	<0.01**
IES-R					
Avoidance	7.96	5.15	5.67	4.94	<0.01**
Intrusion	8.69	4.71	5.27	4.11	<0.01**
Hyperarousal	6.49	4.05	3.38	2.89	<0.01**
Total score	23.14	12.93	14.32	10.48	<0.01**

*$p < 0.05$.
**$p < 0.01$.
Abbreviations: *SD,* standard deviation; *SDS,* Zung's Self-Rating Depression Scale; *SAS*, Zung's self-rating anxiety scale; *PSQI*, Pittsburgh Sleep Quality Index; *IES-R,* Impact of Events Scale-Revised.

4. Discussion

To the best of our knowledge, this is the first study to investigate the prevalence, socio-demographic and clinical characteristics of depressive symptoms in a population quarantined due to COVID-19 outbreak. First, we found a 6.21% prevalence of depressive symptoms in this population. Second, the significant clinical correlates of depressive symptoms in this population were age, marriage, education level, SAS score, PSQI score, IES-R total score, IES-R Avoidance factor and IES-R Hyperarousal factor.

In this study, we found an increased prevalence of depressive symptoms in Shenzhen quarantined population (6.21%), which is similar to the recent report of health workers in Nanjing (6.46%) (Shen et al., 2020) and Vietnamese outpatients (7.44%) (Nguyen et al., 2020), but higher than that of the general population without quarantine in Chongqing (3.7%) (Tan et al., 2020) during the COVID-19 pandemic, and also higher than that of migrant workers in service

industry in Shenzhen without the COVID-19 pandemic and quarantine (2.5%) (Xu Yanmin, 2016). However, it was lower than that of several online surveys conducted in the general population during the COVID-19 pandemic (16.5–48.3%) (Ahmed et al., 2020; Gao et al., 2020; Wang et al., 2020a, 2020b), and also much lower than the prevalence rate of 37.2% in Hubei (Ahmed et al., 2020).

In our sample, the prevalence of depressive symptoms during the COVID-19 pandemic was 6.21%, within the range of the current global prevalence estimates for the general population (3.7–48.3%), but lower than some other studies (Ahmed et al., 2020; Gao et al., 2020; Wang et al., 2020a, 2020b). There may be some explanations for this inconsistency. First of all, there may be due to differences in sampling methods. We adopted cluster sampling method, which had a high response rate (95.8%). Several other studies recruited subjects via the internet (Ahmed et al., 2020; Gao et al., 2020; Wang et al., 2020a, 2020b), which makes it difficult to calculate the actual response rate. Moreover, as Hull (2005) pointed out, a low response rate may lead to an overestimate of the prevalence of symptoms, and people with more severe distress were more likely to respond to study (Hull, 2005). Second, there are the noticeable differences in the research subjects. In this study, we recruited quarantined general population in Shenzhen with unconfirmed COVID-19 infection. However, Ahmed et al. mainly recruited the general population from Hubei province (Ahmed et al., 2020). Gao et al. recruited the general population from 31 provinces (Gao et al., 2020), and Wang et al. recruited the general population from 194 cities (Wang et al., 2020a, 2020b), while the general populations from different regions in China mean that they may suffer from different levels of stress and emotional distress. Third, there were differences in the time points of mental health assessment. Our investigation period corresponded to the debilitating stage after the largest outbreak of COVID-19-19 epidemic in China (Shen et al., 2020). Several other studies assessed the mental health statue of the early epidemic in China (Gao et al., 2020; Qiu et al., 2020). After taking effective preventive measures, the degree of distress may decrease over time, such as strictly locking Wuhan and some other cities. Therefore, conducting mental health assessments at different time points in a pandemic may be related to varying degrees of distress. Fourth, there are differences in the screening tools for depression. We use Zung's self-rating depression scale (SDS), while some other studies used DASS21 or PHQ-9. Different screening tools may lead to different results. Taken together, this study demonstrated that the prevalence of depressive symptoms in the quarantined population increased during the pandemic.

Furthermore, our study identified several risk factors for depressive symptoms in quarantined population in Shenzhen. We found that SDS score was inversely correlated with age, which was consistent with previous study on migrant workers in Shenzhen (Zhong et al., 2015). Also, our study found that lower education was a risk factor for depressive symptoms, which was confirmed in a previous study of migrant workers in Shenzhen (Zhong et al., 2015). In addition, our study also found that single respondents were more likely to suffer from higher levels of depression than married respondents, which was in accordance with previous research during SARS (Liu et al., 2012). Moreover, our study found a significant positive correlation between depressive symptoms and anxiety, which was consistent with previous studies. For example, Huang et al. found that the anxiety rate of Chinese MDD patients was 74.2% (Huang et al., 2019). Another survey by the Chinese Psychiatric Association (n = 1178) showed that the anxiety rate of MDD patients in China was 77.7% (Xin et al., 2015). As reported in these studies, depression and anxiety disorders are common co-existing mental disorders, and this highly comorbid relationship has also been observed in our quarantined subjects.

Interestingly, the relationship between depression and sleep quality has been well documented. Most of previous studies have shown that depression is inversely correlated with sleep quality, while insomnia is a predictor of depression (Baglioni et al., 2011; Bergmans et al., 2019; Gonzalez-Mesa et al., 2019; Oh et al., 2019; Wakefield et al., 2020). In our current study, multiple stepwise regression showed that poor sleep quality was a risk factor for depressive symptoms, which was consistent with these previous studies, indicating that depressive symptom and poor sleep quality may interact with each other in our quarantined individuals.

In addition, we also found a significant positive correlation between depressive symptoms and post-traumatic stress symptoms. Specifically, multiple stepwise regression demonstrated that except for intrusion symptoms, hyperarousal symptoms and avoidance symptoms were risk factors for depressive symptoms, which was consistent a recent study in non-suicidal self-injury adolescents (Sami and Hallaq, 2018). Previous studies also demonstrated that depression was a predictor of PTSS (Hawryluck et al., 2004; Liu et al., 2012). Therefore, these findings suggest that depression and PTSS are mutually predictive variables. We should pay more attention to PTSS, especially avoidance symptoms and hyperarousal symptoms. Individuals who are prone to PTSS are more likely to suffer from depression or develop into chronic depression and post-traumatic stress disorder(PTSD).

Several limitations of this study should be noted. First, this is a cross-sectional design study that does not show a causal relationship between depression and related clinical factors. The risk factors for depression need to be further explored in the longitudinal design studies. Second, all our subjects were recruited from Nanshan District, Shenzhen City, Guangdong Province, China. The severity of the pandemic varies in different regions, and the availability of medical services also varies. These factors may lead to varying degrees of distress. At the same time, Nanshan District GDP (Gross Domestic Product) ranks among the top five in the country, and the local government has an efficient public health system and convenient medical resources, which can provide adequate support and effective intervention for the quarantined personnel. Therefore, whether our research results can be extended to other regions of China or other ethnic populations needs to be further confirmed by multicenter research. Third, in this study, SDS was used to quantify depressive symptoms; however, it cannot be used for the diagnosis of depression. Instead, SCID should be used for diagnosis. Therefore, the diagnosis of depression cannot be determined in this study. Fourth, we did not have a control group of the general population without quarantine, nor did we have a quarantined control group as comparison. Fifth, we collected drug abuse/addiction data for all subjects, which were based on self-reported questionnaires. As the proportion was very low (less than 1%), we did not exclude these individuals with drug abuse/addiction. At the same time, we collected information about physical diseases of all subjects through a self-reported questionnaire, accounting for less than 5% of all subjects. Therefore, due to the relatively low proportion of drug abusers/addicts and the subjects with physical diseases, we did not exclude drug abusers/addicts or with subjects suffering from physical diseases.

In conclusion, our results show that the prevalence rate of depressive symptoms in the quarantined individuals was 6.21%, suggesting an increased prevalence of depressive symptom in the quarantined population during the COVID-19 pandemic compared to the general population without quarantine. Compared with non-depressed subjects, depressed subjects were younger, less educated, and less married. Moreover, depressive symptoms were positively associated with anxiety, poor sleep quality, PTSS, avoidance symptoms and hyperarousal symptoms, suggesting coexistence of depression, anxiety, poor sleep quality and PTSS in quarantined population. Although this is a cross-sectional design study, these results suggest that attention should be paid to depressive symptoms during quarantine. The results shared in this article may be useful for other countries that may encounter COVID-19.

Author statement

Contributors

Min Peng designed the study. Qiwen Deng and Xiangyang Zhang instructed the study design. Min Peng, Beirong Mo, Yansong Liu, Mingming Xu, Xinran Song, Luyu Liu, Yeqing Fang, Tianyou Guo, Jinying Ye, and Zhijian Yu participated in the data collection. Min Peng undertook the data analysis and wrote the manuscript. Xiangyang Zhang revised the manuscript. All authors contributed to and approved the final manuscript.

Authorship and copyright

All authors confirm that the work presented here has not been published previously, nor is it being considered for publication elsewhere.

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Role of the sponsor

The funding agency had no role in the research design, data collection, publication decisions and manuscript preparation.

Ethical approval

This study was approved by the Ethics Review Committee of Shenzhen Nanshan People's Hospital affiliated to Shenzhen University. All procedures complied with the ethical standards of the latest version of the Helsinki Declaration.

Declaration of Competing Interest

No conflict of interest was disclosed for each author.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2020.06.035.

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