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Clinical study

Anxiety and depression in spinocerebellar ataxia patients during the COVID-19 pandemic in China: A cross-sectional study

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Abstract

Coronavirus disease 2019 (COVID-19) is currently a global concern, and the psychological impact cannot be overlooked. Our purpose was to evaluate the anxiety and depression in spinocerebellar ataxia (SCA) patients during the pandemic and to analyse the influencing factors. We conducted an online questionnaire survey among 307 SCA patients from China and selected 319 healthy people matched by sex and age as the control group. The questionnaire included general information, the self-rating anxiety scale (SAS), and the self-rating depression scale (SDS). The relevant factors included COVID-19 risk factors, age, sex, body mass index (BMI), educational background, disease course, score on the scale for the assessment and rating of ataxia (SARA), Mini-mental State Examination (MMSE) and International Cooperative Ataxia Rating Scale (ICARS). The proportion of SCA patients with anxiety was 34.9%, and the proportion with depression was 56.7%. The SAS and SDS scores of the SCA patients were significantly higher than those of the control group (SAS: 45.8 ± 10.1 vs. 40.6 ± 8.9, P < 0.01; SDS: 55.1 ± 12.2 vs. 43.6 ± 11.9, P < 0.01). In SCA3, the risk of exposure to COVID-19, educational level, disease course and the severity of ataxia may be factors affecting patients’ mental health. More attention should be paid to the mental health of SCA patients during the COVID-19 pandemic.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has spread across China since the end of December 2019, and the disease has rapidly spread throughout many countries around the world, becoming a global health emergency [1]. At present, the pandemic has been effectively controlled in China, but the psychological impact of the pandemic cannot be overlooked. Addressing the psychological crisis induced by the COVID-19 pandemic has become an essential part of pandemic prevention and control.

Spinocerebellar ataxias (SCAs) are a group of autosomal dominant inherited progressive neurodegenerative disorders, the clinical hallmarks of which are the loss of balance and coordination accompanied by the slurring of speech [2]. Its prevalence varies according to subtype, geography, and ethnicity, and SCA3 is the primary subtype in patients in China [3]. SCAs are affected by factors such as (CAG)n length. They mainly occur in adults aged 30–40 years old but can also occur in children and the elderly population [4–6]. In addition, SCA patients have many non-ataxia symptoms, such as spasticity, dystonia, dysphagia, parkinsonism, oculomotor abnormalities, and sleep disorders [7–10]. SCA patients’ ability to move and communicate becomes significantly limited, which seriously negatively affects their quality of life, making them vulnerable to anxiety and depression. Pathological studies have shown that depression in SCA patients may be associated with neuronal polyglutamine inclusion bodies in some brain regions, such as the raphe nucleus and locus coeruleus [11].

A previous cohort study of 526 SCA patients confirmed three independent predictors of health status in SCA patients, namely, ataxia severity, non-cerebellar symptom severity, and depressive symptoms [12]. Previous studies have shown that depression affects 17–26% of SCA patients; Depression not only affects their...
life and social functioning but also may reduce their compliance with SCA treatment, increase their disease burden, and lead to a poor prognosis [12,13]. Therefore, the management of SCA patients during the outbreak should involve particular attention paid to their mental health [14]. Nevertheless, few studies have focused on the mental health of SCA patients during the pandemic. The purpose of the current study is to evaluate the psychological status of SCA patients in China during the COVID-19 pandemic and facilitate the provision of better mental support to SCA patients.

2. Participants and methods

2.1. Participants

We recruited 307 patients in the Chinese spinocerebellar ataxia online group to participate in this survey from February 8, 2020, to March 8, 2020 (at the height of the COVID-19 epidemic in China), and we selected 319 healthy people matched by sex and age as the control group. The inclusion criteria for SCA patients were as follows: (1) a definite genetic diagnosis of SCAs; (2) signature on the informed consent form; (3) no recent traumatic experiences or other stressful events such as divorce, becoming a widow(er), unemployment, etc. As a pre-investigation, we randomly sampled 100 SCA patients from February 1, 2020, to February 7, 2020, of whom 60% had anxiety and 65% had depression. The calculation of the sample size was based on the formula “n = 400 × (1 − p) / p”, where “n” was the minimum sample size and “p” was the prevalence rate of mental illness in the preliminary survey. The sample size of SCA patients was calculated to be at least 266. We sent a total of 1000 questionnaires and finally collected 307 valid questionnaires from SCA patients and 319 valid questionnaires from the control group, with a total valid response rate of 62.6%.

2.2. Questionnaires

The questionnaires consisted of three parts: basic demographic characteristics, risks of exposure to COVID-19, and mental health assessments.

2.2.1. Demographic characteristics

The basic demographic data consisted of sex (male or female), age (years), height and weight (to calculate the BMI), and educational level (primary school education, middle school education, university education). SCA patients were asked to fill in their disease duration (years).

2.2.2. Risk of exposure to COVID-19

We determined the risk of exposure to COVID-19 through the following questions: Have you ever had any symptoms indicative of COVID-19, such as fever, fatigue, or dry cough? Have you or your family been diagnosed with COVID-19? Have your neighbours been diagnosed? Have you ever been to Hubei Province or had contact with people from there? The answer to each question was yes or no.

2.2.3. Mental health assessments

The SAS scale is a self-rating scale to evaluate the severity of anxiety with the standard scores categorized as follows: minimal/no anxiety (<50), mild anxiety (50–59), moderate anxiety (60–69), or severe anxiety (>69) [15]. The SDS scale is a self-report scale used to assess the severity of depression, with the standard scores categorized as follows: minimal/no depression (<53), mild depression (53–62), moderate depression (63–72), or severe depression (>72) [16]. In addition, we obtained the MMSE scores of the SCA patients, which were classified into normal and mild cognitive impairment.

2.3. Clinical assessment

The severity of ataxia was assessed clinically with the International Cooperative Ataxia Rating Scale (ICARS) and the scale for the assessment and rating of ataxia (SARA). The ICARS has 4 parts that yield a total score from 0 (no ataxia) to 100 (most severe ataxia): 1) posture and gait disturbance (score 0–34); 2) limb kinetic functions (score 0–52); 3) speech disturbance (score 0–8); and 4) oculomotor disorders (score 0–6). The SARA has 8 items that yield a total score from 0 (no ataxia) to 40 (most severe ataxia) [17]. Owing to the COVID-19 outbreak, we were unable to conduct a home visit. Therefore, we consulted the data of 62 SCA3 patients who participated in the questionnaire and recently visited the Department of Neurology at Xiangya Hospital Central South University (from January 2019 to January 2020) and recorded their ICARS and SARA scores at the last visit. All patients were evaluated by 2 experienced neurologists.

2.4. Statistical analysis

We conducted a descriptive analysis of the general data of the SCA patient group and the control group and compared them with the chi-square test. For count data, we used frequencies and percentages. The independent-samples t-test was utilized to compare the scale scores between SCA patients and the control group. To ensure the homogeneity of the results and avoid the influence of different subtypes on psychological score, we only included 273 SCA3 patients for factor analysis (Univariate analysis and Multivariable linear regression analysis). SAS scale scores and SDS scale scores of SCA3 patients in different groups were compared with independent-samples t-tests and one-way analysis of variance (ANOVA). The Bonferroni test was used for post hoc pairwise comparisons. With all of the demographic variables as independent variables and psychological scale scores as the outcome variables, multivariable linear regression analysis was conducted to determine the factors related to the SCA3 patients’ mental health status. To exclude the impact of disease duration, we calculated the partial correlation between the severity of ataxia and psychological scale score in 62 SCA3 patients. SPSS (version 22.0) statistical software was used for data analysis. Statistical significance was set at P < 0.05 with two-sided tests.

3. Results

3.1. Anxiety and depression in SCA patients during the COVID-19 pandemic

A total of 307 SCA patients and 319 healthy controls completed the survey questionnaire. The details of the demographic characteristics are presented in Table 1. The average age of the SCA patients was 40.0 years (standard deviation [SD]: 8.8, range: 25–66), and the average age of the control group was 42.4 years (standard deviation [SD]: 11.3, range: 21–71). In comparison with the control group, the SCA patient group had a lower BMI (P < 0.01). There was no significant difference in sex, age, educational level or risk of exposure to COVID-19 between the two groups (all P > 0.05).

In this study, participants came from different provinces in China but were mainly distributed in Hunan, Hubei, Guangdong, and Jiangxi Provinces, which are near Wuhan city in Hubei Province, the area in which the COVID-19 pandemic was most concentrated in China (Fig. 1A). None of the 307 SCA patients had been...
diagnosed with COVID-19. There were a total of 38 patients who had risk factors for exposure to COVID-19: 18 of them had recently developed symptoms such as fever, fatigue, dry cough and dyspnoea; 17 of them had been to the Hubei region or had had contact with people from there; and six patients replied that there were confirmed COVID-19 patients in their community.

### Table 1
Baseline characteristics of 626 enrolled participants in the study.

| Variables                        | Group 1: patients with SCA (n = 307) | Group 2: general population (n = 319) | χ²   | P value |
|----------------------------------|-------------------------------------|--------------------------------------|------|---------|
| Risks of exposure to COVID-19    |                                     |                                      |      |         |
| Yes                              | 38 (12.4%)                          | 56 (17.6%)                           | 3.286| 0.070   |
| No                               | 269 (87.6%)                         | 263 (82.4%)                          |      |         |
| Gender                           |                                     |                                      |      |         |
| Male                             | 146 (47.6%)                         | 153 (48.0%)                          | 0.011| 0.919   |
| Female                           | 161 (52.4%)                         | 166 (52.0%)                          |      |         |
| Age                              |                                     |                                      |      |         |
| <30                              | 41 (13.4%)                          | 51 (16.0%)                           | 3.993| 0.262   |
| 30–40                            | 124 (40.4%)                         | 107 (33.5%)                          |      |         |
| 40–50                            | 99 (32.2%)                          | 105 (32.9%)                          |      |         |
| >50                              | 43 (14.0%)                          | 56 (17.6%)                           |      |         |
| Education                        |                                     |                                      |      |         |
| university                       | 138 (45.0%)                         | 157 (49.2%)                          | 1.920| 0.383   |
| middle school                    | 139 (45.3%)                         | 127 (39.8%)                          |      |         |
| primary school                   | 30 (9.7%)                           | 35 (11.0%)                           |      |         |
| BMI                              |                                     |                                      |      |         |
| BMI < 18.5                       | 64 (20.8%)                          | 20 (6.3%)                            | 31.870| <0.01   |
| BMI 18.5–24                      | 189 (61.6%)                         | 212 (66.5%)                          |      |         |
| BMI > 24                         | 54 (17.6%)                          | 87 (27.3%)                           |      |         |

Abbreviations: SCA, spinocerebellar ataxia; BMI, body mass index.

Fig. 1. The approximate geographic locations map and subtype distribution for SCA patients. (A) Map of the approximate geographic locations for SCA patients in this study. Participants came from different provinces in China but were mainly distributed in Hunan, Hubei, Guangdong, and Jiangxi provinces, which provinces were on the brink of Wuhan city, Hubei province, the area that COVID-19 was mainly concentrated in China. (B) SCA subtype distribution in the 307 SCA patients, and SCA3 was the primary subtype in our study. (C) The CAG repeat expansions in SCA3 patients. The number of CAG pathological repeats ranged from 65 to 79 in 273 SCA3 patients, with an average of (72.21 ± 2.57) times.
SCA3 was the primary subtype in our study. Among the 307 SCA patients, 273 SCA3 patients were detected (Fig. 1B). The number of CAG pathological repeats ranged from 65 to 79 in those 273 SCA3 patients, with an average of 72.21 ± 2.57 repeats (Fig. 1C). In addition, 14 SCA1 patients were detected, in whom the number of CAG pathological repeats ranged from 45 to 60, with an average of 51.12 ± 3.28 repeats. In 7 patients with SCA2, the number of CAG pathological repeats ranged from 38 to 53, with an average of 42.14 ± 3.30 repeats. SCA6 was identified in 2 patients, and the numbers of CAG pathological repeats were 26 and 21. SCA7 was found in 1 patient, and that patient had 61 CAG pathological repeats.

Our results showed that among 307 SCA patients, the total proportion with anxiety was 34.9%. Depressive symptoms were more common than anxiety symptoms in the study subjects, and the total proportion with depression was 56.7%. In addition, the mean standard score on the SAS scale in SCA patients was higher than that in the control group (p < 0.01). Similarly, the average standard score on the SDS scale in SCA patients was also higher than that in the control group (p < 0.01) (Fig. 2).

3.2. Risk factors for anxiety and depression in SCA3 patients

In 273 SCA3 patients, SAS scores and SDS scores significantly differed across different education levels, risks of exposure to COVID-19, and disease durations (P < 0.05), while there were no statistically significant differences in psychological scores of other grouping variables such as sex, age, BMI and MMSE scores (Table 2). Scores of those patients whose disease duration was longer than ten years were significantly higher than those whose disease duration was less than five years (P < 0.05). The scores of patients with a college education were significantly lower than the scores of those with middle and primary school educations (P < 0.05).

The multiple linear regression analysis showed that after excluding the influence of other variables, the risk of exposure to COVID-19 (β: 0.131, P < 0.05), education level (β: −0.214, P < 0.01), and disease duration (β: 0.140, P < 0.05) were significantly associated with the SDS scores. Meanwhile, the educational level (β: −0.219, P < 0.01) and risk of exposure to COVID-19 (β: 0.176, P < 0.01) were correlated with the scores on the SAS (Table 3).

3.3. Correlation analysis of the severity of ataxia with the SAS scale and SDS scale score in SCA3 patients

In 62 SCA3 patients, after excluding the influence of the disease duration, partial correlation analysis showed that there was a positive correlation between the SARA score and the SAS score (r = 0.429, P < 0.01). There was also a positive correlation between the ICARS score and the SDS score (r = 0.380, P < 0.01). There was no statistically significant correlation between the ICARS score and the SDS score (r = 0.201, P > 0.05). There was also a positive correlation between the ICARS score and the SDS score (r = 0.420, P < 0.01). Among the four sections of the ICARS, posture and gait disturbance, limb kinetic functions and speech disturbance were all positively correlated with the SDS score (P < 0.01), but there was no statistically significant correlation between the oculomotor disorder score and the SDS score (P > 0.05) (Fig. 3).
4. Discussion

Our psychological assessment was in the form of an online cross-sectional survey, which is a convenient method of gathering data on more factors that could influence patients’ psychological states at a given time point during the current pandemic. In our study, we observed that SCA patients were more likely to have anxiety and depression during the COVID-19 pandemic compared with the general population. Depressive symptoms were more prevalent than anxiety symptoms among the 307 SCA patients: the proportion with anxiety was 34.9%, and the proportion with depression was 56.7%. Another two-year cohort study using the Patient Health Questionnaire (PHQ) to investigate the depression status of 300 patients showed that 26% of SCA patients had depression [13].

The proportion of SCA patients with depression in our study was 56.7%, which was significantly higher than the 26% reported in a previous study, indicating that the COVID-19 pandemic may be having a significant impact on the mental health of SCA patients. The difference may also be due to the different depression scales used in the studies. Compared with the PHQ scale, the SDS scale has a reverse scoring standard, which is more scientific from the perspective of the scale design. Overall, the Zung scale is superior in terms of sensitivity [18].

What made the patients anxious? We obtained feedback from 307 SCA patients in the comments section. In our study, 82% of SCA patients said they felt nervous because there was no specific drug to cure SCAs to date, and the progress of the disease could not be halted; 71% of SCA patients said they did not receive enough social attention; 58% of SCA patients said their exercise and communication abilities were considerably limited, seriously affecting their quality of life; and 37% of SCA patients said they could not take care of themselves and felt pressure from their families and society. In addition, the time for recruitment was from February 8, 2020, to March 8, 2020, when the pandemic was unclear and more dangerous. At that time, the COVID-19 virus was highly infectious, rapidly spreading and difficult to control. Due to the constant fear of becoming infected and inadequate availability of personal protective equipment, some people may have an acute stress reaction, which may influence the scores of psychological scales.

Univariate analysis and multivariate linear regression analyses showed that the risk of exposure to COVID-19 was independently associated with the SAS and SDS scores in SCA patients. According to the latest guidelines, fever, fatigue, dry cough, and dyspnoea are the main symptoms of COVID-19; therefore, patients with SCA who develop these symptoms during the pandemic may feel

Table 2
Psychometric scores of 273 SCA3 patients with different variables (n = 273).

| Characteristics                  | Number of patients (%) | Anxiety (SAS) | Depression (SDS) |
|----------------------------------|------------------------|---------------|------------------|
| Risks of exposure to COVID-19    |                        |               |                  |
| Yes                              | 34 (12.4%)             | 49.9 ± 8.1    | 59.0 ± 13.9      |
| No                               | 239 (87.6%)            | 45.2 ± 9.2    | 54.6 ± 11.1      |
| Gender                           |                        |               |                  |
| Male                             | 128 (46.9%)            | 46.0 ± 9.8    | 54.8 ± 12.3      |
| Female                           | 145 (53.1%)            | 45.4 ± 9.4    | 55.1 ± 11.0      |
| Age                              |                        |               |                  |
| <30                              | 38 (14.0%)             | 43.8 ± 9.4    | 52.4 ± 10.1      |
| 30 - 40                          | 111 (40.6%)            | 45.0 ± 8.3    | 53.9 ± 11.1      |
| 40 - 50                          | 89 (32.6%)             | 47.5 ± 10.7   | 56.9 ± 10.7      |
| >50                              | 35 (12.8%)             | 45.2 ± 10.1   | 54.5 ± 15.7      |
| Education                        |                        |               |                  |
| University                       | 121 (44.3%)            | 43.9 ± 8.5    | 53.0 ± 11.6      |
| Middle school                    | 127 (46.5%)            | 46.4 ± 10.6   | 56.5 ± 11.8      |
| Primary school                   | 25 (9.2%)              | 50.6 ± 6.1    | 57.2 ± 7.9       |
| BMI                              |                        |               |                  |
| BMI < 18.5                       | 57 (20.9%)             | 46.6 ± 9.5    | 57.4 ± 11.4      |
| BMI 18.5 – 24                    | 167 (61.2%)            | 45.4 ± 9.9    | 54.1 ± 11.5      |
| BMI > 24                         | 49 (17.9%)             | 45.6 ± 8.4    | 55.5 ± 11.6      |
| Disease course                   |                        |               |                  |
| 0 – 5 years                      | 97 (35.6%)             | 43.8 ± 8.9    | 52.8 ± 11.4      |
| 5 – 10 years                     | 114 (41.7%)            | 46.2 ± 10.3   | 55.4 ± 11.7      |
| >10 years                        | 62 (22.7%)             | 47.7 ± 8.6    | 57.9 ± 10.9      |
| MMSE                             |                        |               |                  |
| Normal                           | 251 (91.9%)            | 45.5 ± 9.7    | 55.0 ± 11.8      |
| Mild cognitive impairment        | 22 (8.1%)              | 48.5 ± 7.2    | 54.9 ± 8.8       |

Abbreviations: SCA, spinocerebellar ataxia; SDS, self-rating depression scale; SAS, self-rating anxiety scale; BMI, body mass index; MMSE, Mini-mental State Examination.

Table 3
Results of multiple linear regression on factors associated with scores of SAS scale and SDS scale in 273 SCA3 patients (n = 273).

| Variables                  | SAS Coefficient | SAS P  | SDS Coefficient | SDS P  |
|----------------------------|-----------------|--------|-----------------|--------|
| Risks of exposure to COVID-19| 0.176           | 0.003  | 0.131           | 0.029  |
| Gender                     | -0.042          | 0.494  | 0.020           | 0.742  |
| Age                        | 0.050           | 0.419  | 0.024           | 0.704  |
| Education                  | -0.219          | 0.001  | -0.214          | 0.002  |
| BMI                        | -0.072          | 0.247  | -0.074          | 0.238  |
| Disease course             | 0.111           | 0.068  | 0.140           | 0.023  |
| MMSE                       | -0.018          | 0.789  | -0.108          | 0.107  |

Abbreviations: SCA, spinocerebellar ataxia; SDS, self-rating depression scale; SAS, self-rating anxiety scale; BMI, body mass index; MMSE, Mini-mental State Examination.
Fig. 3. Correlation of the severity of ataxia with SAS scale and SDS scale score in 62 patients with SCA3. (A) After excluding the influence of the disease duration, partial correlation analysis showed that there was a positive correlation between the SARA score and the SAS score ($r = 0.429$, $P < 0.01$). (B) There was also a positive correlation between the SARA score and the SDS score ($r = 0.380$, $P < 0.01$). (C) There was no statistically significant correlation between the ICARS score and the SAS score ($r = 0.201$, $P > 0.05$). (D) There was also a positive correlation between the ICARS score and the SDS score ($r = 0.420$, $P < 0.01$). (E-G) Among the four sections of the ICARS, posture and gait disturbance ($r = 0.349$, $P = 0.006$), limb kinetic functions ($r = 0.365$, $P = 0.005$) and speech disturbance ($r = 0.417$, $P = 0.001$) were all positively correlated with the SDS score, but there was no statistically significant correlation between the oculomotor disorder score and the SDS score ($r = 0.103$, $P = 0.428$).
uneasy because they suspect that they have been infected with the virus. If someone in a community is infected with the virus, the whole community is isolated, inevitably affecting a patient’s psychological state. Furthermore, many hospitals did not open their regular neurology outpatient departments during this pandemic, which meant that SCA3 patients could not go to the clinic on time to get their medicine, which may have caused more adverse emotions.

Additionally, the average scores on the SAS and SDS decreased with increasing educational levels among SCA3 patients. Previous studies have reported a strong association between a lower education level and severe depression [19]. Patients with a college education can communicate better with doctors, actively collect the latest research on SCAs, and learn more about the current situation of the COVID-19 pandemic from the media, which can reduce their anxiety and depression to some extent. In addition, the benefits associated with a higher education level are multifactorial, including cultural capital, a higher income, and more job security.

This study also showed that the disease duration affected the SDS scores in SCA3 patients. The longer the disease duration is, the more severely impaired the cerebellar function, which may lead to negative psychological outcomes. Emerging research has shown that the cerebellum is a brain structure that is critical for understanding the development of mental disorders [20]; depression and anxiety stem from network changes in the cerebellum, possibly including the interaction of the cerebellum with the cortex or changes in the cerebellum alone [21,22]. Intriguingly, no significant difference was observed in SAS scores based on disease duration, which may be related to the fact that the prevalence of anxiety in SCA3 patients is lower than that of depression. We need to expand the sample size in future studies.

Our results showed that the more severe the ataxia was, the higher the SARA score and the ICARS score and the higher the risk of anxiety and depression comparatively in SCA3 patients. Among the four sections of the ICARS scale, except for oculomotor disorders, posture and gait disturbance, limb kinetic functions and speech disturbance were all correlated with the depression state. Previous studies have shown that the degree of ataxia symptoms and the state of depression jointly determine the subjective health rating of SCA patients [23], and a direct correlation between depression scale scores and motor disability was found [24]. Nevertheless, in the natural history of SCAs, the ataxia symptoms of different SCA subtypes progress at different rates (SCA1 > SCA3 > SCA2 > SCA6). The prevalence of depression does not follow the same developmental order (SCA3 > SCA1 > SCA2 > SCA6), suggesting that depression may not be entirely attributable to motor impairments; other factors, such as non-motor symptoms, must also be considered [25].

In our study, most of the SCA patients were from the area in which the COVID-19 pandemic was most concentrated in China. Nevertheless, none of the 307 subjects had contracted COVID-19. This may be related to the decreased motor ability of SCA patients, resulting in a reduced range of activities and fewer opportunities for them to go out to work and migrate. However, this does not mean that SCA patients are less likely to be infected, and SCA patients still cannot ignore preventive measures. As suggested by the international panel of ataxia experts, it is necessary for SCA patients to continue all necessary medications, stay at home and avoid contacting COVID-19 during the epidemic. It may be important to remind patients, caregivers, and paramedics that ataxia may worsen due to the lack of rehabilitation or the interruption of medications [26]. In regard to the psychological problems of SCA patients, we could establish a psychological consultation program to track the condition of patients and order proper treatment, establishing appropriate long-term mental health management for SCA patients. We could also use the virtual telemedicine platforms or the automated telephone call service to assess the overall mental state of SCA patients in a timely manner and to examine their degree of ataxia, which would also help maintain the social connection with patients and their families and give them confidence that they are being cared for and are not being abandoned [27,28].

There still exist several limitations of the present study. First, we did not perform the factor analysis in other SCA subtypes except SCA3, because of the limited numbers. Second, due to the COVID-19 pandemic, we were only able to administer the questionnaires online, which may have caused selection bias, such as the inability of elderly patients to use the Internet and the reluctance of patients with severe negative psychology to complete the questionnaires. However, our results evaluated the psychological status of SCA patients in China during the COVID-19 pandemic, which could still provide valuable evidence for clinical practice.

Overall, anxiety and depression were more prevalent in SCA patients than in the general population during the COVID-19 pandemic. We call on doctors to pay attention to the mental health of SCA patients and to prioritize psychiatric interventions for SCA patients at high-risk of mental health problems, such as those at high risk of exposure to COVID-19, those with lower education levels, and those with longer disease durations.

5. Consent to participate

All persons gave their informed consent prior to their inclusion in the study. Details that might disclose the identity of the subjects under study were omitted.

6. Consent for publication

All authors agreed to conditions noted on the Authorship Agreement Form and received an authorization-for-disclosure form.

7. Data availability

Anonymized data will be shared by request from any qualified investigator.

8. Funding information

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Ethical statement

Ethical approval

The studies involving human participants were reviewed and approved by Ethics Committee of Xiangya Hospital of Central
South University in China and therefore performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Authors contributions

All authors contributed to the study conception and design. Yiqing Gong wrote the manuscript. Yiqing Gong, Zhao Chen and Hong Jiang designed the project. Mingjie Liu and Linlin Wan organized and executed the experiment. Chunrong Wang, Huirong Peng, Yuting Shi, Yun Peng and Rong Qiu analyzed and interpreted the data. Kun Xia, BeiSha Tang and Hong Jiang revised the manuscript. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declaration of Competing Interest

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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