A cross-sectional survey on the effects of the COVID-19 pandemic on psychological well-being and quality of life in people with spinal cord injury

Ruba Altahla[1], Jamal Alshorman[2], Iftikhar Ali[3] and Xu Tao[1*]

Abstract

Background SARS-CoV-2 (COVID-19) has disrupted lives worldwide, affecting individuals from all walks of life. Individuals who have a spinal cord injury (SCI) are also affected by this phenomenon. This survey compares the quality of life (QOL), depression, and anxiety of SCI patients before and during COVID-19 in Wuhan City, China.

Methods A cross-sectional survey utilized an online questionnaire to assess the QOL, levels of anxiety, and depression among 189 SCI patients admitted to Wuhan Tongji Hospital during pandemic from November 2020 to April 2021. Data before COVID-19 outbreak from November to December 2019 was retrieved from hospital records with the same assessment previously performed in-person or during a follow up visit. However, some participants were excluded for various reasons, such as declining to participate, not being admitted to a rehabilitation program due to the pandemic, or being under 18 years old. The World Health Organization's (WHO) QOL-Brief Version (BREF) and disability (DIS) modules, which focus on disability-related QOL, were used to assess the participants' QOL.

Results SCI patients had lower QOL scores during the pandemic compared to pre-pandemic times. Mean scores on the 12-item DIS module significantly differed before and during the COVID-19 period. Participants showed higher adherence to self-isolation and quarantine measures for high-risk encounters (64.94%), but lower compliance with home disinfection and proper rest practices (23.38%).

Conclusions The COVID-19 pandemic has had a detrimental effect on the QOL of SCI patients in China, highlighting the urgent requirement for telehealth-based rehabilitation to mitigate its impact. It is crucial to provide essential.

Keywords Spinal cord injury, COVID-19 preventive measures, Quality of life, Depression, Anxiety, Pandemic

*Correspondence:
Xu Tao
xutdoc@163.com; i202122089@hust.edu.cn
[1]Department of Rehabilitation, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, 1095#, Jie-Fang Avenue, Qiaokou District, Wuhan 430030, Hubei, China
[2]Department of Orthopedics, Second Affiliated Hospital, Hubei University of Science and Technology, 437100 Xianning, China
[3]College of Physical Medicine and Rehabilitation, Paraplegic Centre, Hayatabad 25100, Peshawar, Pakistan

Background

SARS-CoV-2 (COVID-19) is an unusually contagious viral disease that reached pandemic status on March 11th, 2020, after health officials identified over 10,000 cases worldwide. The exponential rise in infections posed a risk of depleting critical hospital resources and overwhelming global healthcare systems [1]. The COVID-19 pandemic has evolved into a global health crisis, influencing various aspects of society, including health, the economy, and daily routines. It has brought about unprecedented consequences for people worldwide [2].

The COVID-19 pandemic and the implementation of preventive measures such as quarantine and lockdown have significantly impacted various aspects of life. Job loss, financial difficulties, and disruptions to daily routines have undermined life satisfaction, overall well-being, and mental health [3]. COVID-19 has adversely impacted psychological well-being and overall quality of life (QOL) across different societal groups. Restrictions on personal freedoms, prolonged periods of isolation, and separation from loved ones primarily contribute to this impact. These circumstances have inflicted harmful consequences on the psychological state and overall well-being of the general population [4]. The QOL is described as "the degree of need and satisfaction within the physical, social, activity, psychological, material, and structural areas" of personal life [5]. Throughout the early stages of COVID-19, a survey conducted among the Chinese population revealed significant levels of anxiety, unease, and fear, which were closely linked to lower levels of QOL [6].

A study conducted in Saudi Arabia shed light on the profound impact of COVID-19 and frequent lockdown measures on the QOL. Specifically, individuals experiencing depression, anxiety, and chronic diseases were notably affected by these circumstances [7]. Numerous studies have consistently indicated that individuals with chronic conditions are more susceptible to diminished QOL [6–8].

SCI can lead to a range of complications and comorbidities, causing a decrease in QOL when compared to individuals without such health conditions [9–11]. Furthermore, the recurrent closure of cafes, restaurants, and cinemas, designated as high-risk locations for COVID-19 transmission, has imposed restrictions on outdoor activities for those affected. Moreover, in countries with high COVID-19 caseloads, like Portugal, the USA, and Saudi Arabia, measures have been implemented to control the transmission of the virus. These measures have included the suspension of certain healthcare facilities, including physiotherapy and rehabilitation services [12–14].

In response to the outbreak in Wuhan, several outpatient and rehabilitation departments' scaled back medical treatment to mitigate the virus transmission [15]. However, the closure of rehabilitation and physiotherapy services, along with the outpatient clinics, had adverse effects on the psychological well-being, QOL, and mental health of spinal cord injury (SCI) patients' [16]. Furthermore, dedicating additional time to engaging in physical activities and therapeutic exercises has the potential to enhance the patient's well-being and QOL [17, 18]. Nevertheless, individuals with SCI may have faced an increased decline in their QOL during the COVID-19 pandemic and the associated quarantine measures. This is attributed to the prioritization of rehabilitation and healthcare resources towards COVID-19 patients, potentially overlooking the essential needs of individuals with SCI. However, the decrease in hospital admissions for SCI patients was notable due to concerns about the COVID-19 infection. Consequently, there was a reduction in patients' physical activity levels and an increase in unemployment rates [8].

The mounting concerns surrounding infection and the surge in COVID-19 cases give rise to an increased fear of the virus, leading to elevated levels of anxiety and depression [1, 19]. The lack of reliable predictions regarding the duration of the pandemic contributes to feelings of uncertainty [20]. Current studies have substantiated these concerns, with numerous findings supporting this notion. For instance, a survey conducted in China involving 52,730 individuals demonstrated that approximately one-third of the participants experienced psychological distress to varying degrees [21]. Considering that the literature on COVID-19 is still evolving, there is limited research on how the COVID-19 pandemic has specifically impacted the QOL, anxiety, and depression of SCI patients living in the community. To establish a baseline frame of reference, the mental health levels of European community-dwelling individuals (n=511) with traumatic and non-traumatic SCI were examined during non-pandemic periods. The results, measured using the Hospital Anxiety and Depression Scale (HADS), indicated a median depression of 4.0 and a mean of 4.6±3.9 for participants with an average time since injury of approximately 17 years [22]. This survey aims to compare the QOL, anxiety, and depression among SCI patients living in a specific society before and during COVID-19. Additionally, it seeks to investigate the level of compliance with preventive measures among those SCI who have contracted COVID-19. Moreover, the survey aims to investigate how demographic and clinical factors influence the QOL of SCI patients both before and during the pandemic.

Methodology

Participants

Patients were included in this cross-sectional survey based on specific criteria, which involved a confirmed diagnosis of SCI and admission to the Wuhan Tongji

Hospital rehabilitation department with a case record before the COVID-19 (November to December 2019) and during the pandemic (November 2020- April 2021) periods. Data before COVID-19 outbreak from November to December 2019 was retrieved from hospital records with the same assessment previously performed in-person or during a follow-up visit. Those who had contracted COVID-19 and had data available before the pandemic were given an opportunity and requested to participate in this research survey. Some participants were contacted twice via phone interview to complete questionnaires if any information was missing. Initially, through purposive sampling, data from 207 SCI patients were retrieved. Among them, 189 SCI patients were admitted during the study period. Further selection was based on record availability with assessments previously performed, resulting in 130 patients. After excluding 18 patients (10 aged<18 and 8 without a rehabilitation program before the pandemic or incomplete assessment), a total of 112 SCI patients from before the COVID-19 pandemic were included. SCI patients who declined to participate, were not admitted for a rehabilitation program due to the pandemic or incomplete assessment, or were under 18 years old were excluded.

Sample size
Sample size was calculated based on the study by Elaraby et al. [38], which assessed how the COVID-19 pandemic impacts all domains of QOL in Egyptians with SCI. The study reports several effect sizes for different outcome measures; however, the effect size for the change in physical health of QOL was considered, which is 0.45 (moderate effect size). A significance level (α) of 0.05 with a power (1-β) of 0.95 was considered. For a paired sample t-test, the sample size formula used is n = $(Z\alpha/2 + Z\beta)^2 / d^2$, where $Z\alpha/2$ is the critical value of the normal distribution at $\alpha/2$ (such as for a confidence level of 95%, α is 0.05 and the critical value is 1.96), $Z\beta$ is the critical value of the normal distribution at β (e.g. for a power of 95%, β is 0.05 and the critical value is 1.645), and d is the effect size. Based on these parameters (d=0.45, α=0.05, and 1-β=1.645), the required sample size for this survey is 65 pairs of subjects. However, a total of 77 pairs were included.

Data collection
Before proceeding with the questionnaire, participants were provided with a succinct explanation of the research purpose, the procedures involved, and the intended utilization of the collected data. Participants were required to respond to all questions before submitting the survey. Participation in the survey was voluntary, based on individual choice, and participants did not receive any form of compensation for their involvement.

Demographic data, injury information, and the history of COVID-19 infection were obtained from patients' records and other means of communication adhering to the principles outlined in the Helsinki Declaration.

Survey measures
Data were collected based on QOL, anxiety and depression levels, and COVID-19 prevention practices. Additionally, participants completed a socio-demographic questionnaire including age, time since injury, gender, educational status, spousal status, cause of injury, injury classification, and injury level if any pertinent information was missing. The SCI is classified according to the type of injury and the American Spinal Injury Association (ASIA) Impairment Scale (AIS), which categorizes SCI into complete or incomplete groups. According to the AIS, if there is a lack of sensory and motor function, the lesion is classified as complete. Conversely, SCI is classified as an incomplete injury if there is retention of sensory or motor functions below the injury level [23]. Due to quarantine restrictions, the data collection process could not be conducted in person. Instead, the researchers relied on ASIA grades to assess and determine the severity and level of injury. Consequently, the researchers collected the anal sphincter tone from the patients' histories [24]. It is worth noting that a lesion is categorized as incomplete if the sensation reported during digital stimulation, while a lesion is categorized as complete if there is no sensation is reported during examination.

Quality of life
The assessment of QOL for individuals with physical disabilities (PD) utilized the World Health Organization Quality of Life (WHOQOL) Scale [25]. This survey employed a combination of the QOL scales, namely the WHOQOL– Brief Version and disability module (BREF and DIS) scales [26]. The WHOQOL– BREF scale was identified as a suitable generic tool for evaluating health-related QOL in individuals with SCI [27]. It has consistently demonstrated reliable and valid results when used within the SCI population [28]. The WHOQOL– BREF questionnaire was first introduced in mainland China in 1998, providing a Chinese version for assessment purposes [29]. The first two items of the WHOQOL– BREF questionnaire focus on general QOL and health perception. The remaining 24 items are divided into four domains; each rated on a 5-point scale (seven items in physical well-being, six items in psychological well-being, three items in social relationships, and eight items in environmental factors). Following the provided scoring guidelines, the scores obtained were transformed into a linear scale ranging from 0 to 100. On this scale, higher scores corresponded to a higher QOL. The DIS scale module serves as an additional component integrated

into the WHOQOL– BREF questionnaire, specifically designed to evaluate the QOL of individuals with disabilities. It was comprised of 12 items that collectively represent a single comprehensive domain, along with one general item that assesses the overall impact of disability. Participants provided responses to each item on a scale varying from 1 (low) to 5 (high), with a higher score indicating a higher QOL for the participant.

Anxiety and depression

The levels of anxiety and depression were evaluated using the Self-Rating Anxiety/Depression Scale (SAS/SDS) [30, 31]. Comprising 20 items, participants assigned a rating to each item on a 4-point scale. Notably, the raw score derived from the SAS/SDS was multiplied by 1.25 to derive the standardized score. The standardized score ranges from 25 to 100, with higher scores indicative of more pronounced anxiety/depression severity. In this survey, a standard score of 50/53 was employed as the threshold for determining the clinical significance of anxiety or depression [32].

COVID-19 Prevention practices

The prevention practices comprised 15 items, and the Likert scale gauged the participant's level of agreement with each statement. Clarifications were recorded on a scale ranging from 1 (never) to 4 (always). In this section, the standardized scale was used in this survey, and the total scores ranged between 15 and 60, with higher scores indicative of a greater extent of protective actions being implemented [33].

Data analysis

The IBM SPSS software version 23 was used to analyze the data. Data normality was assessed using the Shapiro-Wilk test. Descriptive analyses were conducted for clinico-demographic information, WHOQOL– BREF,

Table 1 Descriptive analysis for quality of life, anxiety, and depression

Variable	Items *n*	Mean ± SD	Median(Range)
Overall QOL	1	3.14 **± 0.94**	3.00(4.00)
Overall health	1	2.69 **± 0.91**	3.00(4.00)
Domain 1: Physical health [a]	7	41.50 ± 10.98	38.00(69.00)
Domain 2: Psychological health [a]	6	52.73 ± 11.60	56.00(75.00)
Domain 3: Social relationships [a]	3	48.46 ± 16.44	50.00(75.00)
Domain 4: Environmental [a]	8	47.83 ± 13.80	50.00(69.00)
Impact of disability [b]	1	2.78 **± 0.83**	3.00(3.00)
DIS module	12	35.28 ± 2.86	35.00(13.00)
Self-rating depression scale	20	52.75 ± 4.62	52.50(27.50)
Self-rating anxiety scale	20	50.45 ± 6.09	51.25(32.50)

[a] QOL: Quality Of Life; [b]DIS: disability module; SD: standard deviation

DIS, self-rating depression, and anxiety scales. Categorical variables are presented as frequencies and percentages. However, continuous variables were expressed as mean ± standard deviation, as well as median and interquartile range (IQR). Furthermore, paired sample t-tests were utilized to determine the effect of COVID-19 on QOL domains and individual items. Similarly, differences in WHOQOL– BREF and DIS scores before and during the pandemic COVID-19, across selected demographic and clinical characteristics, were determined using the appropriate tests (paired t-tests or Wilcoxon signed-rank tests). To compute the practical significance of the findings, the effect size (Cohen's d) was computed at each analysis step, considering the longitudinal connection between each item and domain (*p* value set at 0.05).

Results

Among the 112 participants, 77.68% were male, 86.61% were married, and 60.71% had completed education up to middle school or below. Half of the participants were in the age group of 50 years. The majority of participants had experienced a recent injury within the past year (85.71%), and traumatic injuries were more prevalent (54.46%). The largest proportion of injuries were classified as ASIA grade C (40.18%), followed by B, A, and D, constituting 31.25%, 25%, and 3.57%, respectively.

The majority had sustained traumatic injuries. In terms of injury levels, the most prevalent was T7-T12 (33.93%), while the lowest was T1-T6 (12.50%). Paraplegia and tetraplegia were diagnosed in an equal proportion of participants (50%). The most common cause of injury was traffic accidents (63.39%), followed by falls on roads (18.75%). The majority of injuries were categorized as incomplete (91.07%), with the remaining 8.93% classified as complete injuries.

Quality of life, Depression, and anxiety

Table 1 displays measures of central tendency and dispersion, including mean, SD, median, and interquartile range, for the variables examined. The mean values for overall QOL based on the first item of WHOQOL– BREF were 3.14, and for overall health, they were 2.69. The means for the transformed scores of the WHOQOL– BREF domains of psychological health and social relationships were the higher range (75.00), followed by physical and environmental health in the (69.00) range. The mean value for "the impact of disability" item was 2.78, while the mean score for the 12-item DIS module was 35.28. The means for the standardized scores of the SDS were higher than those of the SAS: 50.45 and 52.75, respectively.

Changes in QOL in two periods (before and during) pandemic COVID-19

Table 2 shows the findings of the paired-samples t-tests that examined the QOL differences before and during the COVID-19 pandemic. The results reveal a significant decrease in the psychological and social relationships domains ($p<0.001$). Furthermore, there was a notable reduction in the physical health ($p=0.050$) and environmental domains ($p=0.071$). These declines in QOL were generally described as having medium- to large-sized effects on SCI patients during COVID-19. SCI patients showed a notable reduction in their QOL and health satisfaction, with observed decreases in the other domains (physical health, psychological, social relationships, and environmental). These declines were particularly evident in areas such as the need for medical treatment, satisfaction with sleep, ability to concentrate, support from friends, personal relationships, perception of the physical environment's healthiness, and satisfaction with living conditions.

Changes in the WHO modules on QOL-DIS, Anxiety/depression before and during COVID-19 pandemic

The paired-samples t-tests revealed the results of a comparison between scores on the DIS, SDS, and SAS before and during the COVID-19 pandemic (Table 3). Participants reported a significantly higher impact of disability during COVID-19 when compared to the pre-pandemic period ($p<0.001$, Cohen's d=1.02). Moreover, the total scores for SDS and SAS were also higher during COVID-19 ($p=0.001, <0.001$, Cohen's d = -0.42, -0.89). The prevalence estimates for mild depression were 52.7% before COVID-19, while anxiety was interpreted as normal by 67.9% of participants. During the COVID-19 pandemic, the prevalence of mild depression and anxiety increased to 68.8% and 77.9%, respectively (Fig. 1).

Table 2 Comparisons in quality of life before and during the COVID-19 pandemic

Items of QoL or Domain	Before COVID-19 pandemic		During COVID-19 pandemic		*p*-value	Cohen's d
	Mean	SD	Mean	SD		
How would you rate your quality of life?	3.13	1.04	3.03	0.96	0.520	-0.10
How satisfied are you with your health?	2.77	0.92	2.69	0.95	0.610	0.09
Physical health	42.40	12.44	38.87	9.56	0.050	0.32
To what extent do you feel that physical pain prevents you from doing what you need to do?	3.29	0.99	2.90	0.79	0.014	0.44
How much do you need any medical treatment to function in your daily life?	3.66	0.69	2.40	0.66	0.000	1.87
Do you have enough energy for everyday life?	2.43	0.97	2.09	0.78	0.027	0.39
How well are you able to get around physically?	2.45	0.85	1.96	0.90	0.001	0.56
How satisfied are you with your sleep?	2.97	0.92	1.97	0.83	0.000	1.14
How satisfied are you with your ability to perform your daily living activities?	2.75	0.91	2.27	0.81	0.002	0.56
How satisfied are you with your capacity for work	3.03	1.00	2.57	0.89	0.003	0.49
Psychological health	56.77	13.37	46.75	8.38	**0.000**	0.90
How much do you enjoy life?	3.19	1.03	2.79	0.95	0.014	0.40
To what extent do you feel your life to be meaningful?	3.26	0.95	2.96	0.98	0.063	0.31
How well are you able to concentrate?	3.55	0.95	3.05	0.83	0.001	0.56
Are you able to accept your body appearance?	3.10	0.79	2.84	0.63	0.016	0.36
How satisfied are you with yourself?	3.42	0.96	2.32	0.82	0.000	1.23
How often do you have negative feelings such as blue mood, despair, anxiety, or depression?	3.01	0.75	3.30	0.84	0.014	-0.36
Social relationships	54.88	16.21	42.18	15.62	**0.000**	0.80
How satisfied are you with your personal relationships?	3.39	0.73	2.71	0.97	0.000	0.79
How satisfied are you with your sex life?	2.90	0.66	2.55	0.85	0.004	0.46
How satisfied are you with the support you get from your friends?	3.29	0.93	2.83	0.94	0.000	0.49
Environment	48.05	16.76	44.49	11.67	0.071	0.25
How safe do you feel in your daily life?	2.81	1.00	2.70	1.03	0.511	0.11
How healthy is your physical environment?	3.10	0.98	2.57	0.80	0.001	0.59
Have you enough money to meet your needs?	2.22	1.02	2.22	0.97	1.000	0.00
How available to you is the information you need in your day-to-day life?	2.83	0.98	2.91	0.85	0.500	-0.09
To what extent do you have the opportunity for leisure activities?	2.43	1.03	2.51	0.98	0.540	-0.08
How satisfied are you with the conditions of your living place?	3.08	0.96	2.79	0.94	0.032	0.31
How satisfied are you with your access to health services?	3.27	0.84	3.09	0.83	0.150	0.22
How satisfied are you with your access to health services?	3.12	0.86	3.03	0.86	0.446	0.10

SD: Standard deveiation

Table 3 Changes in DIS, SDS, and SAS before vs. during the pandemic COVID-19

Variables	Before Covid-19		During Covid-19		*p*-value	Cohen's d
	Mean	SD	Mean	SD		
Impact of disability	2.92	0.80	2.74	0.85	0.148	0.22
DIS module	36.84	2.33	34.23	2.76	0.000	1.02
Self-rating depression scale	51.31	4.24	53.27	5.05	0.001	-0.42
Self-rating anxiety scale	47.42	5.22	52.36	5.87	0.000	-0.89

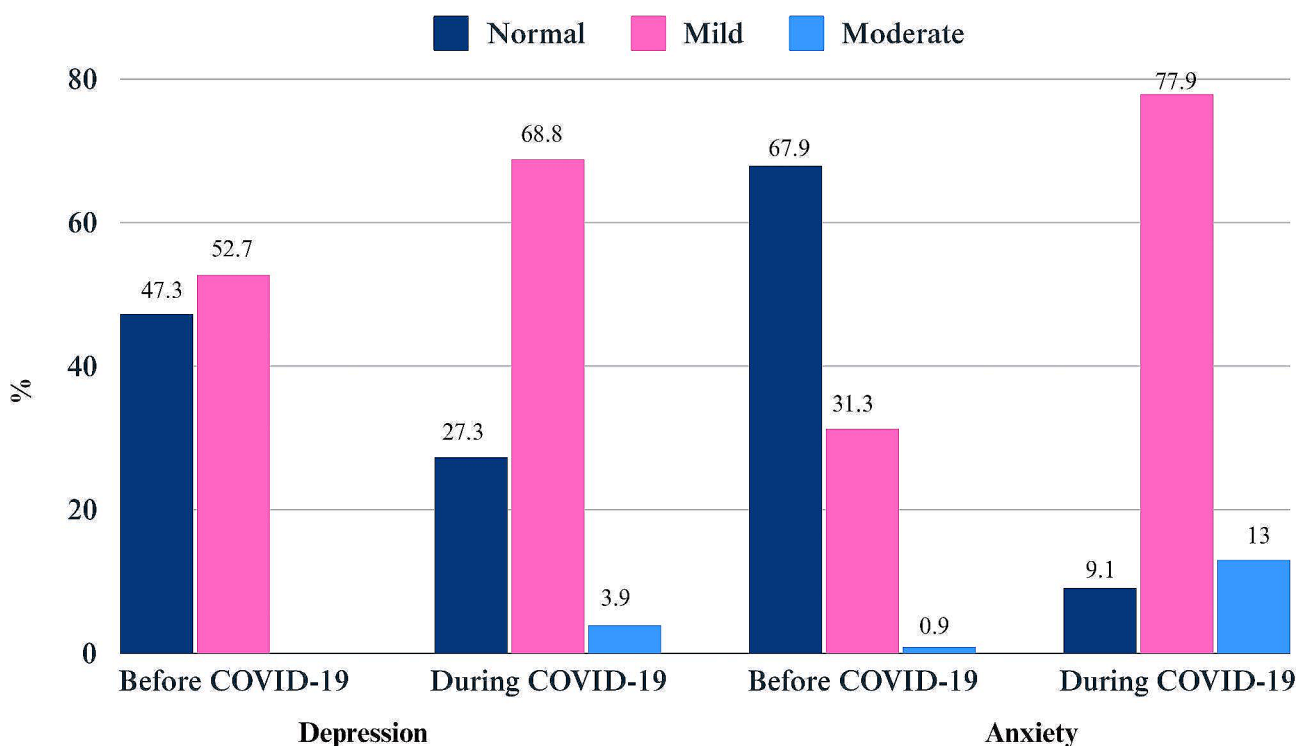DIS: disability, SAS: Self-Rating Anxiety Scale, SDS: Depression Scale

Fig. 1 Bar charts showing Changes in the severity of anxiety and depression levels before vs. during the COVID-19 pandemic

The WHOQOL–BREF and DIS scores comparison for participants stratified by demographics characteristics (gender and age) before and during COVID-19

Table 4 shows the comparison of the WHOQOL– BREF, dimensions, and DIS for the gender and age groups before and during COVID-19. In the male group during COVID-19, there were significant decreases in various dimensions: the physical dimension showed lower scores and a small effect size compared to before COVID-19 (*p*=0.074, d=0.29). Furthermore, the psychological dimension was significantly lower with a large effect size compared to before COVID-19 (*p*=0.000, d=0.97). Additionally, the social relationships dimension showed lower scores with a medium effect size compared to before COVID-19 (*p*=0.003, d=0.61). Moreover, the environmental dimension showed lower scores and a smaller effect size during COVID-19 compared to before COVID-19 (*p*=0.288, d=0.17). In addition, the DIS was significantly lower with a large effect size during COVID-19 than before COVID-19 (*p*=0.000, d=1.83).

However, in the female group during COVID-19, there were significant decreases in various dimensions: the physical dimension showed lower scores and a large effect size compared to before COVID-19 (*p*=0.053, d=0.84). Furthermore, the psychological dimension was significantly lower with a large effect size compared to before COVID-19 (*p*=0.154, d=0.84), and the social relationships dimension was lower with a large effect size during COVID-19 compared to before COVID-19 (*p*=0.003, d=1.49). Moreover, the environmental dimension showed lower scores and a medium effect size during COVID-19 compared to before COVID-19 with a medium effect size (*p*=0.151, d=0.76), and the DIS was significantly lower with a large effect size during COVID-19 than before COVID-19 (*p*=0.001, d=1.77). For participants in the <30 years old group during COVID-19, there were decreases in various dimensions: physical, psychological, and environmental dimensions with a large effect size (d=0.89, 1.16, and 0.96, respectively), while the social dimension had a medium effect size

Table 4 Comparisons between before and during COVID-19 scores for the WHOQOL–BREF and the DIS stratified by gender and age groups

Characteristics		Dimension	COVID-19	Median	IQR	Mean	SD	SE of Mean	Shapiro-Wilk test(p)	p-value	Effect size(d)
Gender	Male	Physical health	Before	44.00	19.75	42.97	12.76	1.62	0.016	0.074[‡]	0.29
			During	38.00	13.00	39.68	9.81	1.25	0.006		
	Female		Before	44.00	12.00	43.92	11.78	2.36	0.157	0.053	0.84
			During	38.00	13.00	35.53	7.85	2.03	0.043		
	Male	Psychological health	Before	56.00	19.00	57.77	14.15	1.80	0.016	0.000	0.97
			During	44.00	12.00	46.87	7.39	0.94	0.000		
	Female		Before	56.00	19.00	55.36	9.64	1.93	0.013	0.154	0.84
			During	44.00	12.00	46.27	11.96	3.09	0.082		
	Male	Social relationships	Before	50.00	25.00	52.21	16.65	2.11	0.000	0.003	0.61
			During	44.00	25.00	42.42	15.20	1.93	0.006		
	Female		Before	69.00	13.00	62.76	10.13	2.03	0.008	0.003	1.49
			During	44.00	19.00	41.20	17.81	4.60	0.410		
	Male	Environment	Before	50.00	25.00	47.53	17.19	2.18	0.010	0.288	0.17
			During	44.00	18.00	45.03	11.02	1.40	0.001		
	Female		Before	56.00	18.00	52.64	12.81	2.56	0.372	0.151[#]	0.76
			During	38.00	19.00	42.27	14.28	3.69	0.830		
	Male	DIS module	Before	37.00	2.25	36.74	2.41	0.26	0.017	0.000	1.83
			During	33.00	3.00	32.81	1.84	0.23	0.016		
	Female		Before	37.00	1.00	37.20	2.02	0.40	0.124	0.001[#]	1.77
			During	33.00	2.00	33.80	1.82	0.47	0.392		

Table 4 (continued)

Characteristics		Dimension	COVID-19	Median	IQR	Mean	SD	SE of Mean	Shapiro-Wilk test(*p*)	*p*-value	Effect size(d)
Age(years)	< 30	Physical health	Before	56.00	19.00	52.13	11.10	2.87	0.007	0.105	0.89
			During	44.00	15.50	42.75	9.89	2.86	0.387		
		Psychological health	Before	63.00	25.00	57.73	13.73	3.54	0.090	0.059	1.16
			During	44.00	3.00	45.50	5.79	1.67	0.011		
		Social relationships	Before	69.00	19.00	59.67	11.93	3.08	0.003	0.018	0.69
			During	56.00	15.50	50.92	13.40	3.87	0.030		
		Environment	Before	56.00	13.00	60.00	8.86	2.29	0.104	0.016	0.96
			During	50.00	21.50	48.67	14.07	4.06	0.652		
		DIS module	Before	37.00	3.00	37.20	1.90	0.49	0.167	0.003	2.10
			During	32.50	2.50	33.25	1.86	0.54	0.060		
	31–40	Physical health	Before	44.00	18.00	48.11	8.92	2.10	0.014	0.067	1.84
			During	38.00	7.00	35.67	3.50	1.17	0.000		
		Psychological health	Before	56.00	13.00	60.72	8.86	2.09	0.009	0.005	1.58
			During	44.00	12.00	47.22	8.24	2.75	0.084		
		Social relationships	Before	53.00	25.00	48.50	15.32	3.61	0.057	0.285	0.26
			During	50.00	6.00	45.11	10.69	3.56	0.106		
		Environment	Before	56.00	13.00	57.06	9.61	2.27	0.191	0.023	1.39
			During	44.00	19.00	42.33	11.57	3.86	0.340		
		DIS module	Before	37.00	2.00	36.89	1.37	0.32	0.018	0.003	2.20
			During	32.00	3.00	32.44	2.51	0 0.84	0.526		
	41–50	Physical health	Before	44.00	18.00	43.30	11.38	2.37	0.406	0.303	0.69
			During	38.00	10.00	37.10	5.51	1.23	0.009		
		Psychological health	Before	56.00	6.00	56.74	9.67	2.02	0.000	0.012	1.45
			During	44.00	6.00	43.20	9.04	2.02	0.004		
		Social relationships	Before	56.00	12.00	51.87	13.19	2.75	0.069	0.021	0.63
			During	50.00	22.00	42.75	15.76	3.52	0.039		
		Environment	Before	56.00	25.00	49.61	14.87	3.10	0.000	0.888	0.56
			During	41.00	15.00	42.00	12.02	2.69	0.036		
		DIS module	Before	37.00	3.00	36.87	2.60	0.54	0.350	0.001	1.58
			During	33.00	3.00	33.20	2.02	0.45	0.420		
	> 50	Physical health	Before	38.00	6.00	39.39	10.85	1.45	0.000	0.616	0.00
			During	41.00	13.00	39.36	11.76	1.96	0.106		
		Psychological health	Before	56.00	13.00	55.38	12.72	1.70	0.003	0.003	0.59
			During	47.00	12.00	49.03	8.31	1.39	0.002		
		Social relationships	Before	56.00	22.00	52.68	17.20	2.30	0.000	0.000	0.86
			During	37.50	25.00	38.22	16.36	2.73	0.175		
		Environment	Before	44.00	18.00	45.46	15.33	2.05	0.009	0.968	0.03
			During	44.00	18.00	45.03	10.66	1.78	0.012		
		DIS module	Before	37.00	3.50	36.71	2.58	0.35	0.070	0.000	1.74
			During	33.00	2.50	32.94	1.64	0.27	0.032		

‡= Wilcoxon signed ranked test, # t-test, IQR: Interquartile Range, SD: Standard deviation, SE: Standard error

(d=0.69) and the DIS showed a large effect size (d=2.10). For participants in the 31–40 years old group during COVID-19, there were significant decreases in various dimensions: physical, psychological, and environmental dimensions with a large effect size (d=1.84, 1.58, and 1.39), respectively, while the social dimension had a small effect size (d=0.26) and the DIS had a large effect size (d=2.20). For participants in the 41–50 year old group during COVID-19, there were significant decreases in various dimensions: physical, social, and environmental dimensions with a medium effect size (d=0.69, 0.63, and 0.56), respectively, while the psychological dimension had a large effect size (d=1.45) and the DIS had a large effect size (d=1.58). For those in the age group>50 year, during COVID-19 there were significant decreases in various dimensions: physical and environmental dimensions, with a small effect size (d=0.00, 0.03), respectively. While the psychological dimension had a medium effect size (d=0.59), the social dimension had a large effect size (d=0.86), and the DIS had a large effect size (d=1.74).

The WHOQOL– BREF and DIS scores comparison based on stratification by injury characteristics (level of injury and ASIA scale) before and during COVID-19

Table 5 displays the comparisons in the two periods for the WHOQOL– BREF, dimensions, and DIS for the level of injury. During COVID-19, the participants in the C1-C4 level injuries experienced significant decreases in various dimensions: physical, psychological, social dimensions, and DIS, with large effect sizes (d=1.10, 1.09, 0.82, and 1.33), respectively, while experiencing a medium effect size (d=0.50) in the environmental dimension. For participants in the C5-C8 level injuries, during COVID-19 there were significant decreases in various dimensions: a small effect size for physical health (d = -0.06) and large effect sizes for psychological and social dimensions (d=1.05, 1.20), respectively. The environmental dimension had a medium effect size (d=0.52) and DIS showed a large effect size (d=1.72). For participants with T1-T6 level injuries during COVID-19, there were significant decreases in various dimensions: physical, psychological, and environmental dimensions with small effect sizes (d=0.43, 0.38, and 0.34), respectively, while the social dimension and DIS exhibited large effect sizes (d=1.05, 2.27), respectively. For those with T7-T12-level injuries, during COVID-19 there were significant decreases in various dimensions: physical, social, and environmental dimensions with small effect sizes (d=0.16, 0.36, and 0.28), respectively, while the psychological dimension and DIS showed large effect sizes (d=1.43, 1.92), respectively. For the participants in the lumbar or sacral level group during COVID-19, there were significant decreases in various dimensions: physical, social, and environmental dimensions with large effect sizes (d=2.09, 0.78, and 1.20), respectively, while the psychological dimension had a small effect size (d=0.22) and the DIS exhibited a large effect size (d=1.67).

Table 6 presents the comparisons in the two periods for the WHOQOL– BREF, dimensions, and DIS for ASIA groups. For SCI with the ASIA grade A group during COVID-19, there were significant decreases in various dimensions: large effect sizes in physical and psychological dimensions and DIS (d=0.76, 0.98, and 1.70), respectively, while the social and environment dimensions showed small effect sizes (d=0.46, 0.12). For participants with ASIA B during COVID-19, there were significant decreases in various dimensions: small effect sizes for physical and psychological dimensions (d=0.160, 1.31), respectively, while the social dimension and DIS had large effect sizes (d=0.92, 1.78), and the environment dimension had a medium effect size (d=0.56). For participants with ASIA scale C during COVID-19, there were significant decreases in various dimensions: the physical dimension had a small effect size (d=0.32), while the psychological, social, and environment dimensions exhibited medium effect sizes (d=0.70, 0.70, and 0.54), respectively. However, the DIS has a large effect size (d=1.85). For the participants in the ASIA grade D group during COVID-19, there were significant decreases in various dimensions: a small effect size for the physical, psychological, and environment dimensions (d=1.83, 1.70, and 2.29), respectively, while the social dimension had a medium effect size (d=0.02) and DIS exhibited a large effect size (d=3.00).

Practices sample with respect to COVID-19

The percentage of individuals always practicing good habits varied from 66.23% for home disinfection to 93.5% for active quarantine and high-risk groups. The practice of keeping warm and avoiding catching a cold had an average value of 90.91%. Except for a few items such as "after the outbreak, stay at home to prevent infection," "wear a mask when going out," "wash hands," "open windows to keep the air fresh," "reduce time in airtight, airless environments," "reduce visits to crowded places," and "avoid direct contact with public facilities that may be infected," the adherence rate to good practices was above 80% (Table 7).

Discussion

Based on the available studies and information, there is no research on the psychosocial effect of COVID-19 specifically on individuals with chronic SCI. The influence of COVID-19 has presented a significant difficulty for healthcare staff and systems worldwide as they grapple with the task of managing and providing long-term or intensive care for a large influx of infected patients. In response to the pandemic, the World Health Organization (WHO) has issued guidelines and protective measures for stakeholders, people with disabilities, and patients with SCI [34].

One of the recommendations put forward by the panel was the utilization of telemedicine as a means to deliver healthcare services to SCI patients during the COVID-19 pandemic. In addition to providing medical care, remote methods such as text messaging, social media, and video conferencing could be employed for investigations, follow-ups, and psychosocial support. By making telehealth services accessible to individuals with SCI, they may increase their empowerment and improve their ability to address common issues. Consequently, this could lead to a reduction in hospital admissions and the need for urgent care [35].

Aligned with the WHO's guidance on implementing telecommunication strategies for individuals with disabilities, this research paper aimed to assess the impact of the pandemic COVID-19 and the preventive measures on QOL domains among Chinese individuals with SCI.

Table 5 Comparisons between before and during COVID-19 scores for WHOQOL–BREF and DIS stratified by injury level

Characteristics		Dimension	COVID-19	Median	IQR	Mean	SD	SE of Mean	Shapiro-Wilk test(*p*)	*p*-value	Effect size (d)
Level of injury	C1-C4	Physical health	Before	50.00	18.00	48.00	10.05	2.19	0.039	0.006	1.10
			During	38.00	13.00	38.78	6.24	1.30	0.003		
		Psychological health	Before	56.00	7.00	56.90	9.46	2.06	0.017	0.013	1.09
			During	44.00	12.00	47.61	7.28	1.52	0.002		
		Social relationships	Before	56.00	19.00	55.67	17.34	3.78	0.003	0.050	0.82
			During	44.00	19.00	42.65	14.10	2.94	0.151		
		Environment	Before	56.00	12.00	51.52	12.31	2.69	0.079	0.233	0.50
			During	44.00	18.00	45.70	10.98	2.29	0.088		
		DIS module	Before	37.00	3.00	36.00	2.90	0.63	0.266	0.002	1.33
			During	32.00	3.00	32.83	1.72	0.36	0.008		
	C5-C8	Physical health	Before	38.00	13.00	37.38	12.68	2.59	0.097	0.895	-0.06
			During	38.00	13.00	38.00	9.34	2.50	0.049		
		Psychological health	Before	56.00	9.50	54.71	10.94	2.23	0.012	0.027	1.05
			During	44.00	6.00	43.86	9.71	2.60	0.032		
		Social relationships	Before	53.00	19.00	54.71	11.36	2.32	0.006	0.003	1.20
			During	44.00	19.00	41.07	11.43	3.05	0.056		
		Environment	Before	50.00	25.00	47.63	16.03	3.27	0.119	0.512	0.52
			During	41.00	19.00	40.21	12.59	3.36	0.133		
		DIS module	Before	37.00	2.00	37.29	2.26	0.46	0.080	0.000	1.72
			During	33.50	2.00	33.50	2.14	0.57	0.154		
	T1-T6	Physical health	Before	44.00	6.00	41.29	10.19	2.72	0.125	0.118	0.43
			During	31.00	19.00	36.57	11.67	4.41	0.252		
		Psychological health	Before	59.50	25.00	54.21	16.59	4.43	0.448	0.612	0.38
			During	56.00	12.00	49.00	9.75	3.68	0.019		
		Social relationships	Before	56.00	19.00	54.86	13.35	3.57	0.185	0.037	1.05
			During	44.00	25.00	41.86	11.28	4.26	0.062		
		Environment	Before	47.00	12.00	48.36	12.43	3.32	0.861	0.830	0.34
			During	44.00	12.00	44.00	13.50	5.10	0.552		
		DIS module	Before	37.00	2.00	37.21	1.37	0.37	0.180	0.015	2.27
			During	32.00	4.00	33.00	2.24	0.85	0.165		
	T7-T12	Physical health	Before	41.00	6.00	42.29	10.07	1.63	0.015	0.575	0.16
			During	44.00	6.00	40.63	11.35	2.07	0.055		
		Psychological health	Before	56.00	13.00	60.79	11.49	1.86	0.005	0.000	1.43
			During	44.00	6.00	46.57	8.16	1.49	0.004		
		Social relationships	Before	50.00	12.00	49.16	16.90	2.74	0.004	0.096	0.36
			During	50.00	31.00	42.47	19.91	3.63	0.049		
		Environment	Before	56.00	19.00	50.76	17.24	2.80	0.000	0.586	0.28
			During	47.00	18.00	46.77	10.24	1.87	0.039		
		DIS module	Before	37.00	2.00	36.92	2.41	0.39	0.323	0.000	1.92
			During	33.00	2.00	33.03	1.56	0.29	0.212		
	Lumbar or sacral	Physical health	Before	44.00	19.00	50.67	11.37	2.94	0.061	0.034	2.09
			During	31.00	13.00	31.33	6.51	3.76	0.915		
		Psychological health	Before	56.00	12.00	52.53	9.46	2.44	0.490	0.655	0.22
			During	44.00	19.00	50.33	10.97	6.33	0.000		
		Social relationships	Before	56.00	38.00	52.87	17.82	4.60	0.010	0.109	0.78
			During	44.00	19.00	41.67	9.71	5.61	0.600		
		Environment	Before	50.00	12.00	52.20	11.16	2.88	0.017	0.285	1.20
			During	38.00	37.00	33.67	18.88	10.90	0.618		
		DIS module	Before	37.00	3.00	36.73	1.98	0.51	0.895	0.213	1.67
			During	30.00	7.00	31.67	3.79	2.19	0.253		

DIS: Disability, IQR: Interquartile Range, SD: Standard deviation, SE: Standard error

Table 6 Comparisons between before and during COVID-19 scores for WHOQOL–BREF and DIS stratified by ASIA groups

Charac-teristics		Dimension	COVID-19	Median	IQR	Mean	SD	SE of Mean	Shapiro-Wilk test(*p*)	*p*-value	Effect size (d)
ASIA	A	Physical health	Before	47.00	15.00	47.04	12.88	2.43	0.031	0.117	0.76
			During	38.00	13.00	38.52	9.14	1.99	0.163		
		Psychological health	Before	56.00	22.00	55.25	12.14	2.29	0.230	0.004	0.98
			During	44.00	6.00	44.71	9.24	2.02	0.008		
		Social relationships	Before	56.00	25.00	51.14	19.22	3.63	0.001	0.336	0.46
			During	50.00	25.00	43.10	15.56	3.40	0.038		
		Environment	Before	53.00	18.50	48.11	18.35	3.47	0.041	0.820	0.12
			During	44.00	18.00	46.29	11.68	2.55	0.447		
		DIS module	Before	37.00	3.00	37.32	2.48	0.47	0.566	0.000	1.70
			During	33.00	3.00	33.43	2.09	0.46	0.467		
	B	Physical health	Before	38.00	6.00	41.77	9.64	1.63	0.000	0.536	0.16
			During	44.00	6.00	40.20	9.91	1.98	0.004		
		Psychological health	Before	56.00	7.00	58.86	9.57	1.62	0.000	0.001	0.131
			During	44.00	12.00	47.32	8.01	1.60	0.006		
		Social relationships	Before	50.00	25.00	54.49	14.19	2.40	0.006	0.000	0.92
			During	44.00	19.00	41.00	15.11	3.02	0.134		
		Environment	Before	56.00	13.00	52.23	12.82	2.17	0.000	0.116	0.56
			During	50.00	18.00	45.56	11.10	2.22	0.068		
		DIS module	Before	36.00	3.00	36.63	2.53	0.43	0.105	0.000	1.78
			During	33.00	2.00	32.84	1.62	0.32	0.209		
	C	Physical health	Before	44.00	6.00	41.84	12.07	1.80	0.015	0.137	0.32
			During	38.00	13.00	38.29	10.17	1.92	0.126		
		Psychological health	Before	56.00	13.00	55.31	12.43	1.85	0.015	0.105	0.70
			During	44.00	12.00	48.11	7.71	1.46	0.008		
		Social relationships	Before	56.00	25.00	52.31	15.14	2.26	0.001	0.005	0.70
			During	44.00	25.00	41.25	16.52	3.12	0.119		
		Environment	Before	50.00	12.00	48.76	13.85	2.06	0.137	0.165	0.54
			During	41.00	22.00	41.61	12.44	2.35	0.225		
		DIS module	Before	37.00	3.00	36.60	2.07	0.31	0.122	0.000	1.85
			During	33.00	3.00	32.93	1.90	0.36	0.225		
	D	Physical health	Before	47.00	12.00	47.00	7.75	3.87	0.972	0.180	1.83
			During	38.00	7.00	35.67	4.04	2.33	0.000		
		Psychological health	Before	62.50	22.50	67.25	15.13	7.56	0.225	0.207	1.70
			During	44.00	25.00	43.67	12.50	7.22	0.956		
		Social relationships	Before	56.00	3.00	54.50	3.00	1.50	0.001	1.000	0.02
			During	50.00	25.00	54.33	13.05	7.54	0.443		
		Environment	Before	63.00	3.50	61.25	3.50	1.75	0.001	0.109	2.29
			During	50.00	12.00	50.00	6.00	3.46	1.000		
		DIS module	Before	37.00	2.00	38.00	2.00	1.00	0.001	0.109	3.00
			During	32.00	4.00	32.00	2.00	1.15	1.000		

ASIA: American Spinal Injury Association Impairment Scale, IQR: Interquartile Range, SD: Standard deviation, SE: Standard error

However, the survey was conducted from November 2020 to April 2021, comparing in-person follow-up visits before the COVID-19 outbreak with the current situation influenced by the pandemic. This survey asked the participants voluntarily to evaluate how the pandemic COVID-19 and the associated preventive measures affected the QOL domains. It included the SAS/SDS, the COVID-19 prevention practices, the WHOQOL– BREF, and the DIS. This survey clearly demonstrated a decrease in QOL across all domains during the pandemic. Moreover,

it supports the previous research indicating that the COVID-19 pandemic highly affects QOL in individuals with SCI with greater negative effects than before the pandemic. However, the previous studies consistently reported lower scores across QOL domains compared to healthy communities or other chronic diseases. Considering the existing literature [36, 37], it is reasonable to expect the current findings in SCI patients of decreased QOL during the COVID-19 pandemic. This was reported in the domains of physical health (41.50±10.98),

Table 7 The COVID-19 prevention practices by cross secotional survey sample ($N = 77$)

Items	Always n (%)	Often n (%)	Sometimes n (%)	Never n (%)
After the outbreak, stay at home to prevent infection	44(57.11)	19(24.68)	11(14.29)	3(3.90)
Wear a mask when going out	50(64.94)	18(23.37)	6(7.79)	3(3.90)
Wash hands	38(49.35)	27(35.06)	8(10.39)	4(5.20)
Seek medical advice when symptoms such as fever and cough appear	40(51.95)	18(23.37)	15(19.40)	4(5.19)
Monitor body temperature	29(37.66)	26(33.76)	18(23.30)	4(5.19)
Open windows to keep the air fresh	42(54.55)	25(32.46)	10(12.90)	0
Rest properly and don't stay up late	31(40.26)	25(32.46)	16(20.70)	5(6.49)
Appropriate exercise	30(38.96)	27(35.06)	15(19.40)	5(6.49)
Home environment disinfection	18(23.38)	33(42.85)	21(27.20)	5(6.49)
Reduce time in airtight, airless environments	39(50.65)	24(31.16)	10(12.90)	4(5.19)
Reduce visits to crowded places	43(55.84)	26(33.76)	7(9.09)	1(1.29)
Avoid direct contact with public facilities that may be infected, such as elevator buttons and stair railings	39(50.65)	28(36.36)	8(10.38)	2(2.59)
Active quarantine after contact with high-risk groups	45(58.44)	27(35.06)	3(3.90)	2(2.59)
Cover mouth and nose when coughing or sneezing	44(57.14)	21(27.27)	10(12.90)	2(2.59)
Keep warm and avoid catching cold	45(58.44)	25(32.47)	7(9.09)	0

psychological health (52.73±11.60), social relationships (48.46±16.44), and environmental (47.83±13.80), which matches the results of Hearn et al. [38]. The pandemic presented SCI patients with a range of personal, physical, psychological, and social challenges. These challenges had the potential to adversely impact their daily functioning and overall QOL. Rudolf et al., reported different results and did not observe any notable variations in the four domains of WHOQOL– BREF among SCI patients before and during the pandemic [39]. However, the largest reductions were reported in participants' satisfaction with their daily medical treatment [16]. Moreover, the heightened risk of infection, which remains the primary cause of mortality following SCI [40], further contributes to the deterioration in health. Other studies have been conducted in Tanzania, Canada, and Hong Kong and found that SCI patients had a greater negative impact on the physical health domain than other domains [36, 41, 42]. However, many studies have documented the current findings that there was an increase in sleep disturbances during COVID-19 [43, 44]. Moreover, sleep disruption can negatively affect psychological, cognitive, and social functioning, ultimately reducing the patient's QOL [45]. The psychological health domain covers life satisfaction, sense of meaning, concentration ability, body acceptance, self-contentment, and negative emotions like sadness, distress, anxiety, and depression [46]. However, the present outcome revealed a significant decline in psychological health compared to the period before COVID-19. This survey finding is consistent with a Japanese study that indicated that 44.4% showed symptoms of deterioration during the pandemic period [47]. Additionally, the largest reduction occurred in concentration ability and self-satisfaction. The findings of this survey were in line with the Hearn et al., study, which showed a significant

decline in the psychological well-being of individuals with SCI [16]. The deterioration in psychological health can be linked to the restricted availability of healthcare organizations and the required isolation during quarantine. Despite numerous studies conducted to evaluate the effects of COVID-19 on psychological health, there are a limited number of studies that have specifically assessed the influence of COVID-19 on the psychological well-being of individuals with SCI. Telemedicine interventions have contributed to reducing the fear of infection and COVID-19 outbreaks among SCI patients. By conducting tele-rehabilitation sessions, telemedicine provides a safe and secure communication platform for patients. This approach supports the psychosocial well-being of SCI patients by allowing them to receive necessary rehabilitation services while minimizing the risk of exposure to the virus. The social relationships domain includes satisfaction in social relationships, sexual behavior, and friend support [46]. This cross-sectional survey revealed a substantial decrease in social domain QOL during the pandemic compared to the pre-pandemic. In contrast, García-Rudolph et al. indicated no disparity between the two periods in terms of the social aspect of the WHO-QOL– BREF and these results are inconsistent [39]. However, a significant reduction was reported in patient's satisfaction with their friends support and in social relationships. This inconsistency is attributed to the enforced distancing policies during COVID-19, which aimed to protect high-risk individuals by promoting limited face-to-face contact and confinement to their home.

However, the environmental domain covers aspects of freedom perception, physical and financial assurance, social and healthcare services, living satisfaction, opportunities for learning and skill development, engagement in activities, and the availability of entertainment

activities [39]. According to this survey, the largest decreases occurred in how healthy their physical environment was and their satisfaction with their patients living conditions. Nonetheless, previous studies conducted before COVID-19 documented lower scores in the environmental domain [48]. Therefore, COVID-19 might influence the environmental domain, and SCI patients already experienced a pre-existing low QOL.

The findings of the survey indicate the importance of raising awareness about the specific challenges experienced by SCI patients during the pandemic. This awareness can play a significant role in fostering improved support and understanding from broader communities. By implementing the mentioned recommendations, healthcare providers, policymakers, and stakeholders can collaborate to alleviate the adverse impact of the pandemic on the psychological well-being and overall QOL of SCI patients.

The DIS, SDS, SAS before and during pandemic COVID-19

As for the DIS module, participants before COVID-19 had a few QOL scores lower than participants during COVID-19. This agrees with a study by Lakhani et al., who showed a difference between the two periods of the DIS [49]. Moreover, this means providing valuable insight into the specific needs and areas of improvement for individuals with disabilities and helping to report interventions, policies, and support services that promote their overall well-being and QOL.

In this survey, the participants showed a significant increase in depression, with a mild level of severity, as indicated by the SDS assessment. Similarly, anxiety levels significantly rose, reaching a mild level of severity, as reported through the SAS assessment, in contrast to the period before COVID-19, where anxiety levels were within the normal range. These results are coordinated with those of García-Rudolph et al. [39].

Comparisons WHOQOL–BREF and DIS stratified before and during COVID-19 periods by gender and age groups

There were no significant differences in any of the WHOQOL– BREF dimensions. In addition, the effect size of WHOQOL–BREF dimensions in the older adult group was smaller than in the young adult group. This result coordinated with Susan et al., as individuals' transition from young to old and older adults frequently express lower levels of negative emotions and comparable or higher levels of positive emotions compared to comparatively young adults [50]. However, this survey found significant differences in DIS scores when classifying the participants according to age (<30, 31–40, 41–50 and >50). The adult group reported significantly lower DIS scores during COVID-19 than before it competed with younger adults. This difference suggests that older adults

may face specific challenges and limitations that result from previous studies.

Meanwhile, this survey revealed a significant difference before and during COVID-19 in psychological health, social relationships, and DIS scores among gender groups. Men and women may utilize distinct coping strategies in response to the COVID-19 pandemic, which can influence their psychological well-being and ability to maintain satisfying social relationships in difficult circumstances. In addition, the biological differences between genders can influence psychological health and social relationships [51].

Comparisons WHOQOL–BREF and DIS Stratified Before and During COVID-19 Periods by injury Level and ASIA Grades

Regarding injury level, all of C1-C4, C5-C8, and T7-T12 had a large psychological effect size. Higher injury levels are associated with increased psychological distress and lower psychological health scores due to the physical limitations and the impact on overall well-being [52]. In addition, many factors affected psychological health after SCI, such as level of injury, personal strength, community support, healthcare provision, and coping skills. Particularly in the C1-C4 and C5-C8 levels with a medium effect size, and T1-T6, T7-T12 with a small effect size in the environmental domain. While all injury levels were with a large effect size of the DIS module.

In contrast, ASIA grades had a large effect size on physical health, with more injury severity in ASIA grade A, while the other domains (psychological, social, and environmental) significantly decreased with various effect sizes. Loss of motor function, sensory impairments, reduced mobility and physical activity, challenges in self-care and daily activities, and secondary health complications are all due to lower physical health with a more severe injury [53].

COVID-19 preventative behaviors

This survey demonstrated that SCI patients received less home environment disinfection due to travel constraints and environmental barriers that prevent SCI individuals from optimal hygienic practice and restrict adequate exercise and rehabilitation ability [54–56]. In contrast, Huiming et al. found poorer access to observe body temperature, coughing, and sneezing hygiene in the Chinese participants [33]. The findings indicated that individuals with SCI had the lowest likelihood of disinfecting their home environment. The results of this survey align with previous research conducted on Chinese participants regarding their disinfection practices at home [33]. Chinese SCI patients are more likely to voluntarily self-isolate and actively quarantine themselves upon encountering high-risk groups. This behavior can be attributed to their excellent awareness of COVID-19 symptoms and

adherence to preventive measures imposed by the Chinese government, which is widespread among the Chinese population [33].

Limitations
First, the small and biased sample, as well as the convenience of the data collection, prevents the representativeness of the results. Moreover, readers should approach the outcomes with an optimal level of attention. Second, the participants had varying levels of education, which could have influenced their understanding of the questionnaire. This difference in educational background presents an additional potential source of response bias. Furthermore, the survey did not gather information regarding participants' vaccination status or history of COVID-19 diagnosis. Consequently, future research would be advantageous in examining the associations between these variables, COVID-19 preventive behaviors, implications and recommendations for healthcare providers, and QOL. Finally, a recent report discussed some thoughts on SCI and COVID-19 after the first wave [35]. However, it is essential to establish a long-term follow-up with these patients during the pandemic peak level and in the current phase of controlled viral infection.

Conclusions
This survey individual with SCI experienced decreased QOL levels in all domains during the COVID-19 pandemic compared to their QOL before COVID-19. Chinese individuals with SCI displayed reduced compliance with COVID-19 preventive measures, particularly in relation to disinfecting their home environment. However, they showed higher a likelihood of active quarantine after contact with high-risk communities. The younger group experienced a greater impact from COVID-19, with a moderate to large effect size in the WHOQOL–BREF dimension. In contrast, the older group showed a smaller to medium effect size, suggesting their resilience in the face of challenges. However, during COVID-19, older adults had significantly lower DIS scores than younger adults, indicating that their quality of life deteriorated more markedly during the pandemic. Regarding the level of injury and ASIA grades before and during COVID-19 periods, there were significant decreases in various WHOQOL–BREF and DIS dimensions. The significant decline in QOL reported by individuals with SCI in China during the COVID-19 pandemic emphasizes the importance of providing rehabilitation and mental health services. Specifically, utilizing telehealth services can be instrumental in mitigating the impacts of the pandemic on their well-being. Furthermore, it is crucial to provide psychoeducation, support, and COVID-19 preventive behaviors in this particular region. Additionally,

to support individuals with SCI during the pandemic, enhance access to health services, integrate health support into rehabilitation programs, and advocate for policies prioritizing their health care needs.

Abbreviations
QOL	Quality of life
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SCI	Spinal cord injuy
WHO	World Health Organization
WHOQOL–BREF	World Health Organization Qualiy of Life-Brief Version
DIS	Disability-related QOL
HADS	Hospital Anxiety and Depression Scale
ASIA	American Spinal Injury Association
AIS	Impairment Scale
PD	Physical disabilities
WHOQOL	World Health Organization Quality of Life
SAS/SDS	Self-Rating Anxiety/Depression Scale
IQR	Interquartile range

Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
All human subjects involved in this study were treated in accordance with the ethical principles outlined in the Declaration of Helsinki, and the study approved by the ethics committee of Huazhong University of Science and Technology, Tongji Hospital, Tongji Medical College (No. TJ-IRB20210314). The patients/participants provided their written informed consent to participate in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

References
1. Wu Z, McGoogan JM. Characteristics of and important lessons from the Coronavirus Disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020;323(13):1239–42.
2. Coates A, Warren KT, Henderson C, McPherson M, Obubah O, Graaff P, et al. The World Health Organization's Frontline support to Countries during the COVID-19 pandemic in 2020. Front Public Health. 2022;10:850260.
3. Galea S, Merchant RM, Lurie N. The Mental Health consequences of COVID-19 and physical distancing: the need for Prevention and early intervention. JAMA Intern Med. 2020;180(6):817–8.

4.   Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395(10227):912–20.

5.   Post MW. Definitions of quality of life: what has happened and how to move on. Top Spinal Cord Inj Rehabil. 2014;20(3):167–80.

6.   Zhang Y, Ma ZF. Impact of the COVID-19 pandemic on Mental Health and Quality of Life among local residents in Liaoning Province, China: a cross-sectional study. Int J Environ Res Public Health. 2020;17(7).

7.   Alqahtani FD, Hassan SU, Alsaif B, Zrieq R. Assessment of the quality of life during COVID-19 pandemic: a cross-sectional survey from the Kingdom of Saudi Arabia. Int J Environ Res Public Health. 2021;18(3).

8.   Vives Alvarado JR, Miranda-Cantellops N, Jackson SN, Felix ER. Access limitations and level of psychological distress during the COVID-19 pandemic in a geographically-limited sample of individuals with spinal cord injury. J Spinal Cord Med. 2022;45(5):700–9.

9.   Trgovcevic S, Milicevic M, Nedovic G, Jovanic G. Health Condition and Quality of Life in persons with spinal cord Injury. Iran J Public Health. 2014;43(9):1229–38.

10. de França IS, Coura AS, de França EG, Basílio NN, Souto RQ. [Quality of life of adults with spinal cord injury: a study using the WHOQOL-bref]. Rev Esc Enferm USP. 2011;45(6):1364–71.

11. Tulsky DS, Kisala PA, Victorson D, Tate DG, Heinemann AW, Charlifue S, et al. Overview of the spinal cord Injury–Quality of Life (SCI-QOL) measurement system. J Spinal Cord Med. 2015;38(3):257–69.

12. Alpalhão V, Alpalhão M. Impact of COVID-19 on physical therapist practice in Portugal. Phys Ther. 2020;100(7):1052–3.

13. Parnes N, Tousant C, Perrine J, DeFranco MJ. Outpatient Orthopedic Rehabilitation in New York State during the COVID-19 pandemic: therapist perspectives. Orthopedics. 2020;43(5):292–4.

14. Elsayed W, Albagmi F, Hussain M, Alghamdi M, Farrag A. Impact of the COVID-19 pandemic on physical therapy practice in Saudi Arabia. PLoS ONE. 2022;17(12):e0278785.

15. Carda S, Invernizzi M, Bavikatte G, Bensmaïl D, Bianchi F, Deltombe T, et al. COVID-19 pandemic. What should Physical and Rehabilitation Medicine specialists do? A clinician's perspective. Eur J Phys Rehabil Med. 2020;56(4):515–24.

16. Hearn JH, Rohn EJ, Monden KR. Isolated and anxious: a qualitative exploration of the impact of the COVID-19 pandemic on individuals living with spinal cord injury in the UK. J Spinal Cord Med. 2022;45(5):691–9.

17. Mickens MN, Perrin P, Goldsmith JA, Khalil RE, Carter Iii WE, Gorgey AS. Leisure-time physical activity, anthropometrics, and body composition as predictors of quality of life domains after spinal cord injury: an exploratory cross-sectional study. Neural Regen Res. 2022;17(6):1369–75.

18. Dolbow DR, Gorgey AS, Ketchum JM, Gater DR. Home-based functional electrical stimulation cycling enhances quality of life in individuals with spinal cord injury. Top Spinal Cord Inj Rehabil. 2013;19(4):324–9.

19. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The fear of COVID-19 scale: development and initial validation. Int J Ment Health Addict. 2022;20(3):1537–45.

20. Held KS, Steward O, Blanc C, Lane TE. Impaired immune responses following spinal cord injury lead to reduced ability to control viral infection. Exp Neurol. 2010;226(1):242–53.

21. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. Gen Psychiatr. 2020;33(2):e100213.

22. Zürcher C, Tough H, Fekete C. Mental health in individuals with spinal cord injury: the role of socioeconomic conditions and social relationships. PLoS ONE. 2019;14(2):e0206069.

23. Roberts TT, Leonard GR, Cepela DJ. Classifications in brief: American Spinal Injury Association (ASIA) impairment scale. Clin Orthop Relat Res. 2017;475(5):1499–504.

24. Kirshblum SC, Burns SP, Biering-Sorensen F, Donovan W, Graves DE, Jha A, et al. International standards for neurological classification of spinal cord injury (revised 2011). J Spinal Cord Med. 2011;34(6):535–46.

25. Leung KF, Wong WW, Tay MS, Chu MM, Ng SS. Development and validation of the interview version of the Hong Kong Chinese WHOQOL-BREF. Qual Life Res. 2005;14(5):1413–9.

26. Power MJ, Green AM. Development of the WHOQOL disabilities module. Qual Life Res. 2010;19(4):571–84.

27. Lin MR, Hwang HF, Chen CY, Chiu WT. Comparisons of the brief form of the World Health Organization Quality of Life and short Form-36 for persons with spinal cord injuries. Am J Phys Med Rehabil. 2007;86(2):104–13.

28. Wilson JR, Hashimoto RE, Dettori JR, Fehlings MG. Spinal cord injury and quality of life: a systematic review of outcome measures. Evid Based Spine Care J. 2011;2(1):37–44.

29. Zheng QL, Tian Q, Hao C, Gu J, Lucas-Carrasco R, Tao JT, et al. The role of quality of care and attitude towards disability in the relationship between severity of disability and quality of life: findings from a cross-sectional survey among people with physical disability in China. Health Qual Life Outcomes. 2014;12:25.

30. Zung WW, A SELF-RATING DEPRESSION. SCALE Arch Gen Psychiatry. 1965;12:63–70.

31. Zung WW. A rating instrument for anxiety disorders. Psychosomatics. 1971;12(6):371–9.

32. Pakpour AH, Rahnama P, Saberi H, Saffari M, Rahimi-Movaghar V, Burri A, et al. The relationship between anxiety, depression and religious coping strategies and erectile dysfunction in Iranian patients with spinal cord injury. Spinal Cord. 2017;55(7):711.

33. Gao H, Hu R, Yin L, Yuan X, Tang H, Luo L, et al. Knowledge, attitudes and practices of the Chinese public with respect to coronavirus disease (COVID-19): an online cross-sectional survey. BMC Public Health. 2020;20(1):1816.

34. Organization WH. Disability considerations during the COVID-19 outbreak. World Health Organization; 2020.

35. Sánchez-Raya J, Sampol J. Spinal cord injury and COVID-19: some thoughts after the first wave. Spinal Cord. 2020;58(8):841–3.

36. Hu Y, Mak JN, Wong YW, Leong JC, Luk KD. Quality of life of traumatic spinal cord injured patients in Hong Kong. J Rehabil Med. 2008;40(2):126–31.

37. Rofi'i AYAB, Maria R. Quality of life after spinal cord injury: an overview. Enfermeria Clin. 2019;29:1–4.

38. Elaraby A, Shahein M, Bekhet AH, Perrin PB, Gorgey AS. The COVID-19 pandemic impacts all domains of quality of life in egyptians with spinal cord injury: a retrospective longitudinal study. Spinal Cord. 2022;60(8):757–62.

39. García-Rudolph A, Saurí J, López Carballo J, Cegarra B, Wright MA, Opisso E, et al. The impact of COVID-19 on community integration, quality of life, depression and anxiety in people with chronic spinal cord injury. J Spinal Cord Med. 2022;45(5):681–90.

40. van den Berg ME, Castellote JM, de Pedro-Cuesta J, Mahillo-Fernandez I. Survival after spinal cord injury: a systematic review. J Neurotrauma. 2010;27(8):1517–28.

41. Moshi H, Sundelin G, Sahlen KG, Sörlin A. Quality of life of persons with traumatic spinal cord injury in rural Kilimanjaro, Tanzania: a community survey. Disabil Rehabil. 2021;43(20):2838–45.

42. Leduc BE, Lepage Y. Health-related quality of life after spinal cord injury. Disabil Rehabil. 2002;24(4):196–202.

43. Grossman ES, Hoffman YSG, Palgi Y, Shrira A. COVID-19 related loneliness and sleep problems in older adults: worries and resilience as potential moderators. Pers Individ Dif. 2021;168:110371.

44. Altena E, Baglioni C, Espie CA, Ellis J, Gavriloff D, Holzinger B, et al. Dealing with sleep problems during home confinement due to the COVID-19 outbreak: practical recommendations from a task force of the European CBT-I Academy. J Sleep Res. 2020;29(4):e13052.

45. Szentkirályi A, Madarász CZ, Novák M. Sleep disorders: impact on daytime functioning and quality of life. Expert Rev Pharmacoecon Outcomes Res. 2009;9(1):49–64.

46. Xia P, Li N, Hau KT, Liu C, Lu Y. Quality of life of Chinese urban community residents: a psychometric study of the mainland Chinese version of the WHOQOL-BREF. BMC Med Res Methodol. 2012;12:37.

47. Matsuoka M, Sumida M. The effect of the COVID-19 pandemic on the health-related quality of life in home-based patients with spinal cord injuries in Japan. J Spinal Cord Med. 2022;45(5):760–4.

48. Chang F, Xie H, Zhang Q, Sun M, Yang Y, Chen G, et al. Quality of life of adults with chronic spinal cord injury in mainland China: a cross-sectional study. J Rehabil Med. 2020;52(5):jrm00058.

49. Lakhani A, Dema S, Hose J, Erdem N, Wollersheim D, Grindrod A, et al. Predictors of resilience for people with spinal cord injury over two periods of COVID-19 social distancing restrictions: a 12-month longitudinal study using structural equation modelling. BMC Public Health. 2023;23(1):1334.

50. Charles ST, Mogle J, Urban EJ, Almeida DM. Daily events are important for age differences in mean and duration for negative affect but not positive affect. Psychol Aging. 2016;31(7):661–71.

51. Hashem NM, Abdelnour SA, Alhimaidi AR, Swelum AA. Potential impacts of COVID-19 on reproductive health: scientific findings and social dimension. Saudi J Biol Sci. 2021;28(3):1702–12.

52. Noyes ET, Tang X, Sander AM, Silva MA, Walker WC, Finn JA, et al. Relationship of medical comorbidities to psychological health at 2 and 5 years following traumatic brain injury (TBI). Rehabil Psychol. 2021;66(2):107–17.

53. Liu T, Xie S, Wang Y, Tang J, He X, Yan T, et al. Effects of App-based Transitional Care on the self-efficacy and quality of life of patients with spinal cord Injury in China: Randomized Controlled Trial. JMIR Mhealth Uhealth. 2021;9(4):e22960.

54. Swarnakar R, Santra S. Personal hygiene care in persons with spinal cord injury during the COVID-19 pandemic and lockdown: an Indian perspective. Spinal Cord Ser Cases. 2020;6(1):76.

55. Gorgey AS. Exercise awareness and barriers after spinal cord injury. World J Orthop. 2014;5(3):158–62.

56. Altahla R, Alshorman J, Tao X. The impact of COVID-19 on epidemiological features of spinal cord injury in Wuhan, China: a comparative study in different time periods. Medicina. 2023;59(10):1699.

Publisher's Note