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The prevalence and impacts of psychological disorders in Chinese Amyotrophic Lateral Sclerosis (ALS) patients

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Abstract

Objective: To investigate the prevalence and influential factors of depression, anxiety, suicidal tendency and sleep disorders in a group of Chinese amyotrophic lateral sclerosis (ALS) patients. *Methods:* A total of 103 ALS patients were investigated using the Patient Health Questionnaire-9 (PHQ-9), Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), the Nurses' Global Assessment of Suicide Risk scale (NGASR) and Pittsburgh sleep quality index (PSQI). The risk factors related to psychological disorders in the patients were analyzed. *Results:* The medians (range) of PHQ-9, SDS, SAS, PSQI of patients were 8 (1-27), 45 (24-95), 51.30% (25.43%-83.41%), 7 (1-27), respectively. There were 17 (16.50%), 27 (26.21%) and 12 (11.65%) of ALS patients were classified as moderate, high and extremely high suicide risk as showed by NGASR, respectively. Financial supports were negatively associated with PHQ-9 ($p<0.001$), SAS ($p<0.001$), SDS ($p<0.001$) and NGASR ($p<0.001$) of ALS patients. Less food intake was strongly associated to high levels of PHQ-9 ($p=0.009$), SAS ($p=0.012$), SDS ($p<0.001$) and NGASR ($p=0.028$) in ALS patients. Regular reading was significantly related to higher QOL ($p=0.019$) and lower NGASR ($p=0.007$) in ALS population.
Conclusion: Depression, anxiety and poor sleep quality were commonly reported by ALS patients, which may result in high risk of suicide. Decrease in food intake, low financial support, poor functional status and rapid progression were risk factors of psychological distress in ALS population. Psychological treatments were crucial for ALS population, which deserved more attention of clinicians.

Keywords: Amyotrophic lateral sclerosis, depression, anxiety, sleep

INTRODUCTION

Amyotrophic lateral sclerosis (ALS), also known as typical motor neuron disease (MND), is a progressive, neurodegenerative disease leading to paresis, dysarthria, dysphagia, respiratory failure and death.[1] Much is known about the molecular pathology of ALS and the genetic changes of familial ALS subtypes[2] but no causative therapies have been developed to date. Therefore, symptomatic treatment has been the main stay of ALS management, and a comprehensive approach to address the distinct issues faced by the patients is recommended.[3]

Non-motor symptoms have received increasing attention due to the negative effects on the quality of life (QOL) in ALS population, among which psychological distress and sleep disorders are the most commonly reported.[4,5] Relentless progression of limb weakness, fasciculations and bulbar dysfunction results in high prevalence of depression, anxiety and thoughts of suicide in ALS patients.[6-9] Epidemiological investigations reveal that 1/3 to 1/2 ALS patients might suffer from apathy[10-12] and heavy care burden result in drastic negative effect in caregivers' daily lives.[13] These mood symptoms may not only affect the patient's perception of their own conditions and the reliability of clinical surveys, but also indirectly aggravate the poor prognosis.[13,14] Therefore, more attention should be given to the psychological issues of ALS patients in their clinical care.

There have been several studies on the psychological distress among ALS patients in the literature, only a few[8,15-17] of them targeted on Chinese ALS population. Differences in genetic, cultural, and economic backgrounds and healthcare systems among different countries may influence the prevalence of depression and

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anxiety. In this study, we conducted a cross-sectional survey to investigate the prevalence of depression, anxiety, suicidal tendency and sleep disorders in Chinese ALS patients. Potential risk factors and impacts of these mood and sleep symptoms would also be explored. We hope to provide more clinical evidence and basis for the systematic management of Chinese ALS patients.

METHODS

Subjects

A prospective single-center cohort study was conducted at the Department of Neurology, Peking Union Medical College Hospital (PUMCH). Patient diagnosed with ALS according to the Awaji criteria[18] was consecutively recruited from the ward or outpatient department. All enrolled patients were recorded with their name, gender, age and clinical symptoms with detailed physical examination. All included patients were assessed using the ALS Functional Rating Scale-Revised (ALSFRS-R).[19] The maximum of ALSFRS-R score was 48. Muscle strength was measured using the Medical Research Council (MRC) score, including bilateral assessment of the following limb muscle actions: shoulder abduction, elbow flexion, elbow extension, wrist flexion, wrist extension, finger flexion, finger extension, thumb abduction, little finger abduction, hip flexion, knee flexion, knee extension, ankle dorsal extension, ankle plantar flexion, toe dorsal extension, and toe plantar flexion. The total MRC score was 160.

For the convenience of follow-up, we established an online medical platform to facilitate the contacts between clinicians and ALS patients. All recruited patients could apply and log in the platform. A follow-up interview was performed every three months either by online survey or phone call to collect a follow-up ALSFRS-R score. Patients that were unable to cooperate in completing the interview due to severe dysarthria or cognitive impairment were not included. The progression rate was calculated by the difference of the ALSFRS-R score at the first and last visit divided by the time interval between these two visits in months (decrease of ALSFRS-R per month).[19] When a patient died, the date of death and causes of death would be collected and then his/her information would be removed from the platform. As of February 2024, a total of 368 patients could be contacted on the platform.

This study was approved by the Ethics Committee of the PUMCH (JS1218). All enrolled patients provided written, informed consent to be included in the study.

An online survey on psychological disorders

We designed a online questionnaire to investigate the levels of depression and anxiety, risk of suicide, sleep quality in our cohort. The questionnaire included:

(1) Demographic information (the patient's name, age, gender, nationality, marital status, residence, years of education);
(2) Personal financial status; the level of financial support including personal income, support from families and relatives and support from social charity organizations and government funding. The participants were asked to rate each item from 0 to 10 points; affordability for treatment;
(3) ALSFRS-R scale[19];
(4) Treatment including etiologic treatment and symptomatic treatment;
(5) Nutritional status including body mass index (BMI) and food intake;
(6) Daily lifestyles (smoking, alcohol drinking, pet raising, occupation, reading, participation in social activities);
(7) QOL scale including 12 activities of daily living. For each items the participants were asked to indicate the subjective importance and to rate the subjective degree of satisfaction from 0 to 100 (steps of ten, 0=not satisfied at all, 100=perfectly satisfied), respectively. The final QOL score was then calculated as the sum of those satisfaction ratings, ranging from 0 to 1200[20,21];
(8) The Patient Health Questionnaire-9 (PHQ-9)[22] and Self-Rating Depression Scale (SDS)[23] for the assessment of the level of depression;
(9) Self-Rating Anxiety Scale (SAS)[24] for the assessment of the level of anxiety;
(10) The Nurses' Global Assessment of Suicide Risk scale (NGASR)[25] for the assessment of the risk of suicide;
(11) Pittsburgh sleep quality index (PSQI)[26] for the assessment of sleep quality.

The definition and relevant explanations of involved variables were provided in Supplementary Table 1. All included scales were self-report surveys. The questionnaire was sent to all users of the online platform and it was totally voluntary survey to avoid causing emotional stress for the patients.

Follow-up phone call if necessary was made to make sure that everyone has received the online questionnaire.

Statistical analysis

The Shapiro-Wilk test was used to assess whether data exhibited a normal distribution. Normally distributed variables were expressed as means (standard deviation, SD) and non-normally distributed variables were expressed as median (range). Due to the non-normal distribution, Mann-Whitney U test or Spearman coefficient was used for the analysis on the relationships between included variables. Two-sided P-values were calculated for all analyses. A value of $P < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS 23.0.

RESULTS

Baseline and follow-up information

We ultimately received 116 questionnaires, of which 103 (88.79%) were valid and included in our analysis. The other 13 cases were excluded due to lack of important information including the patient's name or missing items in several scales. The regional distribution of involved patients was showed in Figure 1. The demographic characteristics, baseline ALSFRS-R score and total MRC score were presented in Table 1. The median (range) duration of involved ALS patients was 13 (3-128) months. The follow-up ALSFRS-R score was 30 (8-45) [median (range)]. The medians (range) QOL were 450 (20-1175) for included ALS patients.

Prevalence of psychological disorders

The results of psychological scales in ALS patients were presented in Table 2. The median (range) of PHQ-9 and SDS in ALS patients were 8 (1-27) and 51.30% (25.43%-83.41%), respectively, which were classified as mild depression. A total of 74 patients (71.84%) were diagnosed with depression evaluated by PHQ-9, which was classified as mild in 33 (32.04%), moderate (18 (17.48%), moderate to severe in 9 (8.74%) and severe in 14 (13.59%). When evaluated by SDS, there were 23 (22.33%), 19 (18.45%), 13 (12.62%) that were classified as mild, moderate and major depression, respectively. The median (range) of SAS was 45 (24-95) and a total of 44 (42.72%) patients were diagnosed with anxiety, which was classified as mild in 6 (5.83%), moderate in 14 (13.59%) and major in 24 (23.30%). Besides, 47 (45.63%) reported low risk of suicide, the other 17 (16.50%), 27 (26.21%) and 12 (11.65%) were classified as moderate, high and extremely high levels of suicide risk as evaluated by NGASR, respectively. The median (range) of PSQI was 7 (1-27). There were 41 (39.81%), 29 (28.16%), 27 (26.21%) and 6 (5.83%) that reported good, not bad, average and poor sleep quality, respectively.

Relationship between psychological variables and clinical variables

As noted in Table 3, no significant influence of onset age, gender, bulbar onset, disease duration, baseline BMI, residence or marital status in the ALSFRS-R rate, QOL or included psychological variables was found (p>0.05).

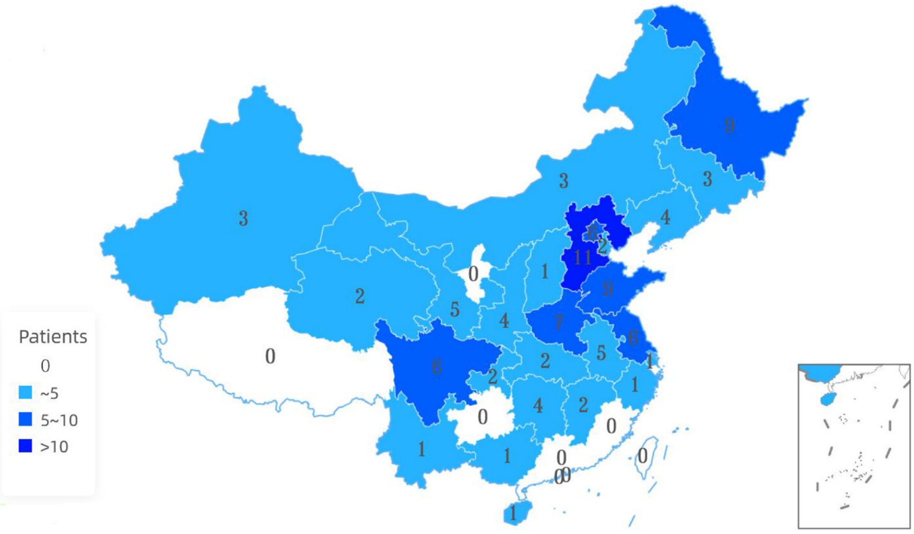

Figure 1. Regional distributiion of included population

Table 1: Demographic characteristics of included ALS patients

Items	ALS patients (N=103)
Age (years old)	47.76 (11.22)
Gender (M/F)	55/48
Nationality (n, %)	
Han	100 (97.09%)
Manchu	1 0.97%)
Korean	1 0.97%)
Hui	1 0.97%)
BMI (kg/m^2)	23.63 (3.27)
Onset (n, %)	
Bulbar	13 (12.62%)
Upper limbs	41 (39.81%)
Lower limbs	49 (47.57%)
Disease duration (months)	13 (3-128)
Baseline total MRC score	137 (68-159)
Baseline ALSFRS-R score	41 (18-47)
Residence (n, %)	
Rural	74 (71.84%)
Urban	29 (28.16%)
Years of education (n, %)	
＞12 years	42 (40.78%)
≤12 years	61 (59.22%)
Martial status (n, %)	
Married	94 (91.26%)
Unmarried	4 (3.88%)
Divorced/widowed	3 (2.91%)
Smoking (n, %)	
Current smoking	19 (18.45%)
Past smoking	17 (16.50%)
No smoking	67 (65.05%)
Drinking (n, %)	
Current drinking	14 (13.60%)
Past drinking	16 (15.53%)
No drinking	73 (70.87%)
Pet raising (n, %)	35 (33.98%)
Academic occupation (n, %)	41 (39.81%)
Regular reading (n, %)	31 (30.10%)
Social activities (n, %)	23 (22.33%)
Follow-up ALSFRS-R score	30 (8-45)
Follow-up QOL	450 (20-1175)

Note: The Shapiro-Wilk test was used to assess whether data exhibited a normal distribution. Normally distributed variables were expressed as means (standard deviation, SD) while abnormally distributed variables were expressed as medians (range).
Abbreviations: ALS amyotrophic lateral sclerosis; ALSFRS-R ALS functional rating scale-revised; BMI body mass index; F female; M male; MRC the Medical Research Council; QOL the Quality of Life scale.

Table 2: Results of psychological scales in ALS patients

Scales	ALS patients (N=103)
PHQ-9 (n, %)	
0-4	29 (28.16%)
5-9	33 (32.04%)
10-14	18 (17.48%)
15-19	9 (8.74%)
20-27	14 (13.59%)
SAS (Standard score) (n, %)	
<50	59 (57.28%)
50-59	6 (5.83%)
60-69	14 (13.59%)
≥70	24 (23.30%)
SDS (Disease index) (n, %)	
<50%	48 (46.60%)
50%-59%	23 (22.33%)
60%-69%	19 (18.45%)
≥70%	13 (12.62%)
NGASR (n, %)	
≤5	47 (45.63%)
6-8	17 (16.50%)
9-11	27 (26.21%)
≥12	12 (11.65%)
PSQI (n, %)	
≤5	41 (39.81%)
6-10	29 (28.16%)
11-15	27 (26.21%)
≥16	6 (5.83%)

Abbreviations: ALS amyotrophic lateral sclerosis; NGASR the Nurses' Global Assessment of Suicide Risk scale; PHQ-9 the Patient Health Questionnaire-9; PSQI Pittsburgh sleep quality index; SAS Self-Rating Anxiety Scale; SDS Self-Rating Depression Scale.

Baseline ALSFRS-R score was weakly related to QOL (p=0.042) while follow-up ALSFRS-R score was positively correlated with QOL (p<0.001) and negatively associated with PHQ-9 (p=0.002), SAS (p=0.006), SDS (p=0.003) and PSQI (p=0.010). No remarkable relationship between total MRC score and involved psychological variables was found (P>0.05).

Less food intake was remarkably related to high levels of PHQ-9 (p=0.009), SAS (p=0.012), SDS (p<0.001) and NGASR (p=0.028) in ALS patients. Patients with high level of education tended to score lower PSQI (p=0.038). Financial support was negatively associated with the QOL

Table 3: Relationships between included variables among ALS patients

	ALSFRS-R rate		**QOL**		**PHQ-9**		**SAS**		**SDS**		**NGASR**		**PSQI**	
Onset age (years old)	0.882		0.753		0.387		0.223		0.561		0.641		0.082	
Gender (M/F)	0.772		0.937		0.859		0.820		0.855		0.682		0.892	
Bulbar onset (Y/N)	0.970		0.911		0.793		0.970		0.970		0.851		0.740	
Disease duration (months)	0.063		0.292		0.817		0.982		0.612		0.153		0.982	
Food intake	0.056		0.081		**0.009**		**0.012**		**<0.001**		**0.028**		0.067	
BMI (kg/m^2)	0.562		0.759		0.553		0.957		0.997		0.723		0.669	
Riluzole (Y/N)	**0.003**		0.964		0.709		0.905		0.905		0.319		0.405	
Edaravone (Y/N)	0.528		0.911		0.793		0.578		0.221		0.851		0.391	
Financial status	0.437		0.149		0.418		0.721		0.117		0.196		0.159	
Financial support	0.281		0.457	**<0.001**	-0.328	**<0.001**	-0.361	**<0.001**	-0.315	**<0.001**	-0.438	**<0.001**	0.106	
Affordability for treatment	0.546		**0.002**		0.251		**0.005**		0.436		**<0.001**		**0.038**	
Residence	0.200		0.386		0.788		0.640		0.868		0.421		0.626	
Years of education	0.905		0.099		0.666		0.085		0.905		0.072		**0.015**	
Martial status	0.505		0.444		0.890		0.851		0.851		0.879		0.259	
Smoking	0.389		0.484		0.531		0.623		0.764		0.419		0.595	
Drinking	0.076		**0.039**		0.132		0.342		0.342		0.177		0.178	
Pet raising	0.944		0.832		0.937		0.944		0.944		0.950		0.937	
Regular reading	0.427		**0.019**		0.982		0.427		0.221		**0.007**		0.089	
Social activities	0.674		0.527		0.563		0.958		0.172		0.103		0.293	
Baseline total MRC score	0.811		0.785		0.480		0.760		0.360		0.855		0.956	
Baseline ALSFRS-R score	0.276		0.201	**0.042**	0.502		0.204		0.820		0.944		0.233	
Follow-up ALSFRS-R score	-0.622	**<0.001**	0.506	**<0.001**	-0.304	**0.002**	-0.270	**0.006**	-0.289	**0.003**	0.055		-0.253	**0.010**
PHQ-9	0.266	**0.007**	-0.587	**<0.001**			0.768	**<0.001**	0.861	**<0.001**	0.595	**<0.001**	0.492	**<0.001**
SAS	0.232	**0.018**	-0.525	**<0.001**					0.659	**<0.001**	0.492	**<0.001**	0.455	**<0.001**
SDS	0.209	**0.034**	-0.539	**<0.001**							0.510	**<0.001**	0.550	**<0.001**
NGASR	0.292	**0.003**	-0.598	**<0.001**									0.463	**<0.001**
PSQI	0.067		-0.382	**<0.001**										

Note: Due to the abnormal distribution, Mann-Whitney U test or Spearman coefficient was used for the analysis. Significant data ($p<0.05$) were bold and relevant coefficients were presented. Abbreviations: ALS amyotrophic lateral sclerosis; ALSFRS-R ALS functional rating scale-revised; BMI body mass index; MRC the Medical Research Council; N no; NGASR the Nurses' Global Assessment of Suicide Risk scale; PHQ-9 the Patient Health Questionnaire-9; PSQI Pittsburgh sleep quality index; SAS Self-Rating Anxiety Scale; SDS Self-Rating Depression Scale; Y yes.

($p<0.001$), PHQ-9 ($p<0.001$), SAS ($p<0.001$), SDS ($p<0.001$) and NGASR ($p<0.001$) but showed no significant relationship with ALSFRS-R rate ($p=0.281$). Financial status showed no noticeable correlation with ALSFRS-R rate or psychological variables ($p>0.05$). Affordability of treatment was strongly correlated to high level of QOL ($p=0.002$) and low levels of SAS ($p=0.005$) and NGASR ($p<0.001$). No significant relationship between treatment of edaravone or riluzole and psychological variables was found ($p>0.05$). (Supplementary Figure 1).

Compared to patients drinking alcohol, ALS patients with no history of alcohol consumption had a higher QOL ($p=0.039$). There was no association between smoking, pet raising or participation in social activities and QOL or psychological variables ($p>0.05$). Regular reading was significantly related to higher QOL ($p=0.019$) and lower NGASR ($p=0.007$) in ALS population.

All PHQ-9 ($p<0.001$), SAS ($p<0.001$), SDS ($p<0.001$), NGASR ($p<0.001$) and PSQI ($p<0.001$) were negatively related to QOL of ALS patients. Besides, PHQ-9 ($p=0.007$), SAS ($p=0.018$), SDS ($p=0.034$), NGASR ($p=0.003$) were positively associated with ALSFRS-R rate, while no significant correlation between PSQI and ALSFRS-R rate was revealed. Besides, a statistically significant correlation was observed between any two involved psychological variables ($p<0.05$).

DISCUSSION

In the study, we designed an online questionnaire to investigate the prevalence of anxiety, depression, tendency of suicide and poor sleep quality in Chinese ALS population. Our results showed that at least 50% of ALS patients suffered from different degrees of depression, which was comparable to the data from other studies in China.[8,15-17] Studies from Western Europe and America showed that 1/4 to 1/3 of ALS patients had reported depression or anxiety[4], which was slightly lower than our results. The unsatisfactory healthcare system, insufficient social security system and high costs of the treatment might contribute to the high prevalence of depression and anxiety in Chinese ALS patients, which was supported by our results and online literature.[13] Besides, differences in study sample size and scales used to assess depression and anxiety might be responsible for the varied results among studies.[27,28] It was noteworthy that diagnosis of depression was based on the Structured Clinical Interview according to Diagnostic and Statistical Manual of Mental Disorders (DSM) -V (SCID)[29] and the commonly used scale assessment in clinical studies might overestimate the prevalence of depression. Only a few studies used the SCID reported that the rates of depression in patients with ALS was 9-11%[30-32], indicating that considerable ALS patients suffered from transient depressive symptoms but could not reach the diagnosis of depression. Multi-center and large sample studies with unified evaluation methods according to DSM-V might be needed to further explore the prevalence of anxiety and depression in ALS population.

A systematic review in 2016 suggested that levels of anxiety and depression were risk factors for a poorer QOL in ALS[33-35], which was consistent with our results. The contribution of anxiety and depression to the loss of appetite in ALS has also been reported.[36] We found a significantly negative relationship between the level of anxiety or depression and the functional status or progression rate of ALS patients. Subjective feelings and psychological distress could significantly influence the self-reported ALSFRS-R score and rapid loss of voluntary function might induce depression and anxiety, which gave rise to a vicious cycle among ALS population. It has been reported that the severity of mood symptoms increased with the prolongation of disease duration and patients in the advanced stages were more likely to suffer from serious emotional issues.[37,38] Timely symptomatic treatments to address common symptoms including anxiety, depression, emotional lability (pseudobulbar affect) could offer some hope and improve outcome for patients with ALS.[39] However, clinical studies on pharmacological treatment of depression or anxiety medications in ALS patients was scarce and the majority of trials for people with ALS have neglected the importance of neuropsychiatric symptoms and cognitive impairment.[40] More efforts and funding should be paid to provide reference for the selection of antidepressants and anxiolytics in ALS. Besides, non-pharmacotherapeutic treatments including acceptance and commitment therapy[41] or mindfulness[42] might be useful options. We suspected that changes in lifestyles including pet raising, participation in social activities might not aid in alleviating anxiety and depression in ALS patients. History of alcohol drinking seemed to be a negative factor of QOL in ALS, which might be explained by chronic damage of alcohol to the nervous system and other injuries.[43]

However, we noticed that quitting drinking might further decrease the QOL of included patients. A structured plan for abstinence of drinking might be needed for ALS patients.

Sleep disturbance was another problem for ALS patients. A recent systematic review in 2020 showed that 50-63% of patients with ALS have poor sleep quality as reported using the PSQI[5], which was corresponding to our results. Worries about the costs for ALS treatment, overall QOL and negative emotions were significantly associated with sleep disorders in ALS patients. Utilizing polysomnography (PSG), various degrees of impairment to sleep microstructure and architecture among ALS patients[44-48] have been detected. In addition, neuroimaging and pathological studies reported that pathophysiology of ALS extended beyond the motor cortex, involving brain stem areas in the brain that are involved in rapid eye movement (REM) sleep.[49,50]

Nocturnal hypercapnea due to diaphragm involvement may also play a role. These changes could underlie the increased sleep latency, reduced slow-wave sleep, reduced and fractured eye movement stages, and reduced sleep efficiency that could be seen in patients with preserved diaphragmatic and respiratory function.[46,51,52] Preclinical evidence indicated that disruptions to the rhythmicity of the sleep/wake cycle, activity/rest, and hormone release occur in the *SOD1G93A* mouse model[53,54], which have not been confirmed in ALS patients. In any case, sleep disorders were common in patients with ALS and deserved more attention.

We found that over half of ALS patients reported moderate level of suicide risk, among whom more than 10% participants were of extremely high risk. This was not surprising considering the high prevalence of depression and sleep disorders in ALS population. Besides, less food intake, bad nutritional status, poor financial support and heavy economic burdens could cause persistent physical and psychological stress in ALS and we occasionally noticed the consultation and discussion of euthanasia in the contact platform. In an earlier study from Oregon, USA, about 56% of all ALS patients considered physician-assisted suicide (PAS; legalized after 1997) during the terminal phase.[55] In counties where euthanasia was legal, such as Norway and Switzerland, the risk of committing suicide of ALS patients was significantly higher than that in general population.[9,56] Euthanasia involved many ethical issues and was illegal in China currently. For instance, end-of-life decisions were influenced by the psychological well-being of the patients.[57] It has been reported that the more a patient with ALS were depressed, the more likely he/she was to decline life-prolonging measures.[57,58] As there was no effective treatment that could reverse the disease condition, any method that might delay disease progression or improve QOL of ALS patients should be attempted to reduce the risk of suicide among ALS population. It was noteworthy that regular reading might significantly reduce the suicide risk and improve the QOL of ALS patients as shown by our results, which might be a surrogate for cognitive reserve or social engagement. Devices that assisted disabled people to read should be provided for ALS patients to help them find their meaning for living. Besides, palliative care and psychological treatment might be helpful for ALS patients to better acknowledge the death and make their end-of-life decisions without emotional distortions from depression.[59]

There were some limitations to this study. First, the different data types of involved variables made it difficult to conduct multivariable analysis with adjustment of p-values. Depression, anxiety, suicidal tendency and sleep quality were closely related to each other and their correlation with clinical variable deserve more investigations. Second, the cross-sectional design disabled us to explore the casual relationships between included variables. The incidence and changes of depression and anxiety after onset of ALS also needed future investigations. Third, cognitive levels of included patients were not evaluated. Pronounced cognitive disorders might impact the credibility of our results. Fourth, the low response rate might cause hardly ignorable selection biases. Not all approached patients agreed to participate, typically because of perceived lack of time or because they preferred not to think about their illness and its effects. Communication difficulties such as dysarthria and severe weakness in upper limbs may reduced the participation rate. Besides, psychological morbidity other than depression or anxiety in individuals with ALS also deserved more attention, such as hopelessness, phobic Anxiety and somatization.[60] More well-designed prospective studies with comprehensive evaluation of psychological distress, validated diagnostic interviews and exploration of cognitive impairment of ALS patients were needed.

In conclusion, depression, anxiety and poor sleep quality were commonly reported by our group of Chinese ALS patients, with high risk of suicide. Decrease in food intake, low financial support, bad functional status and rapid progression were risk factors of psychological distress in our ALS population. Psychological treatments were crucial for ALS population, which deserved more attention of the clinicians. A more comprehensive social and medical security system in China should be established to provide more support for ALS patients.

DISCLOSURE

Ethics: The study was approved by the Ethics Committee of the Peking Union Medical College Hospital (PUMCH) (JS1210). All enrolled patients in our database provided written, informed consent to be included in the study.

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Conflict of interest: None

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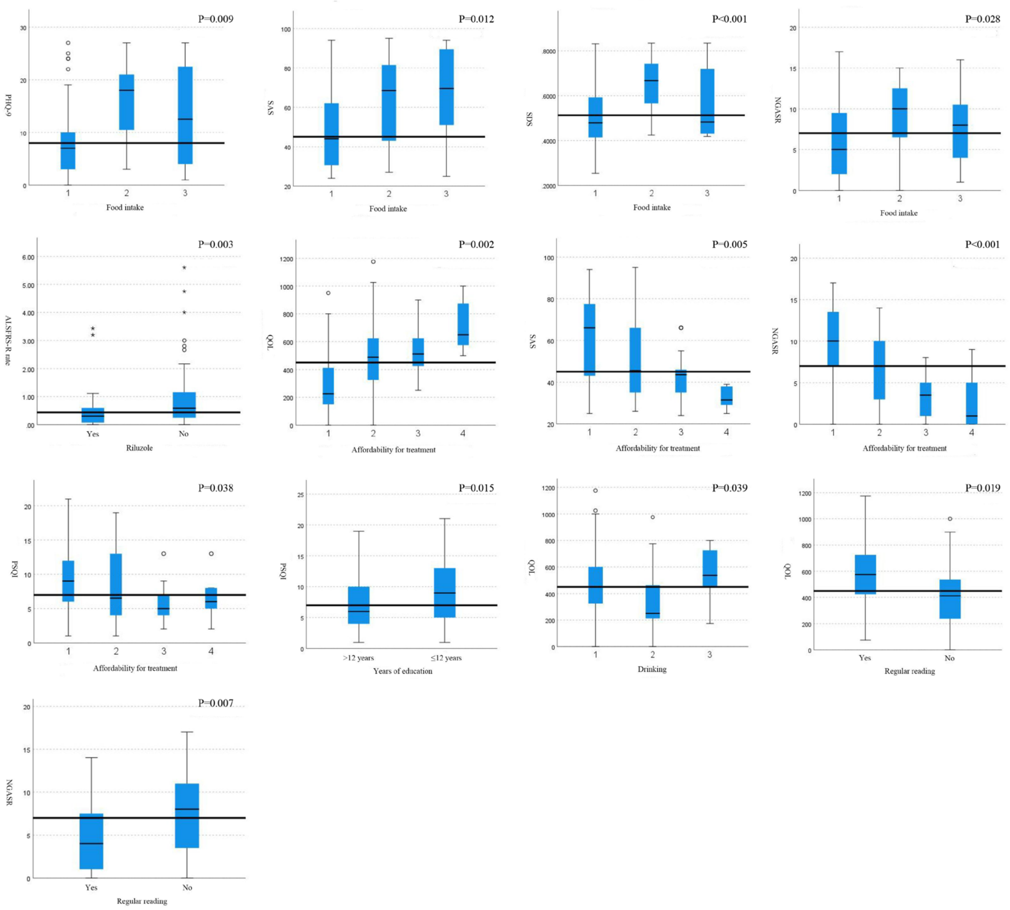

Supplementary Figure 1. Significant results of nonparametric test.

Note: Food intake: normal (option 1), decrease of less than (option 2), no less than (option 3) half of the food intake compared to that before onset; Affordability for treatment: giving up treatment due to inability to afford the cost of treatment (option 1), costs of treatment significantly influence family lives (option 2), affordablity of treatment with decrease of quality of life (option 3), no significantly financial burden caused by the treatment (option 4); Drinking: current drinking (option 1), past drinking (option 2), no drinking (option 3).

Supplementary Table 1: Definitions and explanations of involved variables

Variables	References	Option/Score	Definition
Personal financial status	The 2023 national per capita disposable income level released by the National Bureau of Statistics)	1	<5000 yuan/month
		2	5000-20000 yuan/month
		3	20000 yuan/month
Affordability for treatment		1	Giving up treatment due to the inability to afford the cost of treatment
		2	Costs of treatment significantly influence family lives
		3	Affordability of treatment with decrease of quality of life
		4	No financial burden caused by the treatment
Food intake	Comparisons with food intake before ALS onset	1	Normal
		2	Decrease of less than 1/2
		3	Decrease of more than 1/2
Martial status		1	Unmarried
		2	Married
		3	Divorce or widowhood
Smoking		1	Current smoking
		2	Past smoking (quitting smoking for more than 6 months)
		3	No smoking (never smoking)
Drinking		1	Current drinking
		2	Past drinking (quitting drinking for more than 6 months)
		3	No drinking (never drinking)
PHQ-9		0-4	No depression
		5-9	Mild depression
		10-14	Moderate depression
		15-19	Over Moderate depression
		20-27	Severe depression
SAS (Standard score)		<50	No anxiety
		50-59	Mild anxiety
		60-69	Moderate anxiety
		≥70	Severe anxiety
SDS (Disease index)		<50%	No depression
		50%-59%	Mild depression
		60%-69%	Moderate depression
		⩾70%	Severe depression
NGASR		⩽5	Low risk of suicide
		6-8	Moderate risk of suicide
		9-11	High risk of suicide
		⩾12	Extremely high risk of suicide
PSQI		⩽5	Very good sleep quality
		6-10	Good sleep quality
		11-15	General sleep quality
		⩾16	Poor sleep quality

Abbreviations: ALS amyotrophic lateral sclerosis; NGASR the Nurses' Global Assessment of Suicide Risk scale; PHQ-9 the Patient Health Questionnaire-9; PSQI Pittsburgh sleep quality index; SAS Self-Rating Anxiety Scale; SDS Self-Rating Depression Scale.