



# Depression, anxiety, and fear of COVID-19 in patients with multiple sclerosis in pandemic era: a cross-sectional study

Mohammad Alirezaei<sup>1</sup> · Sharareh Eskandarieh<sup>1</sup> · Mohammad Ali Sahraian<sup>1</sup> · Abdorreza Naser Moghadasi<sup>1</sup>

Received: 12 April 2021 / Accepted: 10 September 2021 / Published online: 23 September 2021  
© Fondazione Società Italiana di Neurologia 2021

## Abstract

**Background** Depression and anxiety are the two important factors determining quality of life of patients with multiple sclerosis (PWMS). In COVID-19 pandemic era, several factors can provoke mental issues of people and patients. In this cross-sectional study, we aim to estimate the new prevalence of anxious and depressive symptoms and their relating factors in PWMS.

**Methods** In this cross-sectional study, we include PWMS who are recruited in the MS clinic of Sina Hospital, Tehran, and are joined in our channel of Telegram media. A self-designed online questionnaire consisted of 4 parts handed out between patients: demographic and clinical data, Beck depression inventory, Beck anxiety inventory, and Fear of COVID-19 Scale. Univariate and multiple logistic regression analyses were performed to find the relating factors of expression of depressive and anxious symptoms in PWMS.

**Results** Of a total of 282 participants with the mean age of 35.66 (30.75–40) years, had been suffering from multiple sclerosis for 7.36 (3–10) years, 81.7% were women and 69.1% classified as relapsing–remitting MS. Mean score of BDI was  $17.13 \pm 11.51$  which is classified as minimal-moderate depressive symptoms. 48.6% of patients did not express depressive symptoms ( $BDI-II \leq 14$ ) and the others reported some degrees of depression. In the univariate analysis employment ( $p=0.015$ ), marital status ( $p=0.022$ ), level of education ( $p=0.004$ ), number of hospitalization due to MS attacks ( $p=0.048$ ), and fear of COVID-19 ( $p \leq 0.0001$ ) associated significantly with presence of depressive symptoms. After entering these factors in a binary logistic regression model, level of education ( $p=0.019$ ), marital status ( $p=0.044$ ), number of hospital admissions due to MS relapses ( $\beta=1.10$ ,  $p=0.02$ ), and fear of COVID-19 ( $\beta=1.07$ ,  $p \leq 0.0001$ ) remained significant as relating factors. Mean score of the anxiety calculated  $14.54 \pm 9.75$  and just 3.2% of patients had severe anxiety. Employment ( $p=0.045$ ), EDSS score ( $p=0.004$ ), and fear of COVID-19 ( $p \leq 0.0001$ ) reported relating to anxious symptoms significantly in the univariate analysis. After entering in the logistic regression analysis, EDSS ( $\beta=1.30$ ,  $p=0.001$ ) and fear of COVID-19 ( $\beta=1.13$ ,  $p \leq 0.0001$ ) remained as significant relating factors of anxious symptoms.

**Conclusion** The overall prevalence of depressive symptoms in PWMS in our MS clinic is 51.4% which is obviously higher than other world's centers which could be due to fear of COVID-19. In addition to fear of COVID-19, presence of depressive symptoms in PWMS is related significantly with level of education, number of hospital admissions due to MS relapses, and marital status. Other side, the patients classified as suffering from anxious symptoms had more severe problems on fear of COVID-19. But it is recommended for future studies to compare patients score in the COVID-19 era with their score before this pandemic.

**Keywords** Depression · Anxiety · Fear of COVID-19 · Multiple sclerosis

## Introduction

One of the recent most important health issues concerning the world health is the spread of COVID-19 pandemic, the first case of which was reported on December 2019 in Wuhan, China [1]. This betacoronavirus with the

✉ Abdorreza Naser Moghadasi  
abdorrezamoghadasi@gmail.com

<sup>1</sup> Multiple Sclerosis Research Center, Neuroscience Institute, Tehran University of Medical Sciences, Tehran, Iran

single-stranded, enveloped RNA, belonging to the Coronaviridae family, is the seventh type of coronavirus in human-kind [2].

Beyond the physical effects and neurological involvements, every newly defined pandemic can potentially lead to psychological effects in all members of a society. Usually, at the beginning of the emergence of any new disease, on the one hand, due to the lack of specific, efficient, and effective treatments, and on the other hand, due to the successive questioning of existing information about every aspect of this disease, people would be prone to psychological disease. Furthermore, large-scale involvement in the disease may lead to adoption of strict policies such as public quarantine resulting in the reduction of the level of social communication, increase in domestic violence, reduction in access to public recreation, and suspension of payments (i.e., people may lose their revenue sources) [3].

The most common psychiatric problems with the highest DALY (disability-adjusted life years) in Western societies are depressive and anxiety disorders. For instance, in the USA, between 5.1 and 11.9% of the population suffer from generalized anxiety disorder [4–7], and the lifetime prevalence of a minor depression episode and a major depression disorder is 9–10% and 17%, respectively [5, 8]. In the last decades, the severity and prevalence of depressive disorders have promoted from subsyndromal and minor depression to major depression disorder (MDD) [9, 10]. The point prevalence of MDD has more than doubled from 1991 to 2001 in two nationally representative surveys in the USA, and the prevalence of depressive disorders in 2011 has reached about 18% in the developed countries [11].

Some studies have reported that this pandemic is leading to different health problems such as anxiety, insomnia, anger, depressive symptoms, denial, and fear globally [12] and had a mild stressful impact on people [13].

In addition to the general population, these two mood disorders have a special role in the course of other chronic diseases, including multiple sclerosis. According to recent review articles, the most common comorbidity associated with multiple sclerosis is mood disorders, particularly depression [14], where up to 30–50% of patients suffer from depression and up to 22.1% of patients suffer from anxiety [15, 16]. In multiple sclerosis population, the level of anxiety has increased compared to the recent year and before the pandemic. The individuals' most concerns were the possibility of the involvement and death of their acquaintances, as well as the lack of specific treatment for this epidemic [17, 18].

Various studies have shown the impacts of depression on the patients' quality of life. In this regard, a global review article published in 2020 examined factors associating health-related quality of life in MS patients. It was revealed that age, depression, and disease duration had the greatest

impact, but fatigue and expanded disability status scale (EDSS) had the less effect [17, 19]. Various studies have also shown the effect of anxiety and stress on the onset of MS and its relapses [20]. Besides these physical effects, recent efforts are made to evaluate the relation between depression and mood disorders, and invisible complications of MS, like fatigue and cognitive function [21].

In addition to depression and anxiety, fear of COVID-19 in people and patients is another psychosocial effect of this pandemic, knowing the severity of which is essential in recognizing whether preventive and lockdown strategies are required [22]. Furthermore, it affects the medication seek in patients with chronic or acute diseases and may result in psychological complications and life dissatisfaction [23].

In this study, we aimed at estimating the prevalence of depression and anxiety in patients with multiple sclerosis (PWMS) in the COVID-19 outbreak and evaluating the potential relating factors which may predict their prevalence.

## Materials and methods

### Participants

This study was conducted in a cross-sectional manner in PWMS, including the patients who recruited in the MS clinic of Sina Hospital, Tehran, Iran, in August and October 2020. All patients were definitely diagnosed with MS or clinically isolated syndrome by a neurologist based on the McDonald's diagnostic criteria revised in 2017 [24]. In order to provide remote services or consultations and avoid unnecessary visits, all patients were invited to join in a channel on the Telegram social media. This study was approved by the ethical committee of Tehran University of Medical Sciences (IR.TUMS.SINAHOSPITAL.REC.1399.065).

A four-part self-designed questionnaire was prepared and administered on-line for data gathering by a general practitioner. After explaining the aim and design of the study, the patients were asked to answer the questions within the coming 3 weeks, unless they had a relapse and steroid therapy within the last month. Out of 453 members of the channel, 282 patients accepted to participate in the survey and filled all the parts completely. The first part was about demographic and clinical features of the participants. Second and third parts were the Beck depression inventory [25] and Beck anxiety inventory [26] consisting of 21 multiple-choice questions with a total score of 63. Patients with a score of 15 and 11 or higher were classified as presence of depressive and anxious symptoms, respectively. The last part was assigned to evaluate the severity of fear of COVID-19 in the participants. A 7-item questionnaire validated on

Iranian participants with the overall score of the summed-up items, ranged from 7 to 35 indicated the severity of the fear of COVID-19 [27].

### Variable definition

Ongoing and past medical condition of patients were asked with clear questions in first part of the questionnaire, including type of MS, disease duration, treatment duration, medication, number of hospital admissions, EDSS score, past psychiatric history, and history of COVID-19 infection. Disease duration and treatment duration were considered as the years passed from physician diagnosis and the first time the patients have been using medications regularly. For estimating the frequency of relapses, we just included the attacks leading to hospitalizations and entered them as a quantitative variable in the analysis.

Past psychiatric history of patients was asked by whether they have ever been prescribed a medication by a physician for psychological issues. All data were rechecked according to the patients' medical records.

### Statistical analyses

Descriptive analysis was reported as number (percentage) and mean (first and third quartiles) for qualitative variables and quantitative variables with abnormal distributions. Normality of the study population was examined by Kolmogorov–Smirnov test.

First, different variables across depression and anxiety were examined through chi-square, *U* Mann–Whitney, and Kruskal–Wallis test. Finally, age, gender, and past history of psychological diseases were fixed in the univariate logistic regression model as potential confounders and all other significant factors revealed in the first step were examined in an enter model. All *p* values were considered as 2-tailed with a statistical significance of  $p \leq 0.05$ . SPSS statistical software version 23 was used for statistical analyses.

### Results

Of a total of 282 participants (81.7% female) with a mean age of 35.66 (30.75–40) years, 208 patients (73.7%) had college education while others did not have. Most (69.1%) of them were suffering from relapsing–remitting multiple sclerosis and only 7.1% had been diagnosed as CIS. They have experienced 2.23 (0–2) hospital admissions due to MS attacks in a 7.36 (3–10) years of disease duration. Of 26 participants reported as recent cases involved with COVID-19, only one patient was admitted in hospital for supportive therapy. BDI and BAI indicated that 145 (51.4%) and 171

(60.2%) of patients scored higher than 14 and 10; they were classified as presence of depressive and anxious symptoms, respectively. See Table 1 for a comprehensive description of the study population.

Among all demographic features and clinical factors in Table 1, education ( $p$  value = 0.004), employment ( $p$  value = 0.015), marital status ( $p$  value = 0.022), number of hospital admission due to MS attacks ( $p$  value = 0.048), and severity of fear of COVID-19 ( $p$  value  $\leq 0.0001$ ) had significant differences in the presence of depressive symptoms (Table 2).

For prediction of the prevalence of depressive symptoms in PWMS, level of education ( $p$  value = 0.019), marital

**Table 1** Description of the study sample

Characteristics	Mean or number
Age**	35.66 (30.75–40)
Gender (female)*	232 (81.7%)
Education*	
Middle school degree	10 (3.5%)
High school diploma	64 (22.5%)
Associate/bachelor degree	149 (52.5%)
Graduate degree	59 (20.8%)
Marital status*	
Single	93 (32.7%)
Married	155 (54.6%)
Divorced	34 (12%)
Employment (yes)*	108 (38%)
MS type*	
CIS	19 (6.7%)
RRMS	197 (69.4%)
PPMS	22 (7.7%)
SPMS	46 (16.2%)
Disease duration**	7.36 (3–10)
Treatment duration**	6.21 (3–9)
Drug*	
Immunomodulator	160 (56.3%)
Immunosuppressive	122 (43%)
Hospital admissions**	2.23 (0–2)
EDSS**	2.88 (1.5–4)
Past psychiatric history*	56 (19.7%)
COVID-19 infection*	26 (9.2%)
BDI**	14.54 (6–19)
BAI**	17.13 (8–25)

\*Qualitative variables reported as number (percent)

\*\*Quantitative variables with abnormal distribution reported as mean (first and third quartiles)

CIS, clinically isolated syndrome; RRMS, relapsing–remitting multiple sclerosis; PPMS, primary progressive multiple sclerosis; SPMS, secondary progressive multiple sclerosis; EDSS, expanded disability status scale; BDI, Beck depression inventory; BAI, Beck anxiety inventory.

**Table 2** Qualitative and quantitative variables across expression of depressive symptoms

	Expression of depressive symptoms		<i>p</i> value
	Yes	No	
Age	35.10 (29–40)	36.26 (32–41)	0.310
Gender			0.247
Male	22 (15.2%)	28 (20.4%)	
Female	123 (84.8%)	109 (79.6%)	
Education			0.004
Middle school degree	8 (5.5%)	2 (1.5%)	
High school diploma	43 (29.7%)	21 (15.3%)	
Associate/bachelor degree	69 (47.6%)	80 (58.4%)	
Graduate degree	25 (17.2%)	34 (24.8%)	
Occupational status			0.015
Employed	46 (31.7%)	62 (45.9%)	
Unemployed	99 (68.3%)	73 (54.1%)	
Marital status			0.022
Single	44 (30.3%)	49 (35.8%)	
Married	76 (52.4%)	79 (57.7%)	
Divorced	25 (17.2%)	9 (6.6%)	
MS type			0.547
CIS	9 (6.2%)	10 (7.3%)	
RRMS	97 (66.9%)	98 (71.5%)	
PPMS	11 (7.6%)	11 (8.0%)	
SPMS	28 (19.3%)	18 (13.1%)	
Disease duration	7.31 (3.5–10)	7.41 (3–10)	0.930
Treatment duration	6.04 (3–7.5)	6.4 (3–9)	0.513
Hospital admission due to MS attacks	2.64 (1–3)	1.79 (0–2)	0.048
EDSS	2.97 (1.5–4.5)	2.78 (1.5–4)	0.335
Drug type			0.080
Immunomodulatory	75 (51.7%)	85 (62.0%)	
Immunosuppressive	70 (48.3%)	52 (38.0%)	
Past psychiatric history			0.064
Yes	35 (24.1%)	21 (15.3%)	
No	110 (75.9%)	116 (84.7%)	
COVID-19 infection			0.573
Yes	12 (8.3%)	14 (10.2%)	
No	133 (91.7%)	123 (89.8%)	
Fear of COVID-19	18.93 (14–24)	15.88 (11.5–19)	≤0.0001

*CIS*, clinically isolated syndrome; *RRMS*, relapsing–remitting multiple sclerosis; *PPMS*, primary progressive multiple sclerosis; *SPMS*, secondary progressive multiple sclerosis; *EDSS*, expanded disability status scale; *BDI*, Beck depression inventory; *BAI*, Beck anxiety inventory.

status ( $p$  value = 0.44), hospital admission due to MS attacks ( $p$  value = 0.02), and fear of COVID-19 ( $p$  value < 0.0001) remained significant in our model. It was shown that patients with graduate degree of education compared to patients with high school diploma (odds ratio = 2.74, 95% CI = 1.14–6.58) or middle school diploma (odds ratio = 8.22, 95% CI = 1.43–47.36), and married patients compared to divorced patients (odds ratio = 0.31, 95% CI = 0.13–0.78) were less likely to suffer depressive symptoms. Also, the

higher the number of hospitalization due to MS attacks ( $\beta$  = 1.10,  $p$  value = 0.02) and the greater the fear of COVID-19 ( $\beta$  = 1.07,  $p$  value < 0.0001), the greater was the chance to suffer depressive symptoms (Table 3).

In the present study sample, presence of anxious symptoms associated significantly with fear of COVID-19 ( $p$  value ≤ 0.0001), EDSS score ( $p$  value = 0.004), and their employment status ( $p$  value = 0.045). It was revealed that patients with expression of anxious symptoms compared

**Table 3** Logistic regression for prediction of depressive symptoms in patients with multiple sclerosis

Characteristics	<i>B</i>	Beta	95% of CI	<i>p</i> value
Age	−0.02	0.98	0.94–1.01	0.273
Gender	−0.12	0.88	0.44–1.78	0.736
History of psychological disease	0.59	1.81	0.94–3.47	0.073
Occupational status	−0.15	0.85	0.48–1.53	0.606
Education				0.019
Middle school degree	2.10	8.22	1.43–47.36	
High school diploma	1.00	2.74	1.14–6.58	
Associate/bachelor degree	0.25	1.28	0.64–2.56	
Graduate degree	Reference	Reference	Reference	
Marital status				0.044
Single	−0.93	0.39	0.15–1.00	
Married	−1.14	0.31	0.13–0.78	
Divorced	Reference	Reference	Reference	
Hospital admission	0.10	1.10	1.01–1.20	0.020
Fear of COVID-19	0.07	1.07	1.03–1.12	<0.0001

to other patients were more disable (EDSS score of 3.13 (1.5–4.5) vs 2.49 (1–3.5)), more afraid of COVID-19 (fear of COVID-19 score of 19.22 (15–24) vs 14.72 (10–18)), and more likely to be unemployed (66.1% vs 54.1%) (Table 4).

In an enter model of univariate multiple binary logistic regression of anxiety, fear of COVID-19 ( $p$  value < 0.0001) and EDSS score ( $p$  value = 0.001) remained significant in predicting the prevalence of anxious symptoms. As shown in Table 5, patients with more severe fear of COVID-19 ( $\beta$  = 1.13) and more disability ( $\beta$  = 1.30) were more likely to express anxious symptoms (Table 5).

Entrance of Fear of COVID-19 Scale in our model did not change the significance of other factors neither for prediction of depression nor anxiety.

## Discussion

The present cross-sectional study was conducted on 282 patients referred to the MS clinic of Sina Hospital in the summer of 2020 during the COVID-19 pandemic era to investigate the prevalence of presence of depressive and anxious symptoms in patients and their relationship with fear of COVID-19. In this sample, the prevalence of depressive symptoms in PWMS was 51.4%, which was significantly associated with marital status, level of education, number of MS attacks leading to hospitalization, and the level of fear of COVID-19 in patients with MS. It was concluded that depressive symptoms were more prevalent in patients who have been separated from their partners, had more hospitalization due to MS attacks, were more afraid of COVID-19, and had lower level of education. Also, according to the BAI questionnaire, 60.6% of patients suffered anxious symptoms,

but only 2.3% of them suffered from severe anxiety. It was shown that anxious symptoms prevalence was associated with the level of fear of COVID-19 and the severity of physical disability.

Recent studies with different questionnaires reported depression in up to 50% of patients with MS [15, 28, 29]; however, in one of the large-scale studies conducted in 2016 in Italy which similar to the present study made use of BDI questionnaire, depression prevalence was reported to be 33.9% [30]. Beside the type of questionnaire, sociodemographic characteristics of the study population and type of sampling would explain the difference between the reports, as Seyed Saadat et al.'s study in Iran revealed that 59.4% of patients with MS have been suffering from depression [31]. Furthermore, one of the most important biologic mechanisms developing depression in patients with MS is regional atrophy and lesion burden [15] leading to a higher prevalence of depression in patients with progressive courses [30]. Thereafter, including 23.9% of the sample with progressive types of the disease may justify this high prevalence.

Although the present study, in line with Ahorsu et al. [27], reported a significant relationship between fear of COVID-19 and depression among patients with MS, but it cannot justify the higher prevalence of depression. Moreover, some recent studies [17, 32] comparing neuropsychological status of PWMS before the COVID-19 outbreak with its pandemic level did not report significant differences in this regard.

Solaro et al. [30] reported that PPMS patients were less likely to develop depression in their clinical course compared to RRMS or SPMS. However, the present study, in line with most other recent studies [31, 33, 34] including various demographic and clinical factors, did not find such a significant relationship. In our study population, only 22.5% of patients scored 4.5 or higher in EDSS and it did not show

**Table 4** Qualitative and quantitative variables across expression of anxious symptoms

	Expression of anxious symptoms		<i>p</i> value
	Yes	No	
Age	35.92 (32–40)	35.6 (29–41)	<b>0.354</b>
Gender			<b>0.289</b>
Male	27 (15.8%)	23 (20.7%)	
Female	144 (84.2%)	88 (79.3%)	
Education			<b>0.892</b>
Middle school degree	7 (4.1%)	3 (2.7%)	
High school diploma	40 (23.4%)	24 (21.6%)	
Associate/bachelor degree	88 (51.5%)	61 (55.0%)	
Graduate degree	36 (21.1%)	23 (20.7%)	
Occupational status			<b>0.045</b>
Employed	58 (33.9%)	50 (45.9%)	
Unemployed	113 (66.1%)	59 (54.1%)	
Marital status			<b>0.116</b>
Single	49 (28.7%)	44 (39.6%)	
Married	98 (57.3%)	57 (51.4%)	
Divorced	24 (14%)	10 (9%)	
MS type			<b>0.089</b>
CIS	8 (4.7%)	11 (9.9%)	
RRMS	117 (68.4%)	78 (70.3%)	
PPMS	12 (7.0%)	10 (9.0%)	
SPMS	34 (19.9%)	12 (10.8%)	
Disease duration	7.49 (3–11)	7.98 (3.5–10)	<b>0.487</b>
Treatment duration	6.39 (3–9)	5.95 (3–8)	<b>0.364</b>
Hospital admission due to MS attacks	2.34 (0–3)	2.05 (0–2)	<b>0.251</b>
EDSS	3.13 (1.5–4.5)	2.49 (1–3.5)	<b>0.004</b>
Drug			<b>0.139</b>
Immunomodulatory	91 (53.2%)	69 (62.2%)	
Immunosuppressive	80 (46.8%)	42 (37.8%)	
History of psychological disease			<b>0.770</b>
Yes	33 (19.3%)	23 (20.7%)	
No	138 (80.7%)	88 (79.3%)	
COVID-19 infection			<b>0.457</b>
Yes	14 (8.2%)	12 (10.8%)	
No	157 (91.8%)	99 (89.2%)	
Fear of COVID-19	19.22 (15–24)	14.72 (10–18)	<b>≤0.0001</b>

*CIS*, clinically isolated syndrome; *RRMS*, relapsing–remitting multiple sclerosis; *PPMS*, primary progressive multiple sclerosis; *SPMS*, secondary progressive multiple sclerosis; *EDSS*, expanded disability status scale; *BDI*, Beck depression inventory; *BAI*, Beck anxiety inventory.

any differences regarding the prevalence of depression. On the other hand, other recent studies [33, 34] have shown that patients with more severe disability may more likely experience depression. However, considering the number of attacks along with other demographic and clinical factors, Seyed Saadat et al. [31] omitted the effect of EDSS. Therefore, future studies with larger sample size are required to reevaluate the EDSS and disease course on depressive symptoms in patients with MS.

Regarding anxiety in patients with MS, according to Beck questionnaire, 79.1% of patients scored less than 21 (mild

anxiety), 17.7% of patients scored 22 to 35 (moderate anxiety), and only 3.2% of patients scored more than 36 (severe anxiety). In this regard, according to the different types of questionnaires that have been filled out by patients in different periods of sociopolitical events all over the world, prevalence of anxiety is very heterogeneous. For example, during the COVID-19 outbreak in Italy, Capuano et al. [32] found the prevalence of anxiety in patients with MS at 16.4%, according to the State-Trait Anxiety Inventory (STAI). In another study conducted by Da Silva et al. [35] in 2011 in Portugal on MS patients with the Hospital Anxiety

**Table 5** Logistic regression for prediction of anxious symptoms in patients with multiple sclerosis

Characteristics	<i>B</i>	Beta	95% of CI	<i>p</i> value
Age	−0.00	0.99	0.96–1.03	0.82
Gender	0.19	1.21	0.60–2.45	0.58
History of psychological disease	−0.25	0.77	0.40–1.50	0.45
Occupational status	−0.22	0.79	0.45–1.39	0.42
EDSS	0.26	1.30	1.11–1.53	0.001
Fear of COVID-19	0.12	1.13	1.08–1.19	<0.0001

EDSS, expanded disability status scale

and Depression Scale (HADS), anxiety level was estimated to be 51% and 26.6%, respectively. A recent review article on psychological disease in PWMS estimated the prevalence of anxiety at  $22.1 \pm 8.9\%$  [16].

Recent studies have reported different results of new prevalence of anxiety during the pandemic era. For instance, Stojanov et al. [17] reported an increase in the rate of anxiety in patients with MS, while Capuano et al. [32] did not find any changes. However, it depends on the time of study (early stages vs peak stages) and the type of anxiety questionnaire, but the association between fear of COVID-19 and anxiety has been reported [27].

In line with Mazza et al. [34] and Pham et al. [35], neither occupational nor marital status has an effect on the prevalence of anxiety in patients with MS. However, contrary to Pham et al. [35], in the present study, EDSS score in pandemic period was significantly associated with anxiety prevalence in patients with MS.

The most important limitation in the present study hides in the data gathering stage where information is obtained from patients subjectively. Although this method is acceptable for demographic features and questionnaires of anxiety, depression, and fear of COVID-19, but it will be erroneous in receiving clinical factors from patients. Furthermore, according to DSM V criteria, a close and specific interview with patients rather than BDI-II and BAI questionnaires needs to be done for diagnosis of depression and anxiety. On the other hand, some relatively common conditions like cognitive impairment in PWMS can both interfere with understanding of questionnaire and be confused with depressive symptoms itself. Long aside EDSS, which can reflect the neurological damage, different personalities percept their condition differently, and well-being perception could result in better emotional status. This study lacks of control group for comparing psychological consequences of PWMS with healthy individuals. Another important limitation was the method of cross-sectional study and also the lack of information about the psychiatric status of patients before the pandemic. Future

studies are suggested to examine longitudinal psychiatric changes in patients to determine the effect of COVID-19 pandemic on prevalence of anxiety and depression in PWMS with more certainty.

In conclusion, beyond the physical morbidity and mortality of the COVID-19 pandemic among patients with chronic diseases, it has some concealed effects leading to more exacerbations and reducing patients' performance [20]. This study reported fear of COVID-19 as an important significant factor in predicting the prevalence of depression and anxiety in PWMS. Future studies can find the other consequences of fear of COVID-19 on patients' life, including their medication seek and treatment adherence.

**Author contribution** Mohammad Alirezaei: investigation, resources, software, formal analysis, writing—original draft. Sharareh Eskandari: investigation, resources. Mohammad Ali Sahraian: investigation, resources. Abdorreza Naser Moghadasi: conceptualization, investigation, resources, writing—review and editing, supervision.

**Funding** The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by Tehran University of Medical Sciences.

**Data availability** The data that support the findings of this study are available on request from the first and corresponding author. The data are not publicly available due to information that could compromise the privacy of research participants.

**Code availability** All data were analyzed via SPSS version 22.

## Declarations

**Conflict of interest** The authors declare no competing interests.

**Ethics approval** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.SINAHOSPITAL.REC.1399.065).

**Consent to participate** Prior to administration the online survey, a paragraph about the study conduction and aim was handed out among participants and if they accepted the terms, they completed the survey.

**Consent for publication** Patients accepted publishing their clinical data prior to filling the survey.

## References

- Shi Y, Wang G, Cai XP, Deng JW, Zheng L, Zhu HH, Zheng M, Yang B, Chen Z (2020) An overview of COVID-19. *J Zhejiang Univ Sci B* 21(5):343–360. <https://doi.org/10.1631/jzus.B2000083>
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J et al (2020) A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 382(8):727–733

3. Shatla MM, Khafagy AA, Bulkhi AA, Aljahdali IA (2020) Public concerns and mental health changes related to the COVID-19 pandemic lockdown in Saudi Arabia. *Clin Lab* 66(10). <https://doi.org/10.7754/Clin.Lab.2020.200614>
4. Kessler RC, Gruber M, Hettema JM, Hwang I, Sampson N, Yonkers KA (2008) Co-morbid major depression and generalized anxiety disorders in the National Comorbidity Survey follow-up. *Psychol Med* 38(3):365–374
5. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE (2005) Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey replication. *Arch Gen Psychiatry* 62(6):593–602
6. Wittchen HU, Zhao S, Kessler RC, Eaton WW (1994) DSM-III-R generalized anxiety disorder in the National Comorbidity Survey. *Arch Gen Psychiatry* 51(5):355–364
7. Pietrzak RH, Kinley J, Afifi TO, Enns MW, Fawcett J, Sareen J (2013) Subsyndromal depression in the United States: prevalence, course, and risk for incident psychiatric outcomes. *Psychol Med* 43(7):1401–1414
8. Kessler RC, Zhao S, Blazer DG, Swartz M (1997) Prevalence, correlates, and course of minor depression and major depression in the National Comorbidity Survey. *J Affect Disord* 45(1–2):19–30
9. Lewinsohn PM, Klein DN, Durbin EC, Seeley JR, Rohde P (2003) Family study of subthreshold depressive symptoms: risk factor for MDD? *J Affect Disord* 77(2):149–157
10. Kessler RC, Ormel J, Petukhova M, McLaughlin KA, Green JG, Russo LJ et al (2011) Development of lifetime comorbidity in the World Health Organization world mental health surveys. *Arch Gen Psychiatry* 68(1):90–100
11. Torales J, O'Higgins M, Castaldelli-Maia JM, Ventriglio A (2020) The outbreak of COVID-19 coronavirus and its impact on global mental health. *Int J Soc Psychiatry* 66(4):317–320
12. Zhang Y, Ma ZF (2020) 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* 17(7)
13. Maric GD, Pekmezovic TD, Mesaros ST, Tamas OS, Ivanovic JB, Martinovic VN et al (2020) The prevalence of comorbidities in patients with multiple sclerosis: population-based registry data. *Neurol Sci*
14. Patten SB, Marrie RA, Carta MG (2017) Depression in multiple sclerosis. *Int Rev Psychiatry* 29(5):463–472
15. Boeschoten RE, Braamse AMJ, Beekman ATF, Cuijpers P, van Oppen P, Dekker J et al (2017) Prevalence of depression and anxiety in multiple sclerosis: a systematic review and meta-analysis. *J Neurol Sci* 372:331–341
16. Stojanov A, Malobabic M, Milosevic V, Stojanov J, Vojinovic S, Stanojevic G et al (2020) Psychological status of patients with relapsing-remitting multiple sclerosis during coronavirus disease-2019 outbreak. *Mult Scler Relat Disord* 45:102407
17. Naser Moghadasi A (2020) One aspect of coronavirus disease (COVID-19) outbreak in Iran: high anxiety among MS patients. *Mult Scler Relat Disord* 41:102138
18. Pashazadeh Kan F, Hoseinipalangi Z, Ahmadi N, Hosseinfard H, Dehnad A, Sadat Hoseini B et al (2020) Global, regional and national quality of life in patients with multiple sclerosis: a global systematic review and meta-analysis. *BMJ Support Palliat Care*
19. Artemiadis AK, Anagnostouli MC, Alexopoulos EC (2011) Stress as a risk factor for multiple sclerosis onset or relapse: a systematic review. *Neuroepidemiology* 36(2):109–120
20. Arnett PA, Barwick FH, Beeney JE (2008) Depression in multiple sclerosis: review and theoretical proposal. *J Int Neuropsychol Soc* 14:691–724
21. Pakpour AH, Griffiths MD (2020) The fear of COVID-19 and its role in preventive behaviors. *J Concurr Disord* ISSN 2562-7546
22. Satici B, Gocet-Tekin E, Deniz ME, Satici SA (2020) Adaptation of the Fear of COVID-19 Scale: its association with psychological distress and life satisfaction in Turkey. *Int J Ment Health Addict* 1–9
23. Sacco R, Santangelo G, Stamenova S, Bisecco A, Bonavita S, Lavorgna L et al (2016) Psychometric properties and validity of Beck depression inventory II in multiple sclerosis. *Eur J Neurol* 23(4):744–750
24. Osman A, Hoffman J, Barrios FX, Kopper BA, Breitenstein JL, Hahn SK (2002) Factor structure, reliability, and validity of the Beck anxiety inventory in adolescent psychiatric inpatients. *J Clin Psychol* 58(4):443–456. <https://doi.org/10.1002/jclp.1154>
25. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH (2020) The Fear of COVID-19 Scale: development and initial validation. *Int J Ment Health Addict* 1–9
26. Amtmann D, Kim J, Chung H, Bamer AM, Askew RL, Wu S et al (2014) Comparing CESD-10, PHQ-9, and PROMIS depression instruments in individuals with multiple sclerosis. *Rehabil Psychol* 59(2):220–229
27. Schippling S, O'Connor P, Knappertz V, Pohl C, Bogumil T, Suarez G et al (2016) Incidence and course of depression in multiple sclerosis in the multinational BEYOND trial. *J Neurol* 263(7):1418–1426
28. Solaro C, Trabucco E, Signori A, Martinelli V, Radaelli M, Centonze D et al (2016) Depressive symptoms correlate with disability and disease course in multiple sclerosis patients: an Italian multi-center study using the Beck depression inventory. *PLoS One* 11(9):e0160261
29. SeyedSaadat SM, Hosseinezhad M, Bakhshayesh B, Seyed-Saadat SN, Nabizadeh SP (2014) Prevalence and predictors of depression in Iranian patients with multiple sclerosis: a population-based study. *Neurol Sci* 35(5):735–740
30. Capuano R, Altieri M, Bisecco A, d'Ambrosio A, Docimo R, Buonanno D et al (2020) Psychological consequences of COVID-19 pandemic in Italian MS patients: signs of resilience? *J Neurol*
31. Bamer AM, Cetin K, Johnson KL, Gibbons LE, Ehde DM (2008) Validation study of prevalence and correlates of depressive symptomatology in multiple sclerosis. *Gen Hosp Psychiatry* 30(4):311–317
32. Chwastiak L, Ehde DM, Gibbons LE, Sullivan M, Bowen JD, Kraft GH (2002) Depressive symptoms and severity of illness in multiple sclerosis: epidemiologic study of a large community sample. *Am J Psychiatry* 159(11):1862–1868
33. da Silva AM, Vilhena E, Lopes A, Santos E, Goncalves MA, Pinto C et al (2011) Depression and anxiety in a Portuguese MS population: associations with physical disability and severity of disease. *J Neurol Sci* 306(1–2):66–70
34. Mazza C, Ricci E, Biondi S, Colasanti M, Ferracuti S, Napoli C et al (2020) A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *Int J Environ Res Public Health* 17(9)
35. Pham T, Jette N, Bulloch AGM, Burton JM, Wiebe S, Patten SB (2018) The prevalence of anxiety and associated factors in persons with multiple sclerosis. *Mult Scler Relat Disord* 19:35–39

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.