

ORIGINAL RESEARCH

# Healthcare Disruptions and Use of Telehealth Services Among People With Multiple Sclerosis During the COVID-19 Pandemic



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## Abstract

**Objective:** The current study examined health care disruptions and use of telehealth services among people with multiple sclerosis (pwMS) during the COVID-19 pandemic.

**Design:** Cross-sectional survey.

**Setting:** General community.

**Participants:** Participants (N=163) included 70 pwMS and 93 healthy controls (HCs). The majority of respondents were from the United States (88%).

**Interventions:** Not applicable.

**Main Outcome Measures:** Rates of health care disruptions (eg, missing/canceling appointments, experiencing delays) and telehealth use for MS and non-MS medical care and mental health care.

**Results:** In this U.S. majority, predominantly White, and high socioeconomic status sample, 38% to 50% of pwMS reported experiencing disruptions in their MS and non-MS medical care and 20% to 33% reported disruptions in their mental health care; this was significantly lower than the rates observed among HCs. Compared with HCs, pwMS were more likely to use telehealth than in-person services, especially for mental health care. The majority of pwMS and HCs reported being satisfied with telehealth services. Individuals with higher degrees of functional limitation experienced more health care disruptions and were more likely to use telehealth services than individuals with lower degrees of functional limitation.

**Conclusions:** Despite high health care disruption rates, pwMS frequently used and were highly satisfied with telehealth services during the COVID-19 pandemic. Due to physical limitations commonly observed in the MS population that may preclude travel, telehealth services should be continued even after resolution of the pandemic to expand access and reduce health care disparities.

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To mitigate the transmission of the SARS-CoV-2 virus, which causes COVID-19, many public spaces temporarily shut down

or limited access. This significantly disrupted in-person health care access and delivery (eg, canceled appointments, delays). Multiple sclerosis (MS) is a chronic and progressive neurological disorder and is the leading cause of nontraumatic disability among young and middle-aged adults.<sup>1</sup> People with MS (pwMS) need routine follow-up visits with their neurologists and are more likely to have medical and mental health comorbidities that would require additional care.<sup>2,3</sup> Therefore, the COVID-19 pandemic may have a greater effect on health care

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for pwMS compared with their healthy counterparts. Indeed, extant research has identified significant reductions in outpatient services after March 2020 compared with the same period in the previous year, including neurology and non-neurology visits, magnetic resonance imaging and laboratory tests, and rehabilitation services.<sup>4-9</sup> Many MS providers have changed the way they prescribed disease-modifying therapies,<sup>7,8</sup> due to concerns of safety in relation to COVID-19 (eg, anti-CD20 therapies).<sup>10</sup> PwMS reported being anxious about their disease-modifying therapy regimen (some stopped them altogether), missing hospital appointments, or not going to the hospital when they had a relapse.<sup>9,11</sup> Although informative, these studies did not include a reference group, making it difficult to determine if rates of health care disruption were disproportionately affected in the MS population. Another limitation of these studies is the narrow focus on services directly related to MS care, which does not encompass other types of care pwMS may receive due to medical and mental health comorbidities. The current study will address these limitations by including a healthy control (HC) group and delineating among different types of health care received.

To minimize unnecessary exposure, telehealth appointments were viable and, in some cases, necessary alternatives to in-person visits. Both pwMS and MS providers reported increased use of telehealth services during the COVID-19 pandemic.<sup>5,7,8,12</sup> However, telehealth access and use may depend on social determinants of health such as demographic and disease variables (eg, socioeconomic status, level of functional limitation). There is research suggesting that social determinants of health have had an effect on health care during the COVID-19 pandemic.<sup>13,14</sup> Black Americans were more likely to experience health care disruptions<sup>14</sup> and were less likely to use telehealth services compared with White Americans during the COVID-19 pandemic.<sup>13</sup> In MS research, Moss et al found that pwMS who experienced disruptions in their rehabilitation and homecare services were more likely to be older, have a progressive disease course, use walking aids, and have more comorbidities.<sup>4</sup>

The current study examined health care disruption and telehealth use among pwMS and HCs during the COVID-19 pandemic. The effect of MS disease variables, social determinants of health, and psychological distress from COVID-19 were also evaluated. Better understanding of how the pandemic has affected the health care landscape among pwMS will help inform optimal health care policy for this population.

## Methods

### Participants

The current study was part of a larger cross-sectional investigation of the effect of COVID-19 on adults with MS, traumatic brain injuries, and strokes. Participants were recruited through word of mouth and online advertisements. The current

study only included data from the MS and HC groups. Inclusion criteria included self-reported diagnosis of MS (or no neurological diagnoses for the HC group) and age of 18 years or older. Exclusion criteria included neurological diagnoses other than MS or diagnoses of serious mental illnesses (eg, schizophrenia, bipolar disorder). The study was approved by the Kessler Foundation institutional review board. All participants provided informed consent via REDCap<sup>a</sup> tools.<sup>15,16</sup>

### Procedures and measures

The study consisted of an online survey administered remotely through REDCap. Data collection occurred between September and October 2020. The current study focused on a subset of questions related to demographics, medical history, COVID-19 exposure and stressors, and health care utilization. Besides demographics and MS medical history, all questions used in this study were adapted from the COVID-19: Impact of the Pandemic and HRQOL in Cancer Patients and Survivors scale (F.J. Penedo, unpublished questionnaire, 2020). Questions related to cancer were modified to refer to MS. For health care questions, we expanded the questions to include MS care, care for a major medical condition, general medical care, and mental health care (see supplemental table S1, available online only at <http://www.archives-pmr.org/>, for details on these questions). Although we focused on health care utilization in the current article, we also published another study on changes in occupations of daily living among pwMS during the pandemic.<sup>17</sup>

### Statistical analysis

All data analyses were conducted using R, version 4.0.3.<sup>b</sup> Group differences were analyzed using Welch's 2 samples *t* tests for continuous variables, Pearson's chi-square tests for nominal variables, and Wilcoxon rank-sum test for ordinal variables. For health care utilization, between-group differences were analyzed by Pearson's chi-square tests, and within-subject differences (in-person vs telehealth) were examined using McNemar's tests. For sake of parsimony, major and general medical care were combined into non-MS medical care given no significant differences between these health care categories. For chi-square tests containing cells with expected frequency of less than 5, Fisher exact tests for count data were used. If respondents checked off "prefer not to answer" or "don't know" (<5% of overall data), these responses were designated as missing values in statistical analyses. Because health care access and shutdown policies may differ by country, we also examined rates of health care utilization among only respondents from the United States in a sensitivity analysis.

To identify predictors of health care disruption and telehealth use, binary variables were created to represent whether an individual experienced health care disruptions or used telehealth services. Many of the categorical variables contained categories with limited endorsement, so they were dichotomized for analyses (see supplemental table S2, available online only at <http://www.archives-pmr.org/>, for more details). The MS and HC groups were combined in these analyses, except for MS disease characteristics. We also conducted sensitivity analyses with only the MS sample to ensure generalizability. A threshold of *P* less than .05 was used to determine statistical significance in all analyses.

#### List of abbreviations:

HC	healthy control
MS	multiple sclerosis
pwMS	people with MS

**Table 1** Demographic and disease characteristics

Characteristics	MS (n=70) Mean (SD); Range	HC (n=93) Mean (SD); Range
Age, y	47.66 (12.96); 26-73	43.57 (14.60); 18-84
Disease duration, y	12.77 (9.84); 5 mo to 40 y	—
Years since last exacerbation	3.91 (5.82); <1 mo to 28.5 y	—
	<b>No. (%)</b>	<b>No. (%)</b>
<b>MS phenotype</b>		
Relapsing-remitting	48 (68.6)	—
Secondary progressive	9 (12.9)	—
Primary progressive	9 (12.9)	—
Not sure	4 (5.7)	—
<b>Used ambulatory assistive devices</b>		
Cane	31 (44.3)	—
Walker	27 (38.6)	—
Crutches	13 (18.6)	—
Knee ankle foot orthosis	3 (4.3)	—
Manual wheelchair	7 (10.0)	—
Power wheelchair	7 (10.0)	—
Scooter	4 (5.7)	—
Scooter	5 (7.1)	—
Female	57 (81.4)	78 (83.9)
<b>Race</b>		
White	52 (74.3)	74 (79.6)
Asian	5 (7.1)	8 (8.6)
Black or African American	3 (4.3)	6 (6.5)
American Indian/Alaska Native	2 (2.9)	1 (1.1)
Other	5 (7.1)	2 (2.2)
Prefer not to answer	3 (4.3)	2 (2.2)
<b>Ethnicity</b>		
Hispanic, Latino, or Spanish origin	11 (15.7)	10 (10.8)
<b>Education</b>		
12th grade, no diploma	1 (1.4)	0 (0)
High school graduate	2 (2.8)	4 (4.3)
GED or equivalent	2 (2.8)	2 (2.2)
Some college, no degree	14 (19.4)	6 (6.5)
Associate degree	4 (5.6)	1 (1.1)
Bachelors degree	19 (26.4)	35 (37.6)
Masters degree	22 (30.6)	33 (35.5)
Doctoral degree	8 (11.1)	12 (12.9)
<b>Employment status*</b>		
Employed full time	23 (32.9)	48 (51.6)
Employed part time	12 (17.1)	12 (12.9)
Laid off/furloughed due to COVID-19	3 (4.3)	5 (5.4)
Unemployed (unrelated to COVID-19)	1 (1.4)	5 (5.4)
Retired	8 (11.4)	4 (4.3)
Unemployed due to disability	22 (62.9)	1 (1.1)
Other (eg, student, homemaker)	1 (1.4)	18 (19.4)
<b>Marital status</b>		
Married	36 (51.4)	45 (48.4)
Part of an unmarried couple	3 (4.3)	12 (12.9)
Never married	18 (25.7)	26 (28)
Divorced	9 (12.9)	4 (4.3)
Separated	1 (1.4)	0 (0)
Widowed	1 (1.4)	4 (4.3)
Other	1 (1.4)	1 (1.1)
Prefer not to answer	1 (1.4)	1 (1.1)
<b>Income*</b>		
<\$25,000	12 (17.1)	9 (9.7)
\$25,000-\$49,000	9 (12.9)	10 (10.8)

(continued on next page)

**Table 1** (Continued)

Characteristics	MS (n=70) Mean (SD); Range	HC (n=93) Mean (SD); Range
\$50,000-\$74,000	10 (14.3)	3 (3.2)
>\$75,000	29 (41.4)	64 (68.8)
Don't know/prefer not to answer	10 (14.3)	7 (7.5)
Comorbidity		
Major medical problems*	21 (30.0)	4 (4.3)
Depression*	32 (45.7)	12 (12.9)
Anxiety*	24 (34.3)	13 (14.0)
Setting		
Large city	18 (25.7)	30 (32.3)
Suburbs of a large city	24 (34.3)	26 (28.0)
Small city	7 (10.0)	4 (4.3)
Town or village	15 (21.4)	26 (28.0)
Rural area	6 (8.6)	7 (7.5)
In the United States	59 (84.3)	85 (91.4)
Outside the United States		
Country	MS No. (%)	HC Country No. (%)
Canada	3 (4.3)	Ghana 1 (1.1)
India	2 (2.9)	Israel 7 (7.5)
Ireland	1 (1.4)	
Netherlands	1 (1.4)	
South Sudan	1 (1.4)	
United Kingdom	3 (4.3)	

NOTE. Group differences (MS vs HC) were determined by Welch's 2 samples *t* tests for continuous variables, Pearson's chi-square tests for nominal variables, and Wilcoxon rank-sum test for ordinal variables.

\* Statistically significant differences groups.

## Results

### Demographic and MS disease characteristics

A total of 70 pwMS and 93 HCs were included in this study. **Table 1** summarizes demographic and MS disease characteristics. A significantly higher proportion of pwMS reported being unemployed due to a disability than HCs (31% in MS vs 1% in HC;  $\chi^2 [1]=30.36$ ;  $P<.001$ ). The HC group reported significantly higher household incomes than the MS group (median income, \$50,000-\$74,000 in MS vs >\$75,000 in HC;  $W=3209$ ;  $P=.004$ ). The MS group reported higher rates of comorbidities including major medical problems other than MS (30% in MS vs 4% in HC;  $\chi^2 [1]=20.75$ ;  $P<.001$ ), depression (46% in MS vs 13% in HC;  $\chi^2 [1]=21.82$ ;  $P<.001$ ), and anxiety (34% in MS vs 14% in HC;  $\chi^2 [1]=9.39$ ;  $P=.002$ ). The majority of the sample was from the United States.

### COVID-19 exposure and stressors

**Table 2** summarizes COVID-19 exposure and stressors among the MS and HC groups. Significantly more HCs reported known exposure to someone with COVID-19 (7% in MS vs 23% in HC;  $\chi^2 [1]=7.28$ ;  $P=.007$ ) or being tested for COVID-19 (26% in MS vs 41% in HC;  $\chi^2 [1]=4.27$ ;  $P=.039$ ), relative to pwMS. A higher proportion of the HC group had a friend, coworker, or neighbor who was diagnosed with COVID-19 compared with the MS group (37% in MS vs 60% in HC;  $\chi^2 [1]=8.95$ ;  $P=.003$ ).

### Healthcare disruption and telehealth use

**Table 3** summarizes rates of health care disruption and telehealth utilization during the COVID-19 pandemic. Among pwMS, 38% to 50% experienced a disruption (ie, missing/canceling an appointment, experiencing a delay) in their MS and non-MS medical care. Sixty-six percent of HCs experienced a disruption in their medical care, which was significantly higher than pwMS ( $\chi^2 [1]=12.16$ ;  $P<.001$  for missing/canceling appointments;  $\chi^2 [1]=3.89$ ;  $P=.049$  for delay). Disruption rates in mental health care were slightly lower than medical care at 20% to 33% in pwMS and 26% in HCs, which was comparable between groups ( $P>.05$ ). Relatively few pwMS and HCs experienced disruptions in emergency care and fulfilling medical prescriptions (<17%). Higher proportions of pwMS attended telehealth than in-person appointments across all health care types ( $\chi^2 [1]=6.08$ ;  $P=.014$  for MS care;  $\chi^2 [1]=6.26$ ;  $P=.012$  for non-MS medical care;  $\chi^2 [1]=19.17$ ;  $P<.001$  for mental health care), although this was observed in mental health ( $P=.001$ ) but not in medical care among HCs. Telehealth use was the most frequent in mental health care with 90% in pwMS and 79% in HCs. Among pwMS, 77%, 74% to 84%, and 93% reported that they were very satisfied or somewhat satisfied with their MS medical, non-MS medical, and mental telehealth care, respectively. Similarly high rates were observed among HCs: 71% to 80% and 80% for medical and mental telehealth care, respectively. In sensitivity analyses, rates of health care disruption and telehealth use among respondents from the United States (n=144) were comparable to rates observed in the overall sample.

**Table 2** COVID-19 exposure

Exposure to COVID-19	MS (n=70) No. (%)	HC (n=93) No. (%)	MS vs HC P Value
Known exposure to someone with COVID-19	5 (7.1)	21 (22.6)	.007
Tested for COVID-19	18 (25.7)	38 (40.9)	.038
Positive for COVID-19	3 of 18 (16.7)	2 of 38 (5.3)	NS
A family or household member tested positive for COVID-19	8 (11.4)	12 (12.9)	NS
A family or household member died from COVID-19	3 (4.3)	3 (3.2)	NS
A friend, coworker, or neighbor diagnosed with COVID-19	26 (37.1)	56 (60.2)	.003
A friend, coworker, or neighbor died from COVID-19	12 (17.1)	17 (18.3)	NS

NOTE. Group differences were analyzed by Pearson's chi-square tests (MS vs HC).

Abbreviation: NS, not statistically significant.

## Predictors of healthcare disruption and telehealth use

Contrary to expectations, most demographic and MS disease characteristics were not significantly associated with health care disruption or telehealth use (table 4). PwMS who experienced mental health care disruption had significantly shorter MS disease duration (mean, 8.74y) than pwMS who did not experience mental health care disruption (mean, 16.00y;  $t$  [22.35]=2.62;  $P=.015$ ). Use of an assistive device for ambulation (eg, cane, wheelchair) was significantly associated with

greater non-MS medical telehealth use ( $\chi^2$  [1]=16.44;  $P<.001$ ). In the overall sample, being unemployed due to a disability ( $\chi^2$  [1]=12.58;  $P<.001$ ) and number of debilitating symptoms ( $t$  [125.23]=-4.27;  $P<.001$ ) were associated with greater non-MS medical telehealth use. Greater psychological distress from COVID-19 was significantly associated with mental health care disruptions ( $t$  [43.54]=-2.12;  $P=.040$ ) and tended to be related to greater non-MS medical telehealth use ( $t$  [144.74]=-1.91,  $P=.057$ ). Sensitivity analyses with only the MS sample yielded similar findings as observed with the overall sample.

**Table 3** Healthcare disruption and telehealth utilization during COVID-19 pandemic

MS Care (n=69 Received Care)	MS		HC		MS vs. HC P Value
	n	No. (%)	n	No. (%)	
Missed/Canceled appointment	68	26 (38.2)	—	—	—
Experienced a delay	66	26 (39.4)	—	—	—
Attended in-person appointment	69	27 (39.1)	—	—	—
Attended telehealth appointment	69	42 (60.9)	—	—	—
In-person vs telehealth		.014		—	
		<b>P Value</b>		<b>P Value</b>	
Non-MS Medical Care (n = 157)	n	No. (%)	n	No. (%)	P Value
Missed/Canceled appointment	62	23 (37.1)	88	58 (65.9)	<.001
Experienced a delay	62	31 (50.0)	83	55 (66.3)	.049
Attended in-person appointment	61	24 (39.3)	87	37 (42.5)	NS
Attended telehealth appointment	62	37 (59.7)	87	33 (37.9)	.009
In-person vs. Telehealth		0.012		NS	
		<b>P Value</b>		<b>P Value</b>	
Mental Healthcare (n=51)	n	No. (%)	n	No. (%)	P Value
Missed/canceled appointment	30	10 (33.3)	19	5 (26.3)	NS
Experienced a delay	30	6 (20.0)	19	5 (26.3)	NS
Attended in-person appointment	29	5 (17.2)	19	3 (15.8)	NS
Attended telehealth appointment	30	27 (90.0)	19	15 (79.0)	NS
In-person vs telehealth		<.001		.001	
		<b>P Value</b>		<b>P Value</b>	
Miscellaneous					
Chose not to seek emergency care	59	7 (11.9)	65	11 (16.9)	NS
Difficulty fulfilling prescriptions	65	8 (12.3)	77	12 (15.6)	NS

NOTE. Between-subject differences were analyzed by Pearson's chi-square tests (MS vs HC). Within-subject differences were examined using McNemar's test (in-person vs telehealth).

Abbreviation: NS, not statistically significant.



**Table 4** Associations between demographic/MS disease characteristics and healthcare disruption/telehealth use during the COVID-19 pandemic

	Healthcare Disruption			Telehealth Use		
	MS	Non-MS Medical	Mental	MS	Non-MS Medical	Mental
Disease duration	NS	NS	0.015	NS	NS	NS
Time since last exacerbation	NS	NS	NS	NS	NS	NS
MS phenotype (RRMS vs PMS)	NS	NS	NS	NS	NS	NS
Use of assistive device for ambulation (yes vs no)	NS	NS	NS	NS	<0.001	NS
Age	NS	NS	NS	NS	NS	NS
Education	NS	NS	NS	NS	NS	NS
Race (White vs non-White)	NS	NS	NS	NS	NS	NS
Unemployed due to a disability (yes vs no)	NS	NS	NS	NS	<0.001	NS
Number of debilitating symptoms	NS	NS	NS	NS	<0.001	N.S
Income level	NS	NS	NS	NS	NS	NS
Financial hardship during COVID-19	NS	NS	NS	NS	NS	NS
Psychological distress from COVID-19	NS	NS	0.040	NS	0.057	NS

NOTE. Respondents (MS and HC groups combined) were categorized as either having experienced healthcare disruption or not (ie, missing/canceling appointment or experienced a delay) and utilized telehealth services or not. Values represent *P* values for respective analyses. Abbreviations: NS, not statistically significant; PMS, progressive MS; RRMS, relapsing-remitting MS.

## Discussion

In this U.S. majority sample, contrary to our hypotheses, pwMS experienced significantly fewer health care disruptions (eg, missing/canceling appointments, experiencing delays) than HCs during the COVID-19 pandemic. That being said, rates of health care disruptions were still high among pwMS, with 38% to 50% experiencing disruptions with their MS and non-MS medical care and 20% to 33% with their mental health care, consistent with other MS studies.<sup>4-9,11</sup> Regarding telehealth use, 61% to 62% of the respondents with MS used telehealth for their MS and non-MS medical care and 91% used telehealth for their mental health care; these are significant increases from prepandemic levels (eg, in a study of 2 large MS centers in the United States, teleneurology use increased from less than 10% before the pandemic to more than 90% during the pandemic).<sup>12</sup> The rate of telehealth use was higher in pwMS than HCs. The current study significantly contributes to our understanding of health care utilization during the COVID-19 pandemic and is the first to include a HC reference group and delineate between medical and mental health care services among pwMS.

Consistent with prior research,<sup>14</sup> we found that greater psychological distress from COVID-19 was associated with more mental health care disruptions and more frequent use of telehealth services among both pwMS and HCs. Thus, anxiety about being infected with or dying from COVID-19 may underlie the high degree of health care disruptions observed and more frequent use of telehealth compared with in-person services in our sample. The difference between telehealth and in-person service use was more prominent in pwMS compared with HCs, among whom rates of telehealth appointments almost doubled the rates of in-person appointments for MS and non-MS medical care (60% telehealth vs 39% in-person) and rates of mental telehealth appointments were more than 5 times higher than in-person appointments (90% telehealth vs 17% in-person). Given that pwMS are immunocompromised and therefore may be more vulnerable to SARS-CoV-2 infections and complications, it is possible that more pwMS are choosing telehealth over in-person services to minimize risk of infections and mortality. Additionally, our results indicate that rate of telehealth use was the highest for mental health care among

both pwMS and HCs compared with other types of care. This was not surprising given the nature of mental health services, which can be more easily conducted remotely compared with medical services (which often require physical examinations). Mental health treatment is more important now than ever due to the COVID-19 pandemic. Since the COVID-19 outbreak, there have been significant increases in mental health diagnoses, including higher incidences of anxiety and depressive disorders, trauma and COVID-19 stress-related disorders, substance use disorders, and suicidal ideation.<sup>18,19</sup> The results of this study provide support for the continued use and expansion of tele-mental health services to meet the increased demands during the pandemic.<sup>19,20</sup>

We further argue that some of the temporary governmental policy changes aimed to expand telehealth services during the COVID-19 pandemic should be made permanent, even after the resolution of the pandemic. Although the current public health crisis has highlighted the need for telehealth services at a population-wide scale, certain groups of individuals have always had difficulty accessing in-person health care, such as individuals with significant physical limitations or lower socioeconomic status,<sup>21</sup> as well as rural residents. For example, many pwMS have to travel far to reach a MS clinic, which is challenging for those with significant physical limitations.<sup>22</sup> According to a recent American Academy of Neurology update, telehealth visits reduced travel for pwMS by 258 km, saved more than \$144 of travel costs associated with cognitive testing, reduced lodging costs by 17%, and decreased missed employment by 65%.<sup>23</sup> In support of expanded telehealth use, the current study found that the vast majority of pwMS and HCs (74%-93% in the MS group and 71%-80% in the HC group) were satisfied with their telehealth experiences. That being said, there are limitations to telehealth, such as the inability to perform physical examinations, imaging, and laboratory tests. Therefore, clinicians must exercise their clinical judgment and follow the guidelines established by consensus expert panels.<sup>24,25</sup>

Contrary to our hypotheses, most social determinants of health did not predict health care disruptions or telehealth use. This may be partly due to the homogeneity of our sample (eg, 74% identified as White) and definitions of certain categorical variables (eg,

annual household income had only 4 levels with \$75,000 or higher as the highest level, which comprised 41% of the sample; see [table 1](#)). Disparities have been evident throughout the COVID-19 pandemic. Extant research has identified higher SARS-CoV-2 infection and death rates among Black and Latinx Americans,<sup>26–28</sup> households with lower income,<sup>13</sup> and U.S. counties with higher poverty rates.<sup>26</sup> In MS, before the pandemic, inequalities in health care access had been documented in people with lower socioeconomic status and less education as well as non-White and rural residents.<sup>29</sup> Interestingly, a recent multicenter study found that the number of non-White MS patients who used teleneurology increased from pre- to postpandemic, which the authors attributed to governmental policies that expanded telehealth access.<sup>12</sup> This suggests that continuation of such policies may help reduce health care disparities in the MS population.

In contrast to findings from Moss et al.,<sup>4</sup> we did not find significant associations between most MS disease variables and whether respondents experienced health care disruption. Paradoxically, we did find that shorter MS disease duration was associated with greater mental health care disruptions. It is unclear at this time why we found this association. Future studies may conduct a qualitative interview with pwMS to understand the mechanisms mediating the relationship between disease duration and health care disruptions. Importantly, greater degree of functional limitation (ie, being unemployed due to a disability, use of an assistive device for ambulation, greater number of debilitating symptoms) was significantly associated with more frequent telehealth use among both pwMS and HCs. This may be the result of increased anxiety regarding COVID-19 infections and mortality in functionally limited individuals. Such fears are not unfounded, as illustrated by an epidemiological study of 369 counties across the United States in which higher disability rates were associated with higher COVID-19 death rates.<sup>26</sup>

## Study limitations

Given that this was an online, anonymous survey study, we were unable to verify MS diagnosis status with physicians in the MS sample. The current study had a relatively small sample size, which may affect the generalizability of these results. There is a potential selection bias given the mode of survey distribution (ie, internet based) and the predominantly White and high socioeconomic status sample. Thus, rates of telehealth use may be higher in this sample because respondents were more technologically savvy and had more economic resources. Moreover, we did not collect data on health insurance status (eg, whether respondents had insurance, private vs public), which could have affected health care disruptions and telehealth use. Furthermore, there were very few respondents who were diagnosed with COVID-19, so we were unable to determine if a history of COVID-19 had an influence on our health care outcomes. Finally, we did not collect information about presence of relapses and use of and changes in disease-modifying therapies for the MS respondents.

## Conclusions

In this U.S. majority, predominantly White, and high socioeconomic status sample, high rates of disruptions across MS and non-MS medical and mental health care were reported by pwMS during the COVID-19 pandemic, but these rates were lower than those observed among HCs. Telehealth services may counteract

these disruptions. PwMS were more likely to use telehealth than in-person services, especially for mental health care. Greater degree of functional limitation (ie, being unemployed due to a disability, use of an assistive device for ambulation, greater number of debilitating symptoms) was significantly associated with more frequent use of telehealth services among both pwMS and HCs. Due to significant physical limitations common in the MS population that interfere with travel to MS clinics and high degree of satisfaction with telehealth visits as shown in the current study, telehealth services should be continued for this population even after resolution of the pandemic (in cases when physical examinations are not required) to expand access and reduce health care disparities.

## Suppliers

a. REDCap; Vanderbilt University. b. R, version 4.0.3; R Foundation for Statistical Computing.

## Keywords

COVID-19; Delivery of health care; Multiple sclerosis; Rehabilitation; Telemedicine

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