Original Article

Impact of home confinement during COVID-19 pandemic on sleep parameters in Parkinson's disease

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ABSTRACT

Background: Literature shows that home confinement during coronavirus disease 2019 (COVID-19) pandemic has significantly affected sleep. However, such information regarding subjects having Parkinson's disease (PD) is unavailable.

Methods: This cross-sectional study was conducted using a questionnaire, developed and validated by experts. PD subjects from nine centers across India were included. Questionnaire assessed presence as well as change in sleep-related parameters and PD symptoms during home confinement. Restless legs syndrome (RLS) and REM sleep behavior disorder (REMBD) was diagnosed using validated questionnaire. Additionally, changes in physical activity, adoption of new hobbies during home confinement and perceived quality of life were assessed.

Results: Of 832 subjects, 35.4% reported sleep disturbances. New-onset/worsening of sleep disturbances (NOWS) was reported by 23.9% subjects. Among those with sleep disturbances (n = 295), insomnia symptoms worsened in half (51.5%) and nearly one-fourth reported worsening of RLS (24.7%) and REMBD (22.7%) each. NOWS was common in subjects lacking adequate family support during home confinement (P = 0.03); home confinement > 60 days (P = 0.05) and duration of PD > 7 years (P = 0.008). Contrarily, physical activity >1 h/day and engagement in new hobbies during home confinement were associated with better sleep. NOWS was associated with worsening of motor as well as non-motor symptoms of PD (P < 0.001) and poorer life quality (P < 0.001).

Conclusion: Home confinement during COVID-19 pandemic was significantly associated with NOWS among PD subjects. NOWS was associated with global worsening of PD symptoms and poorer life quality. Physical activity >1 h/day and adoption of new hobbies during home confinement were associated with better sleep.

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1. Introduction

Serial lockdowns and social distancing are commonly employed measures to contain spread of infectious disease that spread through respiratory route viz., coronavirus disease 2019 (COVID-19). COVID-19 pandemic led to an unprecedented situation where people remained confined to their homes for long duration. Although chronic disorders such as Parkinson's disease (PD) do not appear a primary medical concern during pandemic, a dramatic change in lifestyle due to home confinement had significant bearing on the morbidity among these patients [1,2].

Recently, several studies have reported that home confinement has significantly influenced night-time sleep [3—5]. A number of factors have been proposed for sleep disturbances during home confinement that include, but not limited to reduction of face to face social interactions, emotional stress to carry-out occupational work from home, increase in screen time and greater time spent in managing online schooling of children [3—5]. With sleep abnormalities being one of the common non-motor manifestations of PD [6], they are also expected to worsen during home confinement. However, to best of our knowledge this has not been investigated, so far.

Present multi-centric survey across India was planned to assess whether home confinement worsens sleep among subjects having PD. In addition, factors associated with new-onset/worsening of sleep and, effect of home confinement on selected sleep disorders was investigated. Lastly, association of sleep-disturbances with other motor as well as non-motor symptoms of PD was also assessed.

2. Material and methods

This cross-sectional study was conducted using an online survey questionnaire which was circulated to the study population between May 25 to July 20, 2020 (i.e., started after 2 months of lockdown and lasted till the end of fourth month of lockdown) [2]. Patients having diagnosis of PD were enrolled from nine Movement Disorder Centers across India, after obtaining approval from respective ethics committees. Survey questionnaire was shared with study participants using Survey Monkey Audience (Survey-Monkey Inc., San Mateo, California, USA).

Study subjects were identified through chart review, contacted telephonically and were requested to participate in the study after explaining rationale of the study. Written informed consent was obtained digitally. All subjects of PD, who provided written consent to participate in study were included irrespective of duration of symptoms of PD or medications prescribed for its treatment. Exclusion criteria for this study included pregnancy; subjects having significant cognitive decline not having any caregiver to respond on their behalf; subjects involved in providing essential services viz., medical, paramedical staff and policemen; and lastly, patients diagnosed with COVID-19 infection or quarantine for the same.

2.1. Development of the survey questionnaire

For this survey, a questionnaire was developed which had seven sections- (i) informed consent, (ii) socio-demographic data (iii) details regarding PD and comorbidities, (iv) effect of home confinement on availability of medications; (v) change or new-onset of motor, non-motor as well as sleep-related symptoms during home confinement, if any; (vi) effect of home confinement on physical activity; and lastly, (vii) effect of home confinement on social activity, hobbies and quality of life. Two of the authors (NK, RG) developed the questionnaire which was then sent for

validation to the experts. Questionnaire is available as annexure in our previous publication [2].

2.2. Validation of questionnaire

Validation of the questionnaire developed for the study was done by nine experts having proficiency in managing patients with PD following standard procedure [7]. Since it was meant for a cross-sectional survey, only face validity and content validity were assessed. However, validation procedure was not conducted for single questions for the diagnosis of restless legs syndrome (RLS) and REM sleep behavior disorder (REMBD) as they have already been validated [8,9].

- **(a) Face Validity:** Questionnaire was reviewed by experts and they were requested to provide dichotomous responses (Yes/No) (except validated questionnaires) considering the question "whether items appeared to measure what they were intended to measure?" [10].
- **(b) Content Validation:** For the content validation, experts were requested to scrutinize each item carefully and score them on a four-point Likert scale in four domains -relevance, simplicity, clarity, and ambiguity. Of these domains, score obtained on a Likert scale (1- not relevant, 2-somewhat relevant, 3-quite relevant, 4-highly relevant) in "relevance" domain was used for the content validation of each item [7]. Experts were also requested to provide feedback regarding items that scored either 1 or 2. Scores obtained from all the experts were used to calculate item-content validity index (I-CVI), Scale-Content validity index (S-CVI/Ave) and Scale Content Validity Index-Universal Agreement (S-CVI/UA).

Item-content validity index (I-CVI) was calculated for each item. "Highly relevant" or "quite relevant" on Likert scale were re-scored to 1 and the other two categories were re-scored as 0 for each item. Scores given by each expert for each item were added (0 or 1) and then divided by the number of experts to calculate average score for the item [7]. Items having CVI > 0.79 were kept without any revision, items scoring 0.70—0.79 were revised and others were eliminated [7].

Average Scale-Content validity index (S-CVI/Ave) was calculated by adding I-CVI of all items and then dividing the product by the total number of items. This method provided average CVI of the questionnaire.

To calculate Scale Content Validity Index-Universal Agreement (S-CVI/UA), each item was given score of 1 when all experts agreed that item was either "quite relevant" or "highly relevant" on four-point Likert's scale for relevance. When experts were not in universal agreement, item was given score 0. S-CVI/UA was derived by adding UA scores for each item and then dividing it by the number of items [7].

2.3. Assessment of sleep disturbances

All participants responded to a single item "Have you noticed any sleep disturbance or dissatisfaction with your sleep recently?". Those who had an affirmative response to this question were asked about details regarding duration (<3 months or ≥ 3 months) and frequency (<3 nights or ≥3 nights a week) of sleep disturbance. Further items ascertained insomnia symptoms, restless legs syndrome (RLS), snoring or chocking at night and rapid eye movement sleep behavior disorder (REMBD). Insomnia symptoms were diagnosed by asking "Do you have any difficulty in initiating or maintaining sleep?", "Do you wake up earlier than desired wake-time?" as specified in International Classification of Sleep Disorders third

edition [11]. To assess the daytime impact of insomnia, patients were asked if they had experienced any of the following symptoms during the daytime: tiredness, lethargy, irritability, low mood, difficulty in concentration or dull headache [11].

Screening for RLS was done by asking a single question [9]. Since, it was a questionnaire-based survey involving older persons during a potentially stressful environment, this question was broken into small parts. RLS was diagnosed when subjects provided an affirmative response to all parts. It has been found 100% sensitive and 96.8% specific for the diagnosis of RLS in General Neurology patients [9]. Assessment of REMBD was also based on single item screening [8]. It has been found to have 93.8% sensitivity and 87.2% specificity in idiopathic REMBD patients [8]. Among patients having PD, it has a sensitivity of 93% and specificity of 68% [12]. Lastly, patients were screened for sleep disordered breathing (SDB) by asking if they snore and/or experience chocking while asleep.

Patients had to choose the best response for these items from one of the following options- (i) "Never had this symptom", (ii) "Symptoms same as before", (iii) "Symptoms improved than before", (iv) "Worse than before", (v) "New symptom appeared." Categories (ii) and (iii) were clubbed as "No worsening of symptoms during home confinement" and the last two categories were classified as "new onset/worsening of symptoms during home confinement." Patients reporting appearance of a new symptoms or worsening in a pre-existing symptom involving either one or more of the above described sleep parameters within past 3 months were considered having new-onset/worsening of sleep.

2.4. Assessment of quality of life

Assessment of quality of life was done by asking a single item "How satisfied are you with your present quality of life?". Patients responded on five items scale ranging from "Very satisfied", "satisfied", "somewhat satisfied", "dissatisfied" to "very dissatisfied". Assessment of quality of life using single item has been found to provide optimal information when used with a visual analogue scale (VAS) [13]. However, it has been reported that using VAS method, patients tend to respond considering middle point i.e., 50 as neutral [13]. Scores below 50 depicted poor quality while above it showed good quality of life. Patients responding with "very satisfied" or "satisfied" were considered having good quality of life, while the rest were considered having poor quality of life. Patients reporting poor quality of life during home confinement were further enquired regarding perceived reason for poor quality of life, among the given options e.g., worsening of PD symptoms, fear of contracting COVID-19, social factors, inability to exercise and financial constraints.

2.5. Screen time, physical activity and adoption of new hobbies

Change in screen time (<3 h/day or > 3 h/day) and physical activity (<1 h/day or > 1 h/day) was compared by asking the subjects about time spent in these activities each day before and during home confinement. These values were arbitrarily chosen based on our clinical experience. To assess effect of physical activity and screen-time, subjects were divided into four categories- (a) those having low physical activity or screen-time before and after home-confinement (<1 h/day and <3 h/day, respectively); (b) those having adequate physical activity before and after home-confinement (>1 h/day) or had screen time >3 h/day; (c) those having reduced physical activity or screen-time during home confinement and (d) those having increased physical activity or screen time during home confinement.

Participants were further asked if they had started any new recreational activity during home confinement viz., yoga, exercise at home, dancing, playing board games or any other.

2.6. Assessment of symptoms of Parkinson's disease

This has been explained in detail previously [2]. All patients were asked, "Have you noticed any change or appearance of new symptoms in the motor and non-motor domain over past 2 months?" A total of 23 motor and non-motor symptoms were assessed and all patients were requested to provide their best response from options as defined for sleep disturbances.

3. Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0 (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.). Descriptive statistics were calculated. Association between categorical variables was assessed using the Fisher's exact test and Chi-square test. McNemar's test was used to find a change in proportion for the paired data. Bonferroni correction for multiple variables was done, wherever needed.

4. Results

A total of 851 responses were received during the survey, of which 19 were incomplete. They were excluded from the analysis and hence, final sample comprised of 832 responses. Nearly 84% patients were aged 50 years or older. Forty-eight patients (5.7%) reported taking psychotropic medications which were initiated before home confinement, presumably for neuropsychiatric manifestations of PD, with few patients consuming more than one psychotropic drugs. Amongst these, 36 respondents were taking antidepressants (selective serotonin reuptake inhibitor −32, Mirtazapine −3 and venlafaxine −1), 18 were taking hypnotic/anxiolytic drugs (clonazepam − 16, lorazepam − 1 and etizolam − 1) and three were prescribed antipsychotics (quetiapine).

4.1. Validation of the questionnaire

Average Scale-Content validity index (S-CVI/Ave and Content Validity Index by Universal Agreement (S-CVI/UA) for sleep related items of the questionnaire were 0.98 and 0.91, respectively (Supplementary Table 1).

4.2. Effect of home confinement on sleep

In the whole sample, nearly one-third (35.4%) respondents reported sleep disturbances. Supplementary Table 2 depicts comparison of total subjects having PD with those having sleep disturbances on demographic, clinical characteristics and other factors that can influence sleep. In this study sample, new-onset/worsening of sleep disturbances (NOWS) was reported by 199 (23.9%) respondents. Prevalence of individual sleep disturbances and changes during home confinement in this sample is shown in Table 1. Among the 295 PD patients with sleep disturbances, more than half reported worsening in insomnia symptoms and nearly one-fourth described worsening in RLS and REMBD each (Table 1). New-onset/worsening of SDB was reported by 16% subjects. Among subjects experiencing new-onset/worsening of sleep (n = 199), three fourth reported frequent occurrence of symptoms i.e., more than two nights a week.

Table 1
Prevalence of individual sleep disturbances and changes during home confinement in Parkinson's disease subjects with sleep abnormalities (N = 295).

Sl. No.	Sleep parameters	(A) Parkinson's disease subjects having symptom (n; %)	(B) Never had this symptom (n; %)	(C) No worsening during home confinement (n; %)	(D) Worsening/ appearance of new-onset sleep disturbances during home confinement (n; %)
		A (295-B)	B (295-A)	C (A-D)	D (A-C)
1	Insomnia (a/b + c/d)	221 (74.9)	74 (25.1)	69 (23.4)	152 (51.5)
	a. Difficulty falling and/or staying asleep	244 (82.7)	51 (17.3)	109 (36.9)	135 (45.8)
	b. Waking up too early in the morning	240 (81.4)	55 (18.6)	129 (43.7)	111 (37.7)
	c. Fatigued, irritable or low mood the next day	211 (71.5)	84 (28.5)	94 (31.9)	117 (39.7)
	d. Difficult to concentrate and reduced ability to function or heaviness of head next day	198 (67.1)	97 (32.9)	93 (31.5)	105 (35.6)
2	Features suggestive of restless legs syndrome	135 (45.8)	160 (54.2)	62 (21)	73 (24.7)
3	Features suggestive of sleep-disordered breathing (a and/or b)	166 (56.3)	129 (43.7)	119 (40.3)	47 (15.9)
	a. Snoring at night	144 (48.8)	151 (51.2)	119 (40.3)	25 (8.5)
	b. Feeling as if you were not able to breathe at night	81 (27.5)	214 (72.5)	48 (16.3)	33 (11.2)
4	Features suggestive of rapid eye movement sleep behaviour disorder	147 (49.8)	148 (50.2)	80 (27.1)	67 (22.7)

Table 2
Comparison of Parkinson's disease subjects without sleep disturbances with those having new-onset/worsening of sleep disturbances.

Sl. No.	Demographic and clinical characteristics		Parkinson's disease subjects lacking sleep problems (n = 537)	New-onset/worsening of sleep disturbances (n = 199)	P value
1	Age	<50 years	16.4%	15.1%	0.667
		≥50 years	83.6%	84.9%	
2	Gender	Male	69.1%	70.9%	0.644
		Female	30.9%	29.1%	
3	Locality of residence	Village/small city	41.9%	35.7%	0.126
		Large/Metropolitan city	58.1%	64.3%	
4	Presence of adequate family support during home confinement	Yes	74.1%	66.3%	**0.037**
		No	25.9%	33.7%	
5	Duration of home confinement	≤60 days	46.7%	38.7%	**0.05**
		>60 days	53.3%	61.3%	
6	Duration of Parkinson's disease	<7 years	64.1%	53.3%	**0.008**
		≥7 years	35.9%	46.7%	
7	Difficulty in getting face to face neurology consultations and/or medicines for Parkinson's disease[a]	Yes	38.9%	38.7%	0.953
		No	61.1%	61.3%	
8	Overall worsening in Parkinson's disease symptoms	Yes	29.4%	65.3%	**< 0.001**
		No	70.6%	34.7%	
9	Adopted new exercises/hobbies during lockdown	Yes	37.4%	28.1%	**0.019**
		No	62.6%	71.9%	
10	Satisfied with quality of life	Yes	53.4%	25.1%	**< 0.001**
		No	46.6%	74.9%	

[a] 339 subjects in the group of Parkinson's disease subjects lacked sleep disturbances and 181 subjects in the group reporting new-onset/worsening of sleep disturbances needed face to face neurology consultations and/or medicines for Parkinson's disease.

4.3. Factors associated with new-onset/worsening of sleep related symptoms

Table 2 depicts the comparison of respondents experiencing new-onset/worsening of sleep disturbances with "subjects without sleep disturbances" on demographic, clinical and other factors likely to influence sleep. New-onset or worsening of sleep disturbances was associated with inadequate family support during home confinement, home confinement longer than 60 days, duration of PD more than seven years and overall worsening of PD (Table 2). Adopting new hobbies during home confinement reduced chances of new-onset/worsening of sleep disturbances.

Change in physical activity was associated with NOWS (P = 0.003). Subjects with adequate physical activity at both times had better sleep than the group of low physical activity at both time (P = 0.01) and the group with reduced physical-activity during home confinement (P = 0.02). Similarly, screen time >3 h/day both before and during home confinement (P = 0.015) was associated with NOWS.

Table 3
Effect of new-onset/worsened sleep disturbances on worsening of motor and other non-motor symptoms of Parkinson's disease.

Sl. No.	Variables	New-onset/worsening of sleep disturbances (n = 199)	Parkinson's disease subjects who never had sleep disturbances (n = 537)	P[a]
A	**Worsened motor features**			
1	Tremor	36.6%	19.5%	**< 0.001**
2	Stiffness	43.9%	22.9%	**< 0.001**
3	Slowness	53.9%	27.7%	**< 0.001**
4	Speech	44.4%	26.1%	**< 0.001**
5	Swallowing	47%	22.7%	**0.001**
6	Drooling of saliva	43.7%	19.6%	**< 0.001**
7	Gait	56.3%	30.7%	**< 0.001**
8	Freezing of gait	66.1%	30.7%	**< 0.001**
9	Falls	50.5%	33.1%	**0.004**
10	Walking aid	52.5%	28.8%	**< 0.001**
11	Dyskinesias	46.6%	18.2%	**< 0.001**
B	**Worsened non-motor features**			
1	Memory	45.7%	34.6%	0.037
2	Aggressive/impulsive behavior	52.8%	30.8%	**0.001**
3	Depression	56.3%	35.7%	**< 0.001**
4	Anxiety	60%	39.1%	**< 0.001**
5	Visual hallucinations	53.7%	22.4%	**< 0.001**
6	Auditory hallucinations	42.9%	22.7%	0.027
7	Obsession	51.8%	32.6%	**0.009**
8	Pain	55.9%	34.2%	**< 0.001**
9	Urinary problems	40.5%	23%	**0.001**
10	Constipation	37.7%	26.5%	0.011
11	Fatigue	50.9%	32.9%	**< 0.001**
12	Postural dizziness	26.9%	34.4%	0.169

[a] Adjusted P value for motor domain = 0.0045; adjusted P value for non-motor domain = 0.0042.

4.4. Association between worsening of sleep and worsening of other symptoms of PD

We compared the worsening of motor and other non-motor symptoms of PD between patients with NOWS (n = 199) and those lacking any sleep problem (n = 537) (Table 3). PD patients with NOWS reported significant worsening in several motor as well as non-motor symptoms of PD as compared to subjects 'without sleep disturbance ever' (Table 3). Table 4 depicts comparison of worsening of motor and other non-motor symptoms in the two groups of PD patients with sleep disturbances i.e., with and without new-onset/worsening of sleep disturbances.

4.5. Sleep, hobbies and quality of life

Indoor exercises (19.5%), yoga (6.9%) and playing board games (5.3%) were the common new hobbies adopted by respondents during home confinement (Supplementary Table 2). More than half of the subjects (54.2%) were dissatisfied with their quality of life during home confinement (Supplementary Table 2). Worsening of PD symptoms, fear of contracting COVID-19, social factors, inability to exercise and financial constraints were reported as reasons for poor quality of life. Patients with NOWS reported poorer quality of life as compared to PD patients lacking sleep problems (Table 2).

5. Discussion

This multicentric cross-section survey showed that more than one-third subjects having PD report disturbed sleep and symptoms suggestive of sleep disorders. Nearly one-fourth of total respondents reported new-onset/worsening of sleep disturbances during home confinement. NOWS was associated with long duration of PD, home confinement and screen-time, absence of family support during home confinement and overall worsening of PD. Physical activity >1 h/day and adoption of new hobbies during home confinement appeared protective. Among subjects having sleep disturbances, half reported new-onset/worsening of

insomnia symptoms, nearly one fourth reported new-onset/worsening of RLS and REMBD each, and 16% reported new-onset/worsening of SDB. Moreover, NOWS was associated with worsening of motor as well as non-motor symptoms of PD and poorer quality of life.

In this study, more than one third subjects having PD reported disturbed sleep. Sleep abnormalities may affect up to 90% cases and precede the onset of motor symptoms [6,14]. Insomnia, REMBD, RLS and SDB are commonly reported in PD [6,14]. Up to 80% PD patients may report insomnia and 15%—50% patients may develop REMBD [6,14]. While RLS may be seen in up to 20% PD patients, SDB may have a prevalence similar to general population [6]. Prevalence of sleep disturbances in this study goes with that reported in the literature.

This study showed that nearly one fourth subjects reported new-onset/worsening of sleep disturbances during home confinement. Similarly, a sizable number of subjects reported new-onset/worsening of specific sleep disturbances i.e., insomnia, RLS, REMBD and SDB. This data corresponds with the recent studies reporting insomnia symptoms in 9%—38% of the general population during COVID-19 pandemic [3,4]. In addition to the inherent susceptibility for developing sleep disturbances in PD, low physical activity and longer screen time may contribute to worsening of sleep, which was also observed during present study [3,4,6]. A number of other factors viz., stress arising out of lockdown and prevailing uncertainties as well as change in sleep schedule during home confinement can also contribute to poorer sleep. Data from the same geographical area suggests increment in anxiety and depressive symptoms during home confinement in general population [4]. Similar findings were reported from present study sample as well [2]. Anxiety is known to induce hyperarousal that is pathophysiologically associated with insomnia as well as RLS [15,16].

In addition, delayed sleep-wake schedule was reported by a sizable number in general population during home confinement [4], which may apply to present study population. Delayed sleep increases amount of REM sleep which is primarily governed by

Table 4
Comparison of worsening of motor and other non-motor symptoms in Parkinson's disease between subjects with and without new-onset/worsening of sleep with regards to specific sleep disturbances.

Sl. No.	Variables	New-onset/worsening of sleep problem	No worsening in sleep problem	P[a]
A	**Insomnia**	**(n = 152)**	**(n = 69)**	**-**
1	**Worsened motor features**			
	Slowness	57.7%	27.7%	< 0.001
	Swallowing	54.5%	10.7%	< 0.001
	Difficulty walking	57.7%	32.2%	0.001
	Freezing of gait	67.3%	30.4%	< 0.001
	Falls	51.2	21.6	0.002
	Use of walking aid	56.9%	18.8%	< 0.001
2	**Worsened non-motor features**			
	Memory	48.6%	20.4%	0.001
	Depression	61.5%	11.9%	< 0.001
	Anxiety	65.3%	9.3%	< 0.001
	Pain	60%	25%	< 0.001
	Easy fatigability	57.4%	15.1%	< 0.001
	Postural dizziness	52.1%	12.5%	< 0.001
B	**Features s/o Restless legs syndrome**	**(n = 62)**	**(n = 73)**	**-**
1	**Worsened motor features**			
	Drooling	48.6%	13.3%	0.002
	Difficulty walking	63.5%	31%	< 0.001
	Freezing gait	67.9%	28.9%	< 0.001
	Falls	59.2%	23.1%	0.001
	Use of walking aid	65.8%	20%	< 0.001
	Dyskinesias	57.5%	18.4%	< 0.001
2	**Worsened non-motor features**			
	Memory	60.8%	19.5%	< 0.001
	Depression	66%	25.5%	< 0.001
	Anxiety	56.7%	22.9%	< 0.001
	Pain	67.9%	30.8%	< 0.001
	Easy fatiguability	56.4%	24%	0.001
	Postural dizziness	47.9%	16.3%	0.001
C	**Features s/o Sleep-disordered breathing (Snoring at night and/or Feeling of inability to breathe at night)**	**(n = 47)**	**(n = 119)**	**-**
1	**Worsened motor features**			
	Freezing of gait	80%	39.5%	< 0.001
	Falls	66.7%	33.8%	0.002
2	**Worsened non-motor features**			
	Memory	68.4%	27.7%	< 0.001
	Depressive symptoms	60.5%	30.8%	0.002
	Anxiety symptoms	71.4%	24.7%	< 0.001
	Visual hallucinations	61.1%	17.9%	0.001
	Pain	77.1%	37.7%	< 0.001
	Constipation	60.5%	27.7%	< 0.001
D	**Rapid eye movement sleep behavior disorders (enacting dreams or thrashing of limbs in bed)**	**(n = 67)**	**(n = 80)**	**-**
1	**Worsened motor features**			
	Reduced voice clarity	53.6%	24.2%	0.001
	Drooling of saliva	61.3%	20.6%	0.001
	Difficulty in walking			0.001
	Freezing of gait	66.7%	30.2%	< 0.001
	Falls	64.4%	21.3%	< 0.001
	Use of walking-aid	58.3%	20.5%	0.001
2	**Worsened non-motor features**			
	Memory	51%	22.4%	0.002
	Depression	69.2%	30.9%	< 0.001
	Anxiety	64.9%	27.6%	< 0.001
	Visual hallucinations	77.8%	13.8%	< 0.001
	Auditory hallucinations	84.2%	7.1%	< 0.001
	Pain	64.3%	28.3%	< 0.001
	Constipation	50%	20.3%	0.001

[a] Adjusted P value = 0.0022.

circadian factors and increases chances of REMBD as well as SDB. However, in this study, REMBD was diagnosed using single item without polysomnography. Hence, it is possible that reported dream enactment behavior was in-fact "trauma associated sleep disorder" rather than true REMBD [17]. Trauma associated sleep disorder has been proposed to be associated with insomnia and hyperarousal that in turn induces atonia during REM sleep [17].

New-onset/worsening of sleep disturbances was associated with worsening of several motor and non-motor symptoms of PD in this survey. This could be explained by two different facts-first, overlapping neurocircuitry between sleep-wake function and PD [18]. Sleep disturbances may result in suboptimal function of glymphatic system, which is essential for removing neuronal waste, predominantly during sleep [19]. This may possibly hasten the

ongoing dopaminergic and non-dopaminergic degeneration and aggravate underlying motor and non-motor PD symptoms [19]. Involvement of non-dopaminergic pathways may account for concurrent non-motor features including depressive and anxiety symptoms and those of fatigue [20,21]. Stress-induced depressive and anxiety features may worsen during the pandemic due to deficiency of dopamine-dependent adaptation [22,23].

Another reason for an association between NOWS and worsening of symptoms of PD could be sleep disturbance induced cognitive distortions leading to perception of poorer health [24]. Disturbed sleep is an stressful experience that can lead to enhanced negative emotions that in turn increase the perception of disability [25]. This could be another reason why adoption of new hobbies during home confinement was a protective factor for NOWS in this study. It is possible that subjects who have adopted new hobbies already had better mood and sleep that reduced their perception of disability and helped them to adopt meaningful activities during lockdown [25,26].

It has been proposed that remedial measures e.g., tele-consultation to ensure continued care may improve sleep [27]. However, results of the present study showed that difficulty in seeking face to face neurology consultation as well as inadequate availability of medications did not influence either sleep or symptoms of primary disorder. A number of factors could be responsible for this finding viz., severity and symptom cluster of PD, consultation with family physician during home-confinement, absence of comorbidities and lower proportion of psychiatric symptoms in the study group. However, these factors were not systematically assessed and this is an area for future research.

Like any other scientific investigation, present study also had several limitations. First, it was a survey and though exclusion criteria were clearly mentioned, there is a possibility that some patients meeting any of the exclusion criteria might have responded. Second, assessment of insomnia was done using non-validated questions. Hence, we considered them as insomnia symptoms rather than clinical insomnia. Third, validity of single questions for the assessment of RLS has yet to be established in PD. Fourth, since the validated questionnaires that assesses quality of life are lengthy and difficult to use in surveys, we used a single item. Fifth, a small proportion (5.7%) of patients were on psychotropic medications, presumably for the neuropsychiatric manifestations of PD. These medications could have influenced their sleep. Lastly, we kept the cut-off duration for NOWS at 3 months, while survey started only two months after lockdown. It is possible that some of our patients may have developed sleep disturbances in the pre-home confinement period.

In conclusion, home confinement during COVID19 pandemic significantly worsened sleep among subjects having PD. Adequate physical activity and adoption of new hobbies during home confinement was associated with better sleep.

CRediT authorship contribution statement

Dr. Niraj Kumar: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Writing-Original Draft,

Dr. Ravi Gupta: Methodology, Validation, Formal analysis, Investigation, Writing-Review and Editing.

Dr. Hrishikesh Kumar: Validation, Writing-Review and Editing.

Dr. Sahil Mehta: Validation, Writing-Review and Editing.

Dr. Roopa Rajan: Validation, Writing-Review and Editing.

Deva Kumar: Data collection, Writing-Review and Editing.

Dr. Rukmini Mridula Kandadai: Validation, Writing-Review and Editing.

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Banashree Mondal: Data collection, Writing-Review and Editing.

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Ankita Rawat: Data collection, Writing-Review and Editing.

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Dr. Prashanth LK: Validation, Writing-Review and Editing.

Dr. Achal Kumar Srivastava: Validation, Writing-Review and Editing.

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Conflict of interest

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2020.11.021.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2020.11.021.

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