Original Article

Comparison of actigraphy indices among patients with depression and schizophrenia: A preliminary study

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Abstract

Background: Schizophrenia (SCZ) and depression (MDD) are associated with changes in sleep and activity patterns. However, because of a lack of objective evaluation, the diagnostic or clinical value of these sleep-activity patterns is unknown. In this study, we attempted to assess and compare the sleep and activity patterns using actigraphy. **Materials and Methods:** We have recruited 35 patients with SCZ (mean age: 29.29 ± 7.54 years) and 42 patients with MDD (mean age: 27.5 ± 5.59 years) in this cross-sectional study. The actigraphy indices [Time in bed (minutes), Onset latency (minutes), Total sleep time (Minutes), Sleep efficiency (%), WASO (minutes), number of awakening, and activity duration (minutes) were compared among the two groups using unpaired *t*-test and Fisher exact test. **Results:** In the MDD group, the time in bed (minutes) was significantly higher than in the SCZ group (402.7 ± 41.97 vs. 379.1 ± 40.45, $P = 0.01$), while the sleep efficiency was lower in the SCZ group than in the MDD group (60.04 ± 9.25 vs. 65.05 ± 7.16, $P = 0.0092$). An increase in onset latency (minutes) was observed in the SCZ group compared to the MDD group (49.06 ± 16.09 vs. 43.6 ± 10.14, $P = 0.074$). The difference in WASO (minutes), the number of awakenings, and activity duration (minutes) among the two groups were insignificant. **Conclusion:** Actigraphy parameters such as sleep efficiency and time in bed may be a useful sleep process, etiological, and prognostic markers in patients with SCZ and MDD. The longitudinal studies are needed to estimate the predictive role of these parameters for therapeutic outcome in these patients.

Keywords: Actigraphy, actimeter, depression, schizophrenia

Introduction

Schizophrenia (SCZ) and major depressive disorder (MDD) are commonly associated with disturbances in sleep, abnormal sleep-wake cycles, and abnormal motor activity.[1,2] Sleep and activities are generated and regulated through the complex interaction of multiple brain regions which are affected in patients with SCZ and MDD. Delayed onset of sleep, impaired sleep continuity, and increased time wake is reported in these group of patients.[3,4]

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Though these abnormalities in sleep and psychomotor activities can be assessed by commonly used clinical rating scales [e.g. Hamilton depression rating scale (HAM-D) and Positive and Negative syndrome rating scale (PANSS)]. The clinical evaluation for this domain is often inadequate because of limited items in these rating scales. (i.e. HAM-D contains only two items out of the 17 items and PANSS contains only three items out of 30 items to assess the psychomotor symptoms).[5-8] To overcome these limitations Salpetriere Retardation Rating Scale (SRRS) may be the choice to assess psychomotor retardation and to monitor the response to medications.[9] It assesses both psychic and motor disturbance involved in psychomotor retardation. But the scale doesn't consider the indirect role of several items concerning fatigue, lack of concentration, loss of energy and sleep affecting the psychomotor activities.

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Besides, these scales are subjective or partially objective and found as inadequate to measure the disease severity and therapeutic response both in qualitative and quantitative assessment in these patients.[10-12] So, there is a need for an objective scale or biosensor enabling device which can assess the therapeutic response in patients with MDD and SCZ.[13] On the other hand, actigraphy may be useful in patients with MDD and SCZ to record the therapeutic response. Berle *et al.* reported the reduced actigraphic motor activity in patients with depression and SCZ than healthy control.[14] Further, the activity pattern among patients SCZ is less complex and more structured than depression.[14] Therefore, actigraphy appears a promising tool for quantitative and qualitative assessment of symptoms in patients with MDD and SCZ.

So, actigraphicaly measured psychomotor activities may overcome the limitations of the HAM-D, PANSS, and SRRS such as subjective, inadequate items for the evaluation up to a certain extent. However, no study attempted to compare the sleep-activity pattern among the patients with SCZ or MDD by using an actigraphy device. In this study, we attempted to measure the sleep-activity pattern by using actigraphy parameters in patients with MDD and SCZ.

Materials and Methods

Study design and participants

This cross-sectional, comparative study was carried out at a tertiary care rural hospital for 12 months. The study was approved by the institutional ethical committee (IEC) of Datta Meghe Institutes of Medical Sciences, Wardha**.** Patients admitted to the psychiatry ward and diagnosed with either SCZ or MDD were invited to participate in the study. Patients with comorbidities like medical illness (acute or chronic), substance use, pregnancy, and smoking were excluded. Patients aged 18–45 years, drug naïve, and diagnosed with either SCZ or MDD on Diagnostic and Statistical Manual of Mental Disorder (DSM-5) were included in the study.[15]

Study tools

The patient fulfilling inclusion and exclusion criteria and consented to participate in the study was evaluated using the sociodemographic data and the Pittsburgh Sleep Quality Index (PSQI). Then HAM-D, 17 items scale was used to assess the severity of depression among the patients with MDD, while PANSS was used to assess the positive, negative, and general psychopathology symptoms in patients with SCZ.[7,8,16] Also, Actiwatch (Philips, Inc) was used to measure the sleep, circadian rhythm, and rest-activity pattern. Actigraphy objectively measures the ecologically valid data of psychomotor activities and sleep activities using the wearable accelerometer.[17]

Statistical analysis

Statistical Package for Social Sciences (SPSS v21, Chicago, IL, USA) was used for statistical analysis. Mean, standard deviation, or percentage was used to describe the data. The normal distribution of data was assessed by using the Shapiro–Wilk normality test ($P > 0.05$), histograms, and box plots. The unpaired *t*-test and Fisher exact test were used to compare variables. A *P* value of less than 0.05 was considered statistically significant.

Results

Sociodemographics and clinical characteristics of the patients with SCZ and MDD are depicted in Table 1. There was no statistically significant difference between the two groups in terms of age, education, age of onset of illness, the total duration of illness, and the number of relapse among the two groups. The difference between the two groups was significant for gender ($P = 0.04$) and PSQI global score ($t = 4.61$ df $= 75$, $P < 0.0001$). There were a more number of female patients in the MDD than SCZ. The quality of sleep on PSQI was worse among patients with MDD than SCZ.

Among the actigraphy indices, the time in bed (minutes) was higher in patients with MDD than SCZ (402.7 ± 41.97 vs. 379.1 ± 40.45, $P = 0.01$), whereas the overall sleep efficiency was

Table 1: Sociodemographics and clinical characteristics

Variables	SCZ (*n*=35) (Mean±SD)	MDD (*n*=42) (Mean±SD)	Level of significance
Age (Years)	29.29±7.54	27.5±5.59	*t*=1.192 df=75, *P*=0.23
Gender			
Male	22 (62.85%)	16 (38.09%)	*P*=0.04*
Female	13 (37.14%)	26 (61.90%)	
Education (Years)	12.89±3.008	13.05±2.60	*t*=0.25 df=75, *P*=0.80
Age of onset of illness	26.57±6.679	25.4±4.83	*t*=0.88 df=75, *P*=0.37
Total duration of illness	18.23±20.49	15.45±11.69	*t*=0.74 df=75, *P*=0.45
Number of relapse	1.371±2.03	0.69±1.05	*t*=1.89 df=75, *P*=0.06
PANSS Total	78.17±20.64		
P-Total	19.83±6.71		
N-Total	19.34±7.67		
G-Total	39±11.88		
HAM-D		21.76±2.507	
PSQI	11.29±1.88	9.43±1.64	*t*=4.61 df=75, *P*<0.0001

*Fisher exact test

reduced in the SCZ group than in the MDD group (60.04 ± 9.25 vs. 65.05 ± 7.16, $P = 0.0092$) [Table 2]. An increase in onset latency was observed in patients with SCZ than MDD (49.06 ± 16.09 vs. 43.6 ± 10.14, $P = 0.074$). Total Sleep Time (minutes) was highly significant among patients with MDD than SCZ (263 ± 46.7 vs. 229.1 ± 48.88, $P = 0.0027$). There was no significant difference in Wake after sleep onset [WASO] (minutes), the number of awakenings, and activity duration (minutes) among the two groups.

Discussion

Our study findings suggest that actigraphy measured sleep efficiency was poor among patients with SCZ. The increased WASO and sleep latency among the two groups of the patients suggest that these patients are experiencing difficulty in falling and have fragmented sleep. This is in concordance with a previously published studies and systemic review.[18] About 36–45% of patients with SCZ have reported difficulties in sleep initiation and maintenance. The presence of psychotic symptoms interferes with sleep induction. The disrupted sleep further precipitates and maintains the psychotic symptoms.[19]

We found reduced daytime motor activity in both groups which was lower compared to healthy controls in previously published studies.[3,20] This indicates the attenuated sleep pressure may be because of naps and reduced daytime activity leading to delayed sleep phase and further circadian misalignment, which might have compromised sleep initiation and maintenance.[21]

Though the patients with SCZ and MDD have a dysfunctional attitude about sleep, our study findings suggest that changes in actigraphy parameters could be because of the disruption in the sleep process.[22,23] Also, some of the patients with MDD have reported hypersomnia, that is, increased total time spent as sleep and in bed. Such patients may be suggestive of the different phenotypes of MDD or SCZ such as atypical depression and may remain unrecognized with the subjective evaluation. In most of the previous studies, patients receiving antipsychotics or antidepressants were included in the study, thus most of the actigraphy parameters were affected by these drugs.[18,24-26] For example, some antipsychotics are known to increase the sleep duration and continuity by bind to sleep-wake regulating receptors. On the other hand, some antipsychotics (e.g, clozapine, olanzapine) increases the sleep duration by sleep- consolidating and promoting action.[18,26]

Furthermore, the sedentary behavior of patients and the effects of sedative medications reduces the daytime activity and sleep propensity and leads to an increase in sleep fragmentation, latency, and longer time in bed.[18]

Strength, limitations, and future directions

To the best of our knowledge, this study is the first attempt to compare the actigraphy indices in the drug naïve patients with SCZ and MDD in India. Biosensor-enabled devices, that is, actigraphy to measure sleep-activity patterns have clinical and policy relevance in India. In resource limiting setting like India, these findings are useful for developing and implementing primary care physician-based collaborative and integrative model (stepped care or matched care) for mental illness.[27,28] Under these models, the primary care physician can direct the patient care while the specialist provides collaborative care. Actigraphy has been found as a useful objective tool in these models and minimizes human errors and subjective bias in other countries.[29,30]

However, the study finding should be interpreted cautiously for having a small sample size, single-center, and inpatient settings. Specific symptoms of psychopathology such as delusion, hallucinations affect the sleep-activity patterns which were not explored. Further research should focus on a large set of clinical populations, specific symptoms of psychopathology, clinical models, and integrative care. Also, the discriminative potential of individual indices may help researchers to define or discriminate patients with SCZ from MDD.

Conclusion

Our study findings suggest that certain actigraphy indices [e.g. time in bed (minutes), total sleep time (minutes), onset latency (minutes), sleep efficiency (%), and WASO (minutes)] can have discrimination potential. At present, the non-availability of diagnostic or prognostic markers for SCZ and MDD is one of the major challenges in clinical practice. Future studies are needed to evaluate the clinical utility of actigraphy indices in different combinations and settings.

Key points

- Actigraphy is a procedure that objectively records sleep and activity over time.
- In this preliminary study, actigraphy parameters such as sleep efficiency and time in bed were significantly reduced

Table 2: Comparison of Actigraphy Parameters in Patients with SCZ and MDD

Actigraphy Parameters	SCZ (*n*=35) (Mean±SD)	MDD (*n*=42) (Mean±SD)	Level of significance
Time in Bed (minutes)	379.1±40.45	402.7±41.97	t=2.489 df=75, P=0.0150
Total Sleep Time (Minutes)	229.1±48.88	263±46.7	t=3.109 df=75, P=0.0027
Onset Latency (minutes)	49.06±16.09	43.6±10.14	t=1.812 df=75, P=0.0740
Sleep Efficiency (%)	60.04±9.25	65.05±7.16	t=2.675 df=75, P=0.0092
WASO (minutes)	43.71±10.85	43.29±10.29	t=0.1775 df=75, P=0.8596
Number of awakening	55.6±20.01	52.76±14.36	t=0.7228 df=75, P=0.4721
Activity duration (epoch)	1861±228.9	1938±156.4	t=1.75 df=75, P=0.0843

Epoch=30 seconds

in patients with SCZ than MDD.
- These parameters may be useful to monitor the sleep process, etiological, and prognostic markers in patients with SCZ and MDD.
- Actigraphy can be useful for developing and implementing primary care physician-based collaborative and integrative model (stepped care or matched care) for mental illness in low-resource settings. However, further studies are warranted to confirm this.

Abbreviations

WASO = Wake after sleep onset
SCZ = Schizophrenia
MDD = Major depressive disorder

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Conflicts of interest

There are no conflicts of interest.

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