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Sleep disturbances and functional independence improvement in a population of individuals hospitalized in intensive rehabilitation units: observational study

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Abstract

Introduction: Quality of sleep in hospitals is an important issue, especially for rehabilitation patients. The aim of this study was to evaluate the development of sleep disturbances in a population of individuals hospitalized in intensive rehabilitation units and to investigate relationship with functional independence.

Material and methods: The sample was evaluated with the General Sleep Disturbance Scale (GSDS-IT) and Bartel Index (IcaBI) three times: at admission (t0), seven days after admission (t1), and 25 days after admission (t2). The variation in sleep quality between t0-t1-t2 was calculated by performing a paired samples t-test between the scores' averages. A comparison of the functional independence level evaluated through IcaBI of subjects with and without sleep disorders according to GSDS-IT cut-off points was performed via an independent samples t-test between the averages of the scores obtained on the IcaBI at times t0 and t2.

Results: 138 individuals were included in the study, 77 of whom completed the evaluation at t2. Comparison of the mean scores on the GSDS-IT showed a statistically significant worsening of the quality of sleep between t0-t1-t2 ($p < 0.01$). Comparison of the mean scores on the IcaBI showed a statistically significant improvement in functional independence between t0-t1-t2 ($p < 0.01$). The results showed no significant difference between those with or without sleep disorders in terms of improvement of IcaBI scores after 25 days of hospitalization.

Conclusions: This study represent a starting point in highlighting the development of sleep disturbances during hospitalization in rehabilitation units, raising awareness about the importance of adequate sleep among vulnerable hospital population.

Keywords: hospitalization, rehabilitation, sleep disorder

Introduction

Sleep disturbance and poor sleep quality is associated with a general negative impact on health, such

as increased health care costs and increased risk of mental disorders [1–4]. In this study, sleep disturbance was defined as either sleep deprivation resulting from an inadequate total amount of sleep or sleep



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disruption resulting from fragmented sleep during the night [5–8]. Hospitalization is a major cause of sleeping pattern disturbance, because of the effects of illness, drug therapies, pain, and depression, caregiver interruptions and environmental noise [9,10]. In fact, the hospital environment is characterized by noise from different sources such as parametric monitoring devices that indicate a patient's health condition with noisy alarms and "beeps" [11]. The negative implications for the sleep quality [12], can lead in turn hinder recovery from pathologies [8,11]. It has previously been shown that daytime sleepiness is a predictor of poor functional recovery in hospitalized geriatric patients: a significantly positive correlation between the severity of daytime sleepiness and the worsening of the Barthel Index was identified [12]. It is therefore evident that medical awareness of the impact of sleep disorders on hospitalized patients is of vital importance, and that knowledge of the major factors that disturb sleep during hospitalization will allow both researchers and hospital staff to systematically evaluate and treat sleep issues. Although inadequate sleep has a demonstrated negative association with health care outcomes, to date, few studies have examined sleep in intensive rehabilitation units or its association with functional independence outcomes [13–15]. Quality of sleep in hospitals is an important issue in general but possibly even more so for rehabilitation patients who may have long stays. In this study, sleep disturbances were analyzed among patients hospitalized in intensive rehabilitation units, which are characterized by intensive evaluative and therapeutic interventions. Such interventions are typically directed toward patients in the post-acute phase, when rehabilitation can positively influence functional recovery by managing and/or reducing the extent of impairment, i.e., when disability is most modifiable; this phase may also be necessary in situations in which the pathological event is exacerbated or reoccurring. Hospitalization in an intensive rehabilitation unit is usually 25 days. The administration on the day of admission to the hospital of the General Sleep Disturbance Scale (GSDS), that measures sleep disturbances experienced during the previous week, made it possible to assess the quality of the patient's sleep in daily life prior to admission. Furthermore, the time frame of the scale coincides with the period in which factors that could alter the quality of sleep, such as agitation and fear, can more easily occur.

Thus, the aim of this study was to evaluate the presence and development of sleep disturbances in a population of individuals hospitalized in intensive rehabilitation units and to investigate its relationship with functional independence.

Materials and methods

It was observational study using interrupted time series.

Participants

Participants were recruited from the Department of Physical Rehabilitation Medicine at the "Policlinico Umberto I" University Hospital and at the "Policlinico Italia" hospital in Rome.

To be included, participants had to meet the following criteria:

1. be admitted to an intensive rehabilitation unit;
2. have not been an inpatient for longer than seven days at the time of recruitment;
3. be at least 18 years old;
4. have no insomnia symptoms as defined by Diagnostic and Statistical Manual of Mental Disorders (DSM-V) [16] diagnostic criteria [17], the tool used for this was The Sleep Condition Indicator [18];
5. have the ability to communicate in Italian;
6. give signed informed consent for the processing of personal data.

Patients admitted to the intensive rehabilitation unit were informed of the purpose of the study, as well of the methods and timing of the administration of the instruments. Those who showed interest in the study were assessed against the inclusion and DSM-V diagnostic criteria, eligible participants provided their data and signed the informed consent form [19,20]. Institutional ethics committee approval was not required for this study, this research involved secondary use of clinical data which were provided without any identifier or group of identifiers which would allow attribution of private information to an individual. The Sapienza University Ethics Committee approved the research conducted to collect the data (Protocol Number EQL2-15-01, Approval No. 3997).

The GSDS [5] is a self-assessment scale which evaluates how often in the previous week sleep-related disturbances occurred. The total score ranges from 0 to 147, higher scores indicating a higher frequency of sleep disturbances. In a previous study among the healthy Italian population, the optimal cut-off point, i.e., distinguishing good from bad sleep [21,22], for the GSDS was 38.5. In this study the Italian version of the scale was used – GSDS-IT. The Barthel Index [23] is a tool widely used in hospitals to measure independence in activities of daily living (ADLs). The total score ranges from 0 to 100 [24].

The GSDS-IT was administered face-to-face by three rehabilitation experts (two occupational therapists and one physiotherapist) at three time points: at admission to the intensive rehabilitation unit (t0) to detect

the presence of any sleep disturbances during the week prior to admission; seven days after admission (t1) to detect the presence of any sleep disturbances arising during the first week of admission, or to detect the worsening or persistence of disorders already present before admission; and 25 days from admission (t2) to detect an increase, decrease, or persistence of such disorders. Concurrently with the GSDS-IT [22], participants were given the Italian version of the Barthel Index (IcaBI) [24] to evaluate the functional recovery. Demographic and diagnostic information were also collected from participants. The presence or absence of sleep disturbances at admission (t0) was assessed using the GSDS-IT cut-off score calculated during the validation of the scale among the healthy Italian population [22].

Statistical analysis

All statistical analyses were performed using IBM-SPSS version 23.00. In order to assess changes in sleep quality during hospitalization, the average of the scores obtained by the GSDS-IT at time t0 was compared with the mean obtained by the same subjects at t1 and t2, separately, through a paired samples t-test. Differences in the functional independence level between participants showing or not showing sleep disorders, according to the GSDS-IT cut-off score, were assessed. For this purpose, the mean scores of the IcaBI [25] of the two groups were compared by independent samples t-tests. Since it was not possible to record data at time t2 for some participants, all statistical analyses at time t2 were

performed only on the sub-group of subjects for which data could be recorded. The significance level was set for $p \leq 0.05$.

Results

Initially, 184 patients from two intensive rehabilitation units in Rome were recruited. Of these individuals, 138 signed the informed consent form and were therefore included in the study. Table 1 reports the demographic characteristics of 138 participants evaluated at t0.

Figure 1 shows participants' recruitment and inclusion in the study.

An independent t-test showed no statistical differences between participants with or without sleep disturbances as detected according to the GSDS cut-off points.

138 participants were evaluated with the GSDS-IT [21] upon admission (t0), 64 of whom (46.38%) tested positive for sleep disturbances according to the cut-off score obtained during the validation of the scale among the healthy Italian population [21]. One week after admission (t1), 108 participants tested positive for sleep disturbances (78.26%, +31.88% with respect to t0). After 25 days from admission (t2), the number of participants for whom it was possible to record data decreased from 138 to 77. Of these, 63 (81.81%, +3.55% compared to t1) showed signs of sleep disturbances according to the GSDS cut-off points. A comparison

Tab. 1. Demographic characteristics of the 138 participants at admission to the intensive rehabilitation unit

	All sample N = 138	Without sleep disturbance* N = 74	With sleep disturbance* N = 64	p
Mean age \pm SD	70.4 \pm 12.41	70.1 \pm 14.12	70.7 \pm 10.18	0.80
Females number (%)	47 (34.1)	46 (62.2)	46 (71.9)	0.93
Occupation number (%)				
Employee	26 (18.8)	16 (21.6)	10 (15.6)	
Private job	12 (8.7)	6 (8.1)	6 (9.4)	
Retired	100 (72.5)	52 (70.3)	48 (75)	
Family number (%)				
Married	76 (55.1)	35 (47.3)	41 (64.1)	
Single	33 (23.9)	23 (31.1)	10 (15.6)	
Widow	29 (21)	16 (21.6)	13 (20.3)	
Barthel Index mean \pm SD	40.2 \pm 5.9	40.19 \pm 5.8	40.22 \pm 6	0.97

* according to GSDS cut-off points 38.5.

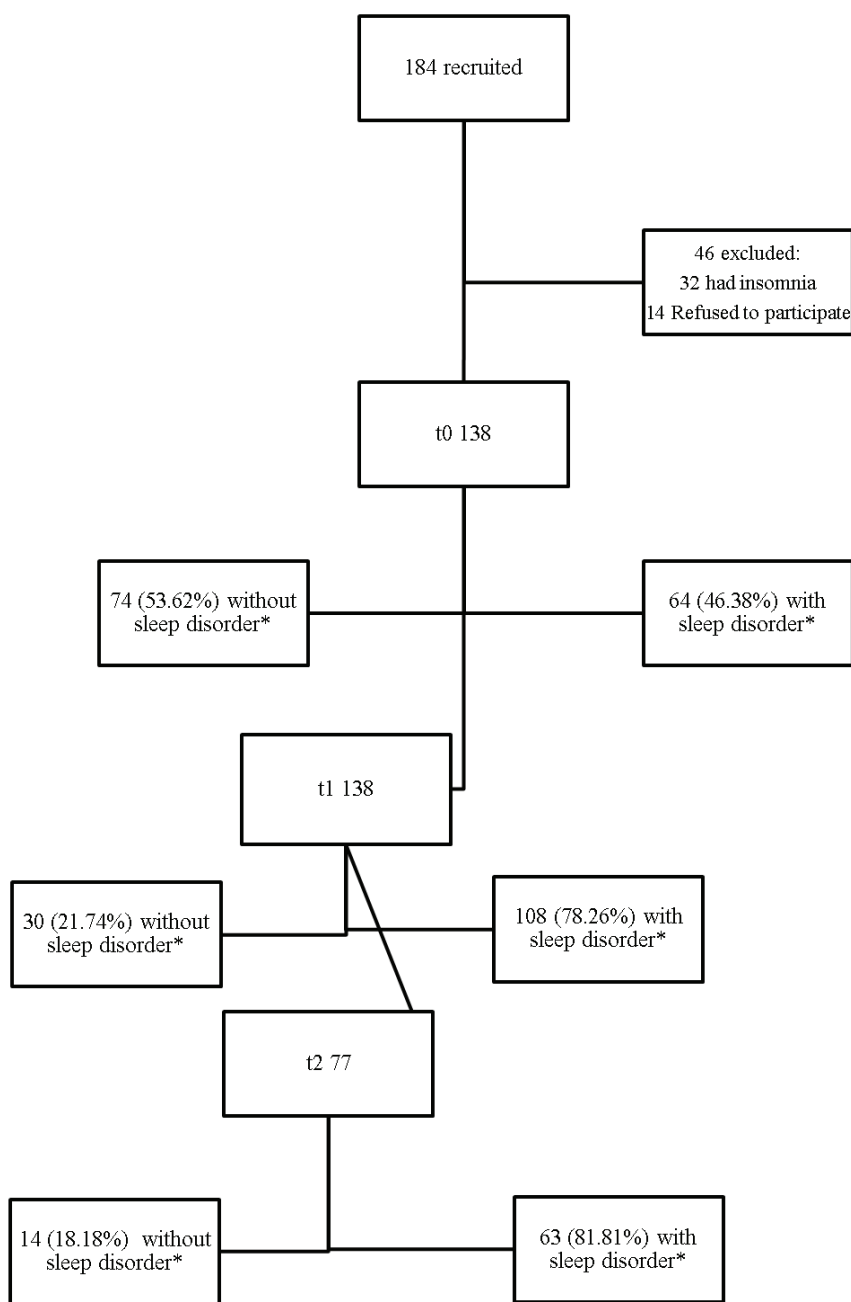


Fig. 1. Flowchart of recruitment and inclusion of participants

between the averages of scores on the GSDD-IT showed a statistically significant increase in the total score as well as in the scores of all sub-scales except the fifth between times t0 and t2, as reported in Table 2. However, a comparison between the averages of the scores on the GSDD-IT recorded at t1 and t2 showed a decrease in the score, thus indicating an improvement in sleep quality from t1 to t2, as reported in Table 2.

A comparison of the IcaBI scores between time t0 and t1 showed a statistically significant improvement in the functional independence of the 138 participants one

week after admission, despite the occurrence of sleep disturbances, as reported in Table 3.

At t1, a comparison of the IcaBI scores between those with ($n = 108$) and without ($n = 30$) sleep disturbances did not show a statistically significant difference between the two groups, although there was a worsening in sleep quality and duration, as reported in Table 2. The same comparison was repeated at t2; again, no statistically significant difference was found in the functional independence level between participants with and without sleep disturbances, as shown in Table 4.

Tab. 2. Comparison between the averages of scores on the GSDS-IT in the total score as well as in the scores of all sub-scales between times t0 and t2

GSDS	All sample (77) T0 mean ± SD	All sample (77) T1 mean ± SD	All sample (77) T2	p t0-t2
Initial insomnia	1.78 ± 2.75	3.83 ± 3.24	3.65 ± 3.26	<0.001
Maintenance insomnia	3.06 ± 2.51	4.65 ± 2.22	5.13 ± 2.14	<0.001
Quality of sleep	0.46 ± 1.76	2.05 ± 2.07	1.81 ± 2.06	<0.001
Quantity of sleep	1.12 ± 1.54	1.97 ± 1.70	1.82 ± 1.69	<0.01
Daytime functionality	2.50 ± 1.02	2.75 ± 1.35	2.62 ± 1.17	0.488
Use of substances that help induce sleep	0.30 ± 0.60	0.87 ± 0.80	0.73 ± 0.76	<0.001
Total	39.07 ± 12.09	53.48 ± 15.71	49.86 ± 13.30	<0.001

Tab. 3. Difference of Barthel index score between t0 (admission to the intensive rehabilitation unit) and t1 (7 days after admission) assessed through t-test for paired samples. Differences at t2 between subsamples of people with or without sleep disturbance assessed through t-test for independent samples

	All sample (138) T0 mean ± SD	All sample (138) T1 mean ± SD	P	Without sleep disturbance* (28) T1 mean ± SD	With sleep disturbance* T1 (110) mean ± SD	p
Feeding	9.43 ± 1.55	9.78 ± 0.85	<0.01	10 ± 0	9.72 ± 0.95	0.12
Bathing	0.82 ± 1.09	3.57 ± 1.59	<0.001	3.82 ± 1.63	3.50 ± 1.58	0.34
Grooming	1.55 ± 1.08	4.68 ± 1.01	<0.001	4.64 ± 1.10	4.69 ± 0.99	0.82
Dressing	3.38 ± 1.76	7.62 ± 2.57	<0.001	7.54 ± 2.50	7.65 ± 2.59	0.84
Bowel	9.53 ± 1.25	9.64 ± 1.41	0.52	9.50 ± 1.93	9.67 ± 1.25	0.56
Bladder	8.61 ± 2.58	9.33 ± 1.95	<0.01	8.86 ± 3.15	9.45 ± 1.50	0.15
Toilet use	1.98 ± 1.90	8 ± 3.56	<0.001	7.86 ± 3.55	8.04 ± 3.58	0.81
Transfer	3.25 ± 1.78	12.38 ± 4.50	<0.001	12.57 ± 4.11	12.33 ± 4.60	0.80
Mobility	0.60 ± 1.34	9.36 ± 6.39	<0.001	8.46 ± 6.83	9.59 ± 6.28	0.41
Stairs	0.04 ± 0.30	1.51 ± 3.19	<0.001	0.71 ± 1.96	1.71 ± 3.41	0.14
Wheelchair use	1.14 ± 1.47	0.80 ± 1.80	0.10	0.89 ± 1.95	0.77 ± 1.77	0.75
Total	40.31 ± 5.88	76.66 ± 19.15	<0.001	74.86 ± 18.17	77.12 ± 19.45	0.58

* sleep disturbance determined according to GSDS cut off points.

Discussion

The aim of this observational study, using interrupted time series, was to evaluate the presence and development of sleep disturbances in a population of individuals hospitalized in intensive rehabilitation units and to investigate relationship with functional independence. The GSDS-IT and the modified IcaBI have been administered at admission, seven days, and 25 days.

Among the study participants who were hospitalized without insomnia according to the DSM-V diagnostic

criteria, [17] that forty-six % of patients had sleep disturbances symptoms (scores above 38.5 on the GSDS) in the week prior to admission, and 82% of the population had developed these symptoms by 25 days. The IcaBI significantly improved during admission, but there was no difference in scores when those with/without ‘insomnia’ symptoms were compared. Thus, the development of sleep disturbances did not seem to significantly affect improvement to functional independence as measured by the IcaBI. This result is understandable given that during the first week of admission, all

Tab. 4. Difference of Barthel index score between t0 (admission to the intensive rehabilitation unit) and t2 (25 days after admission) assessed through t-test for paired samples. Differences at t2 between subsamples of people with or without sleep disturbance assessed through t-test for independent samples

	All sample (77) T0 mean \pm SD	All sample (77) T2	P	Without sleep disturbance* (14) T2	With sleep disturbance* (63) T2	P
Feeding	9.65 \pm 0.89	10 \pm 0	<0.001	10 \pm 0	10 \pm 0	
Bathing	0.78 \pm 1.20	4.35 \pm 1.13	<0.001	4.56 \pm 0.16	4.30 \pm 0.16	0.404
Grooming	1.47 \pm 1.10	4.88 \pm 0.56	<0.001	4.88 \pm 0.13	4.89 \pm 0.07	0.949
Dressing	3.16 \pm 1.69	8.82 \pm 2.00	<0.001	9.44 \pm 0.34	8.66 \pm 0.27	0.167
Bowel	9.60 \pm 1.21	9.95 \pm 0.32	<0.01	10 \pm 0	9.93 \pm 0.05	0.470
Bladder	8.81 \pm 2.36	9.74 \pm 1.04	<0.001	10 \pm 0	9.67	0.266
Toilet use	1.84 \pm 2.01	9.49 \pm 1.92	<0.001	9.38 \pm 0.63	9.52	0.784
Transfer	3.12 \pm 1.70	14.36 \pm 2.50	<0.001	14.25 \pm 0.75	14.39	0.838
Mobility	0.35 \pm 0.97	13.47 \pm 3.93	<0.001	13.63 \pm 0.85	13.43	0.858
Stairs	0.04 \pm 0.34	4.97 \pm 4.30	<0.001	4.38 \pm 1.04	5.13	0.535
Wheelchair use	1.12 \pm 1.36	2.70 \pm 2.49	<0.001	1.56 \pm 0.60	2.95	0.046
Total	39.87 \pm 5.81	92.70 \pm 13.50	<0.001	92.06 \pm 3.14	92.87	0.833

* sleep disturbance determined according to GSDD cut off points.

participants performed rehabilitative treatments aimed at improving their physical and functional performance. The improvement in functional independence one week after admission was comparable between individuals who did not experience sleep disturbances upon hospitalization and those who did. This may be due to the reduced time frame in which these disorders arose, which may not have been enough to interfere with the functional plan. Twenty-five days after admission, most of the participants were still experiencing sleep disturbances associated with hospitalization. However, the functional independence of the participants continued to improve regardless of the presence or absence of sleep disturbances. Although slightly higher improvement was observed among those participants not experiencing a sleep disturbance, the difference was not statistically significant.

However, accordingly to the above results also Hoch et al. [27] could not demonstrate that sleepiness had an impact on functional status, when younger and older healthy subjects were compared. Of note, in that small study self-reported sleepiness was rather mild. In contrast to this, some researches has investigated sleep disturbance/deprivation and the impact on cognition and/or function on elderly population [12]. Stenholm et al. [28] demonstrated that excessive tiredness influenced measured and self-reported mobility outcomes in participants. Gooneratne et al. [29] found that in elderly subjects (>65 years) functional status was significantly impaired in subjects with daytime sleepiness. Even

though sleep deprivation showed adverse effects of on recovery from illness, sleep deprivation among participants remains an incompletely addressed problem [27–29]. Due to the side effects of sedative hypnotics, in previous studies behavioral interventions are recommended as a first-line therapy prior to using pharmacologic therapy [13,30–32]. Environmental modifications including designated quiet time and ear plugs/eye masks, are one of the most recommended intervention, as well as relaxation techniques, improved sleep hygiene or reduced sleep interruption programs, and daytime bright light therapy [14,30–32].

Limitation of the study

Although the IcaBI scale was chosen because it is commonly used to assess participants' level of independence in intensive rehabilitation units in Italy, its results may be too generic for examining associations in functional improvement between people with or without sleep disturbances. Future studies could use more specific scales, such as Berg Balance Score (BBS), or physical activity scale for the elderly (PASE), to obtain more detailed information about the impact of sleep disturbances on rehabilitation outcomes. Moreover, the proportion of patient who did not have difficulties with sleep was so small that it would be difficult to determine if sleep had an impact or not on IcaBI. The percentage of people with sleep disorder was 80% by one week after admission. It is important to be clear in saying that this was a dichotomy around a cut-off point on a scale

i.e. they could be one point over the cut off or 10 points over. Therefore, severity of sleep disorder is not a variable authors looked at. Another limitation is that further information about the study population such as known factors that are related to poor sleep, including pain/depression/anxiety as well as change of environment/bed 'first night effect' (for first week), pain, mental health, medical conditions, medications, side rooms/bays were not collected.

Conclusions

There is a need to highlight the need for rehabilitation treatments focused on sleep disturbances in combination with the pharmacological treatments already in use in the hospital. This study demonstrated that the duration and quality of sleep among participants in intensive rehabilitation units were both significantly affected, raising awareness about the importance of adequate sleep among vulnerable hospital populations and introducing interventions to target sleep-disturbing factors may therefore improve healing [8]. This study represent a starting point in highlighting the development of sleep disturbances during hospitalization in intensive rehabilitation units. Future studies should deepen this analysis finding the exact cause to thereby guide treatment(s).

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Conflict of interests

The authors have no conflict of interest to declare.

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