Time to wake-up: Sleep problems and daytime sleepiness in long-term stroke survivors

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Abstract

Background and Purpose: In our work with chronic stroke patients we observed that patients frequently appear sleepy and often comment on their poor sleep. Sleep difficulties are frequently reported, and indeed clinically recognised in the acute phase post stroke but little is known about the sleep and daytime sleepiness of chronic stroke patients with sustained disabilities. The latter, however, deserves clarification because sleep is a critical modulator of health, daytime performance and wellbeing. The present study therefore explored the sleep and sleepiness in a chronic stroke population with sustained physical deficits.

Methods: An opportunity sample of 20 patients with chronic low-functioning hemiplegia (>12 months) completed the Epworth Sleepiness Scale, Pittsburgh Sleep Quality Index, Medical Outcome Study Short Form 36 and Hospital Anxiety and Depression Scale.

Results: Compared to a normative healthy population, long-term stroke survivors reported poorer sleep and greater daytime sleepiness. Increased levels of sleepiness were associated with longer chronicity, whereas nocturnal sleep parameters were not.

Conclusions: In line with our clinical observations, stroke survivors with sustained physical disabilities report poorer sleep and experience greater levels of sleepiness. Further research in a larger cohort and including objective sleep measures is necessary to investigate the nature and scale of sleep difficulties and daytime sleepiness in more detail so that care and treatment strategies can be developed in due course.

Background:

Stroke remains the most common cause of chronic disability [1] and leaves 71% of survivors with permanent vocational incapacity [2]. Current rehabilitation protocols primarily focus on the physical consequences of stroke, whilst issues which influence the individuals' quality of life receive much less attention [3]. This is particularly true for sleep. Even though problematic sleep is associated with poorer health related quality of life, psychological wellbeing and performance in chronic illness [4], this issue is largely ignored in the rehabilitation setting.

Through our work with chronic stroke patients in the neurological rehabilitation setting, we noticed that our clients were often sleepy during the day and commented on poor sleep at night. In the context of a large body of literature suggesting a pivotal role of sleep and daytime sleepiness for good health and everyday safety, we felt that that our informal observations warranted a more systematic investigation. A literature review indicated that sleep disturbances and excessive daytime sleepiness are common co-morbidities of acute stroke [5-9], and that some sleep disorders (primarily obstructive sleep apnea) constitute a risk factor for stroke. It also revealed that it is unclear to what extent the sleep problems reported in the early phase after a stroke are transient. Some authors suggest that post-stroke sleep disturbances actually persist and become a chronic condition [10-13], but the evidence-base for this claim is poor and the prognosis beyond one-year post injury is not well understood. This is partly due to the use of heterogeneous study groups comprised of patients in various stages of recovery and with various levels of functional ability. The present study therefore aimed to assess subjective measures of sleep and daytime sleepiness in a homogenous group of participants who are in a chronic state with regards to their physical and psychological adjustment (minimum 12 months post stroke), and who all sustained a chronic motor deficit. Drawing on a convenience sample of 20 younger stroke

participants with low-functioning hemiplegia, subjective sleep and sleepiness data, as well as psychometric information was acquired and compared to published norms.

Methods

Thirteen males and seven females (aged 23-69 years, mean: 52, SD 13 years) with low-functioning chronic upper limb hemiparesis (9 left, 11 right hemispheric lesions) following first-time stroke participated in the study. Chronicity ranged between 12 and 180 months (mean: 51, SD 10 months). Daily caffeine intake was 2.90 (0-8, SD 2.40) cups per day and weekly alcohol was 8.48 (0-42, SD 10.63) units per week. One patient appeared to exhibit excessive alcohol consumption. Participants were an opportunity sample derived from a cohort of patients attending a motor rehabilitation trial at the University of Surrey. The latter were recruited via posters in local GP practices, self-help, and local newspaper advertisements. Exclusion criteria comprised higher-functioning recovery [14], Mini-Mental State Score [15] > 24 (group average 28.2), major secondary medical conditions and known mental health problems. These procedures formed a homogenous group. The study was approved by the University of Surrey Research Ethics Committee and the Surrey Research Ethics Committee (NHS).

Daytime sleepiness was assessed with the *Epworth Sleepiness Scale* (ESS). The ESS is a valid and reliable measure of daytime sleepiness [16-18] and has been successfully used with traumatic brain injury and stroke patients [9,10,13,19,20]. It measures daytime sleepiness using eight items on a four-point-likert- scale ranging between 0-6 for low sleepiness, 7-9 for average sleepiness and 10-24 for severe sleepiness.

Sleep was assessed with The *Pittsburgh Sleep Quality Index* (PSQI [21]) which determines subjective sleep quality and has shown high validity and reliability in a

number of studies [22,23]. Importantly, it is particularly useful in distinguishing those with and without sleep disturbance in brain-injured cohorts [9,19,24]. The PSQI contains 19 items weighted on a 0-3 scale, from which seven components (Subjective Sleep Quality (1 item), Sleep Latency (2 items), Sleep Duration (1 item), Habitual Sleep Efficiency (3 items), Sleep Disturbance (9 items), Use of Sleep Medication (1 item), and Daytime Dysfunction (2 items)) are generated and summed to give a Global Pittsburgh Sleep Quality Index (GPSQI) score between 0 and 21. Scores ≤ 5 indicate poorer overall sleep quality.

Quality of life and psychological adjustment were assessed through the *Medical Outcome Study Short Form 36* [25], and the *Hospital Anxiety and Depression Scale* (HADS [26]) respectively. The SF-36 was used to assess physical and psychological health and is known to be a valid measure in stroke patients [27]. It contains 36 items on a five-point likert scale and assesses eight dimensions of physical (physical functioning, physical role limitations, bodily pain, vitality, and general health) and psychological health (social functioning, emotional role limitations and mental health). Scores range between 0-50 for below average and 51-100 for above average. The HADS is a 14-item self-report questionnaire, developed to indicate possible cases of anxiety and depression. This questionnaire has been successfully used in many clinical populations, including stroke [28]. It assesses possible cases of clinical anxiety (seven items) and depression (seven items) on four-point likert scales ranging from 0-21. Scores ≥ 11 indicate a clinically significant condition.

Significant associations between variables were established through simple regressions. Effect size statistics were calculated to determine significant differences between our cohort and published normative data. Where reported, group averages refer to the mean, ± 1 standard deviation and range.

Results

Interestingly half of the patients reported a major change in their sleeping habits since experiencing a stroke. These changes included sleeping longer during the night and feeling more sleepy during the day.

The average ESS score was 7.95 (SD 4.07, 0-16), with seven out of twenty (40%) participants reporting severe daytime sleepiness. A mean GPSQI score of 5.60 (SD 2.72, 2-11) further reflected lower sleep quality in general, with nine out of 20 participants (45%) reporting potential sleep difficulties, based on the cut-off criterion of 5. Compared to normative data [17,21], nocturnal sleep behaviour in our cohort was significantly poorer (GPSQI; cohen's $d=1.52$) and daytime sleepiness was significantly higher (ESS; cohen's $d=0.76$).

Further analysis of the PSQI revealed a sleep-onset latency of 23.40 minutes (SD 22.25, 2-100) with nine out of 20 (45%) participants reporting a sleep-onset latency of ≥ 30 minutes. Sleep duration was in the normal range (475.50, SD 89.35, 300-690 minutes). Sleep efficiency was generally good (85.89, SD 11.82, 60-100 %), however, eight out of 20 (40%) participants exhibited poor sleep efficiency ($< 85\%$). The raw score for sleep disturbance across the group was 11.05 (SD 5.46, 4-24), which greatly contributes to the overall GPSQI.

Overall health, as indicated by the SF-36, was within normal range (58.24, SD 11.99, 32.29-74.51). The 'physical functioning' and 'physical role limitation' components were below average with a mean score of 40.59 (SD 18.88, 12.50-75) and 37.04 (± 22.00 , 0-84.38) respectively. The low scoring on the physical role dimension is unsurprising given that all participants were severely handicapped by their physical disability.

The mean scores for depression and anxiety were 6.79 (SD 5.25, 1-21) and 4.52, (SD 2.40, 1-9.50) respectively. According to the HADS scoring criteria, five out of 20

participants (25%) were classified as having possible depression symptoms, despite the employed exclusion criteria, but none reached clinical significance for anxiety.

Table 1 presents individual patient scores.

--- insert Table 1 about here ---

Demographical factors including age, caffeine and alcohol intake were not associated with nocturnal sleep parameters or sleepiness. However a significant association was revealed between sleepiness and chronicity ($r = 0.49$, $p < 0.05$) indicating that the longer ago the stroke had occurred the greater the daytime sleepiness patients' report. At the same time, age and daytime sleepiness were uncorrelated ($r=0.08$, $p < 0.76$). Interestingly, scores on the ESS did not correlate with any nocturnal sleep measure or the GPSQI score (Figure 1). This suggests that the presence of daytime sleepiness may exist independently of nocturnal sleep disturbances.

--- insert Figure 1 about here ---

With regards to psychological parameters we found that neither sleepiness nor chronicity was associated with depression or anxiety. The correlation analysis of the SF-36 revealed no association with sleepiness, except for 'vitality', which was negatively associated with increased sleepiness ($r=-0.54$, $p<0.01$). Physical role limitations ($r=0.35$, $p<0.05$) and bodily pain ($r = 0.66$, $p<0.001$) were associated with lower sleep quality. Bodily pain correlated with chronicity ($r = 0.46$, $p<0.05$), anxiety ($r=0.57$, $p<0.01$) and longer sleep duration ($r = 0.46$, $p < 0.001$). Increased sleep duration was further associated with increasing anxiety ($r = 0.42$, $p<0.05$).

Discussion

The present study aimed to explore sleep and sleepiness in a group of long-term stroke survivors with equitable levels of recovery. We found that nocturnal sleep quality was generally poorer and daytime sleepiness was higher in patients with a first-time stroke between one and 15 years ago. This supports the assumption that sleep problems, frequently observed in the acute phase post stroke, may indeed evolve into a chronic problem in some individuals [10,12,13]. These results should be interpreted with caution due to the preliminary nature of the study. However, the reported data highlights the importance of sleep behaviour in chronic stroke, and the necessity to consider sleep and daytime sleepiness when assessing treatment and support needs in this population. Poor sleep and high levels of sleepiness have not only adverse effects on health but also on performance and learning. The recognition of problems with sleep and daytime sleepiness is therefore critical, not in the least because the appropriate management of sleep/sleepiness problems is likely to enhance everyday performance, personal well-being and safety.

One obvious explanation for the present findings is that sleep and sleepiness are related to psychological and/or emotional adjustment, which may well be poorer in persons living with a disability for many years. However, we found that sleepiness and poor sleep were unrelated to depression, anxiety, and general psychological health. This therefore suggests that, at least in our cohort, poor psychological adjustment or emotional health is an unlikely explanation for the present findings. Increased levels of daytime sleepiness are typically observed after sleep deprivation. One would therefore predict that changes in the level of daytime sleepiness are actually mirrored by changes in nocturnal sleep. The data of the present study however, indicates a dissociation of daytime sleepiness and nocturnal sleep as the level of daytime sleepiness was associated with chronicity, while the level of nocturnal sleep problems was not. In addition, we found that sleep was primarily

aligned to physical manifestations on the SF-36 (i.e. changes in physical role functioning, pain), while daytime sleepiness was associated with vitality, which is a dimension of psychological health, however contains 2 items which also measure sleepiness. It therefore appears that the relationship of daytime sleepiness and nocturnal sleep problems in chronic stroke is complex. As to the underlying mechanisms, we can only speculate. It may be that the primary and/or secondary effects of the lesion on local and/or global neural processing differentially affects the mechanisms of sleep and daytime sleepiness. Unreliable reporting, a general problem when subjective measures are used, but further be a contributing factor, since recent studies in patients with traumatic brain injury suggest that reporting problems are aggravated in these individuals [29]. Clearly, more research combining a detailed clinical sleep interview with objective data, such as actigraphy and EEG, is necessary to determine a better understanding of sleep and sleepiness perception and reporting in persons with stroke.

The findings of the present study on sleepiness and sleep are preliminary, and can only be considered as suggestive evidence. In the light of the emerging literature on sleep and learning, however, the data are nevertheless important. When we are sleepy, learning and performance is attenuated, while a good night's sleep is conducive to memory consolidation. Initial evidence further suggests that sleep enhances motor learning post stroke [30]. Many stroke patients seek and receive rehabilitation in their chronic state and poor sleep and sleepiness may well interfere with the treatment process. At present, our approach to rehabilitation exclusively focuses on daytime behaviour and basically leaves sleep out of the equation. Recognising the important role of sleep in the care, support and treatment of chronic stroke patients is therefore the first step to what we believe to be a pending paradigm shift towards a 24-hours approach in neurological rehabilitation.

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Figure Legends

Table 1: PSQI Global Score, ESS Total Score, HADS Anxiety and Depression Score, and SF-36 Overall Health Score are presented per patient case. HADS and SF-36 data was unavailable for case 1.

Figure 1: Bivariate regression plot for ESS/GPSQI versus chronicity. A positive association is found for ESS. GPSQI and chronicity are uncorrelated.