Objective and subjective measures for sleep disorders

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Abstract: Subjective and objective measures of sleep structure or quality could help to characterize the chronic sleep disturbances, with relation to patients' risk factor profiles and co-morbidities. Studies have shown that discrepancies can occur between subjective data regarding sleep disturbances and the impact of insomnia and objective assays, and surrogate markers of sleep and sleep disturbances. Both objective and subjective measures should be incorporated into clinic studies. It seems likely that sleep quality is represented by a combination of more than one subjective sleep parameter. Objective and subjective assessments of sleep quality may relate to different parameters. Future studies incorporated both subjective and objective measures could help to address the sleep disorders.

Keywords: objective measures; subjective measures; sleep disorders

Both subjective and objective measures of sleep structure or quality related to patients' risk factor profiles and co-morbidities are helpful to characterize chronic sleep disturbances. This review summarized the various risks associated with sleep impairment.

1 Subjective measures of sleep

Most sleep laboratories and clinics use general sleep questionnaire to aid diagnosis and monitor therapy. These questionnaires provide the subjective information on sleep features such as time of awakening, number of night-time awakenings, and drug intake, as well as the qualitative information on sleep quality, depth of sleep, and difficulty awakening. Some of them also incorporate the measures of severity and frequency of sleep disturbances^[1].

Keklund and Akerstedt^[2] studied the composite factors from total Karolinska Sleep Diary items, by which they labeled the sleep quality index (SQI). Maintaining sleep or sleep continuity includes many details: ease of falling asleep, sleep quality, calm sleep, and sleeping throughout the night. The SQI has the correlating relationships with slow wave

sleep (SWS), sleep efficiency, and total sleep time (TST). Good sleep measured by SQI relates to both continuity (sleep efficiency) and depth (SWS) measured by EEG. There are more than one matter about subjective parameters in measuring sleep quality, it may arise out of a combination of objective parameters.

The use of instruments from other disciplines and general psychiatry in sleep research has provided insights into insomnia consequences and co-morbidities. For instance, the structured clinical interview for DSM-IV and DSM-III-R (SCID) is useful in evaluations of common insomnia co-morbidities such as depression^[4,5]. It has also been used to detect subjects at risk of developing chronic post-traumatic stress disorder on the basis of sleep complaints after trauma^[6].

Several studies have demonstrated the sensitivity of the Short-Form 36-item inventory (SF-36) in evaluating the impact of insomnia, either alone or in combination with psychiatric co-morbidities, on quality of life^[1,7]. A clear relationship between insomnia severity and emotional state and overall quality of life has been shown in some studies incorporating SF-36 evaluations^[8,9].

The Epworth Sleepiness Scale (ESS) is useful in measuring the frequency of daytime sleepiness, and has been used in numerous studies^[10]. ESS evaluations have demonstrated significant associations between daytime sleepiness and insomnia^[11], and have allowed quantitative analysis of the effects of pharmacologic and non-pharmacologic

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therapies on daytime sleepiness in poor sleepers^[12].

Sleep logs provide information on daily night-time sleep habits over short time periods (1-2 weeks), and have been useful in identifying circadian rhythm disorders and poor sleep hygiene^[13].

Actigraphy, where levels of physical activity are used to measure sleep and wake times, is a common surrogate marker for sleep used in epidemiologic studies over long periods^[14]. In clinical practice, actigraphy is not indicated for the routine diagnosis, assessment, or management of sleep disorders^[15]. However, it can serve as a useful objective adjunct to routine evaluations of insomnia, circadian-rhythm disorders, and of specific aspects of sleep problems related to restless legs syndrome (RLS) or periodic limb movement disorder (PLMD).

2 Objective measures of sleep

Objective assessment of sleep may be provided by EEG study of sleep (polysomnography, PSG), an established method of studying sleep architecture. It is generally well accepted by patients in either sleep laboratories or at the individual's home.

Preliminary data indicate that the daytime sleepiness in primary insomnia may be related to reduced thalamic and cortical neuronal activity during waking^[16]. Importantly, similar neuroimaging changes in depression have been seen to be partially normalized by pharmacologic interventions^[17], and further studies are needed to visualize the effects of pharmacologic interventions in insomnia. Sleep laboratory studies using PSG have provided some useful epidemiologic findings (e.g. relating to sleep apnea and excessive daytime sleepiness) in population-based patient samples containing subgroups enriched EEG, electro-oculographic (EOG) and EMG activity during sleep. It is the current gold standard for assessments of sleep structure in research studies, and has enabled objective validation of the effects of both pharmacological and non-pharmacological treatments for insomnia^[18]. PSG evaluations have been useful in determining sleep variables predictive of the self-administration of sleep medications. Quantitative PSG procedures have now been standardized to ensure consistent application and interpretation of clinical findings^[19]. Although it is not currently recommended for routine screening or diagnosis of insomnia in clinical practice^[20], PSG does have utility in clinical practice when a sleep-related breathing disorder or PLMD is suspected, or where an initial diagno-

sis is uncertain in severe cases, and it may be particularly useful in patients with treatment-resistant insomnia^[15]. Standard macrostructural features of sleep such as sleep onset latency (SOL), TST, as well as features of sleep microstructure including arousals and, in particular, cyclic alternating patterns (CAP) can be derived from PSG evaluations^[21]. Computerized analyses of CAP have demonstrated that the CAP rate, a measure of the effort of the brain to maintain sleep, correlates with the subjective appreciation of sleep quality. An increased CAP rate with autonomic activation is potentially correlated with non-restorative sleep^[22]. CAP is also considered a potential objective marker for hypnotic action during sleep pharmacotherapy^[23].

Studies assessing a wide range of physiological aspects in primary insomnia have measured changes in autonomic indices (e.g. heart-rate variability, temperature and metabolic rate)^[24], neuroendocrine function (altered plasma melatonin levels and increased plasma cortisol, indicating activation of the hypothalamic–pituitary–adrenal axis)^[25], and immune function (cellular and humoral immune components)^[26]. Recent functional neuroimaging evidence of increased whole-brain metabolic activity and changes in neuronal function of brain arousal systems has also been observed in primary insomnia patients^[16]. Some of these changes may also be linked with altered psychological aspects (e.g. depressive tendencies and mood states)^[17]. PSG data have also identified features of brain function in insomniacs that indicate cortical hyperarousal during sleep^[27].

Functional neuroimaging findings can also provide objective information on changes in brain activity in relevant brain areas across the sleep–wake cycle, and may contribute valuable data on pathophysiological interactions between insomnia and psychiatric or neurological conditions^[28]. Significant changes in activity have been observed in large-scale neuronal networks in the brain during normal sleep, and fundamental alterations in the function of these neural systems occur in patients with sleep disorders^[17].

3 Comparison between objective and subjective sleep measures

Both subjective and objective measurements play important roles in estimating sleep disturbance, such as monitoring of course of the illness and treatment effects, prediction of prognosis, and identification of relapse^[29]. The two measurements often overlap in diagnosis, but how they

relate to each other is not well established. For example, the relation of SWS to the experience of deep restorative sleep has been challenged^[30].

Although useful in the clinic, these measures have limited use in research because there are very sparse data validating these subjective outcomes against objective measures such as PSG^[31]. There is a high degree of variability and uncertainty in subjective patient evaluations of sleep. Comparative studies have shown significant discrepancies between subjective data regarding the primary symptoms of insomnia reported by patients and objective measures of sleep pathology^[32]. However, some measures of sleep continuity, such as TST and SOL, correlate well in patients between subjective and objective assessments, indicating their direct relationship. The estimation for sleep quality seems different and more complicated. Sleep quality may be estimated by a combination of subjective parameters of initiation and maintenance of sleep, which is probably derived from a combination of SWS and sleep continuity, the objective parameters. The subjective and objective measures appears co-vary with the treatment, resulting in a constant relationship between them^[43].

In particular, extreme deviations can occur between objective and subjective measures in patients with sleep-state misperception, and the frequent co-morbidity of insomnia with other disorders, both within and outside the field of sleep medicine can complicate differential diagnosis. Patients often self-report fatigue, mood disturbance (e.g. depression, irritability), cognitive impairments (e.g. difficulty concentrating, reduced attention and alertness), decreased ability to complete daily tasks, decreased enjoyment of interpersonal relationships, and overall reductions in quality of life^[33]. Most of these elements show an increasing degree of impairment with a greater frequency and severity of sleep disturbances^[34]. In contrast, objective assessments of daytime function (e.g. the multiple sleep latency test, MSLT) in patients with chronic insomnia typically indicate a relative lack of daytime impairment, with no elevation in daytime sleepiness and cognitive or psychomotor abilities remaining relatively intact^[35]. However, Day *et al*^[36] found that subjective sleepiness can predict systematic differences in the PSG characteristics in insomnia patients, and MSLT evaluations have proved very useful in assessing a broad range of patients with excessive daytime sleepiness^[33]. Both objective and subjective measures should therefore be incorporated into clinic studies.

The effective management of chronic insomnia is an important challenge in primary care. Clinical work-up should include a comprehensive medical and sleep history and physical examination, as well as assessment of the presence of any significant medical or psychiatric co-morbidity, and the possible use of substances that may contribute to sleeplessness^[37]. Treatment is warranted in the majority of primary care cases, and can include pharmacological and non-pharmacological treatment^[38]. Both types of therapy have been shown to improve sleep outcomes^[39].

High proportions of people who experience transient insomnia self-medicate for short periods of time (<1 week) with over-the-counter remedies or alcohol^[40]. More persistent insomnia is generally treated with prescription medications, although continuous prescribed treatment is limited to a maximum of 4 weeks at a time^[38]. Both patients and physicians perceive a risk of psychological dependence associated with the long-term use of hypnotic therapies^[41]. However, the risk of dependence with currently available hypnotics is generally overestimated. A substantial proportion of patients use prescribed medication for longer periods^[38]. PSG evaluations have been useful in determining sleep variables predictive of the self-administration of sleep medications^[42]. Evaluations of patient self-administration indicate that patterns of hypnotic use reflect a desire for symptom relief rather than drug craving^[39]. Traditionally, benzodiazepines have been prescribed to treat sleep disturbances, but certain drugs in this class have limited benefits due to residual sedative effects that impair cognitive function, memory and general daytime performance^[38].

Previous studies have shown that discrepancies can occur between subjective data regarding sleep disturbances and the impact of insomnia and objective assays, and surrogate markers of sleep and sleep disturbances^[43]. Future studies incorporating both subjective and objective measures could help to address this. Pathophysiological and epidemiological studies are also needed to characterize the effects of both pharmacologic and non-pharmacologic treatments in insomnia using objective measures such as visual and spectral PSG analyses and functional neuroimaging. Long-term pharmacologic treatment, in particular, the prolonged use of needed treatment regimens should be assessed further. Finally, further data from treatment effectiveness trials and long-term outcome data in the treatment of insomnia are required. These trials need to address is-

sues related to the population or sub-population studied, patterns of treatment use (e.g. continuous *versus* intermittent), timings of medication use relative to drug properties and, of course, global efficacy and overall clinical benefit *versus* safety and tolerability. Similar and comparative outcomes should also be assessed in the evaluation of non-pharmacologic treatments.

4 Summary

The comparisons between subjective and objective sleep measures raise the question: Whether subjective estimation relates to corresponding/non-corresponding objective sleep variables, or whether it is possible to predict specific alterations of sleep structure by the subjective complaints. Estimating insomnia is more complicated in clinical therapy. Objective and subjective assessments of sleep quality, despite the fact that they often carry labels that imply direct relationship or equivalence, may relate to different parameters^[30]. Sleep quality is represented by a combination of more than one sleep parameter.

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睡眠障碍中的主观及客观评价方法

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摘要: 睡眠的主观及客观评价方法均能评估分析睡眠的结构形式和睡眠质量, 在对睡眠障碍患者的诊断和治疗中有重要意义。但是很多研究表明, 两种评价手段对睡眠障碍患者的评估结果并不完全一致, 可能存在偏差, 单凭主观评价或客观评价的个别参数不能确定睡眠质量的好坏, 因此在临床上需根据两种评价方法的特点, 结合使用。本文将对目前临床常用的几种主观评价和客观评价方法进行分析和比较。

关键词: 主观评价; 客观评价; 睡眠障碍