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Original article

Daytime symptoms in primary insomnia: A prospective analysis using ecological momentary assessment ☆

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Abstract

Objectives: To prospectively characterize and compare daytime symptoms in primary insomnia (PI) and good sleeper control (GSC) subjects using ecological momentary assessment; to examine relationships between daytime symptom factors, retrospective psychological and sleep reports, and concurrent sleep diary reports.
Methods: Subjects included 47 PI and 18 GSC. Retrospective self-reports of daytime and sleep symptoms were collected. Daytime symptoms and sleep diary information were then collected for 1 week on hand-held computers. The Daytime Insomnia Symptom Scale (DISS) consisted of 19 visual analog scales completed four times per day. Factors for the DISS were derived using functional principal components analysis. Nonparametric tests were used to contrast DISS, retrospective symptom ratings, and sleep diary results in PI and GSC subjects, and to examine relationships among them.
Results: Four principal components were identified for the DISS: Alert Cognition, Negative Mood, Positive Mood, and Sleepiness/Fatigue. PI scored significantly worse than GSC on all four factors ($p < 0.0003$ for each). Among PI subjects DISS scales and retrospective psychological symptoms were related to each other in plausible ways. DISS factors were also related to self-report measures of sleep, whereas retrospective psychological symptom measures were not.
Conclusions: Daytime symptom factors of alertness, positive and negative mood, and sleepiness/fatigue, collected with ecological momentary assessment, showed impairment in PI versus GSC. DISS factors showed stronger relationships to retrospective sleep symptoms and concurrent sleep diary reports than retrospective psychological symptoms. The diurnal pattern of symptoms may inform studies of the pathophysiology and treatment outcome of insomnia.
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Keywords: Insomnia; Ecological momentary assessment; Experience sampling; Symptoms; Sleep diary; Circadian rhythm; Diurnal variation

1. Introduction

Insomnia refers to the complaint of difficulty falling asleep, difficulty staying asleep, or poor sleep quality in an individual who has adequate opportunity for sleep. However, insomnia is also used to refer to a disorder, characterized not only by nighttime sleep difficulty, but also by daytime symptoms such as fatigue or sleepiness, mood disturbances, and cognitive difficulties [1,2]. These daytime symptoms may provide clues to both the pathophysiology and risks associated with insomnia disorders. Mood symptoms are particularly relevant, given the prevalence of mood and anxiety disorders among individuals with chronic insomnia [3–5] and, conversely,

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the risk that insomnia poses for the subsequent development of syndromal psychiatric disorders [6,7]. Numerous studies in clinical samples have demonstrated that individuals with primary insomnia (PI) report more daytime symptoms of depression and anxiety than good sleeper control subjects (GSC) [8–10] even when individuals with syndromal psychiatric disorders are excluded, as reviewed by Reidel and Lichstein [11]. However, not all studies have found significant differences [12–14]. Daytime symptoms of hyperarousal are also relevant to the study of insomnia. Hyperarousal refers to an elevated state of central nervous system activity/reactivity as reflected in cognitive, emotional, or physiological domains, and is commonly viewed as a potential pathophysiologic mechanism in insomnia [15]. Individuals with insomnia report symptoms consistent with increased arousal [16–18]. Perhaps, paradoxically, fatigue, low energy, and even sleepiness are also reported commonly in insomnia [19–21]. Finally, individuals with insomnia complain of impaired cognitive function that improves with treatment [22], even though objective evidence of pretreatment cognitive dysfunction is difficult to demonstrate [11,23]. At present, the direction and magnitude of relationships between sleep-related symptoms and waking symptoms in insomnia remains uncertain.

One limitation of studying daytime symptoms in insomnia is that these symptoms are typically assessed cross-sectionally, retrospectively, and in the artificial environment of the clinic. Such assessments make it difficult to examine the variability of symptoms that may occur predictably across the course of the day, or unpredictably from one day to the next. This is a particular concern with a disorder such as primary insomnia that often demonstrates considerable variability within and across days. Retrospective reports are also subject to reporting biases such as recency and severity effects; ''telescoping'', in which events are recalled as more recent than they actually occurred; and differences between ''counting'' and ''estimation'' strategies for summarizing experiences [24].

Ecological Momentary Assessment (EMA) is a technique of assessing symptoms prospectively, repeatedly, and in subjects' usual environments [24–26]. Typically, subjects complete questionnaires several times per day during the course of their usual activities. This technique can overcome many of the limitations of retrospective reports noted above. EMA has been extensively used to study phenomena as diverse as daily variation in mood and tiredness [27,28], fatigue [29,30], pain [31], coping [32], eating, smoking, and alcohol behaviors [33–36], and psychosocial correlates of ambulatory blood pressure [37]. We previously reported a pilot study using EMA to measure daytime symptoms in PI [38]. Compared to GSC, individuals with PI reported lower mean ratings, greater day-to-day variability, and different time courses for symptom clusters which we termed Mood, Energy, Concentration, and Alertness. These clusters were determined by clinical insight rather than by statistical means. Another potential problem is that the pilot study used paper-and-pencil questionnaires for EMA; previous studies have shown that subjects do not necessarily complete such instruments at the prescribed times [39]. This problem, which can be minimized with electronic data collection devices such as hand-held computers [40], including alarms that cue subjects to complete ratings, and also provide data on actual time of data entry.

In this paper, we present exploratory analyses of EMA measures of daytime symptoms, collected using hand-held computers, in a larger sample of PI and a comparison group of GSC. The aims of this study were (1) to characterize daytime symptom factors in PI with EMA, using statistical techniques rather than clinical intuition to derive summary scales; (2) to compare these daytime symptom factors in PI and GSC; (3) to compare ''standard'' retrospective psychological and sleep ratings, as well as sleep diary findings in PI and GSC; and (4) to examine relationships between EMA, retrospective psychological and sleep ratings, and sleep diary findings in PI.

2. Methods

These data come from an ongoing study designed to examine mood, arousal, and pharmacologic treatment response in individuals with PI and GSC (MH24652). This study was approved by the University of Pittsburgh, Institutional Review Board, and all subjects provided informed consent. After initial eligibility screening, all participants complete a set of self-report retrospective symptom ratings followed by a 1-week in-home evaluation including sleep diary and daily symptom ratings collected on hand-held computers.

2.1. Participants

Study participants included men and women with PI and GSC, enrolled in a 3:1 ratio and aged 20–50 years. Participants were recruited through media advertisements, word of mouth, and clinical referrals. All participants were evaluated with a medical history, medication/substance history, physical examination, routine blood work, and urine drug screen; psychiatric history using the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (DSM-IV) (SCID) [41,42]; and sleep history using locally developed questionnaires and interviews to yield DSM-IV sleep disorder diagnoses [43]. Inclusion criteria for PI and GSC included provision of informed consent and ability to speak and understand English. For PI, additional inclusion criteria included a