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Original article

Predictors of sleep disorders among patients with type 2 diabetes mellitus

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ABSTRACT

Aims: This study examined the prevalence of sleep disorders (SD) and self-reported sleep symptoms and risk factors among adult patients diagnosed with T2DM.

Methods: Data were obtained from the 2012 US National Health and Wellness Survey, an annual Internet-based survey. A total of 7239 participants reported a diagnosis of T2DM. Patients also provided information on diagnosis of SD (e.g., insomnia, sleep breathing disorder, other sleep conditions, etc.) and regularly experienced sleep symptoms (e.g., difficulty falling asleep, sleep apnea, daytime sleepiness, difficulty staying awake, etc.). Logistic regressions were used to examine factors associated with SD and symptoms.

Results: The average age was 59.9 (standard deviation = 12.2), 59.5% were male, 24.4% were diagnosed with SD, 76.8% reported experiencing any sleep symptom regularly (difficulty falling asleep, 30.5%; sleep apnea, 17.4%; daytime sleepiness, 26.8%; difficulty staying awake, 10.1%). Logistic regression models showed the strongest predictors of diagnosed SD were obesity class (OC) III (OR = 2.20), White (OR = 1.92), OC II (OR = 1.57), smoking (OR = 1.57), lower income (OR = 1.49–1.19), unemployment (OR = 1.38), and comorbidities (OR = 1.35), all $p < 0.05$. The strongest predictors of any sleep symptom were OC III (OR = 2.22), OC II (OR = 1.78), lower income (OR = 1.74–1.24), female gender (OR = 1.72), OC I (OR = 1.60), White (OR = 1.54), and smoking (OR = 1.47), all $p < 0.05$.

Conclusions: Almost 25% of patients with T2DM were diagnosed with SD and over 75% reported experiencing at least one sleep symptom regularly. SD and symptoms were strongly associated with obesity, White ethnicity, gender, low income, and smoking. Interventions focusing on weight management and smoking cessation have shown to improve T2DM and may improve SD.

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1. Introduction

The health burden and cost associated with metabolic disorders, such as Type 2 diabetes mellitus (T2DM) and obesity, have increased dramatically in the past 3 decades across the globe and now represent a major health challenge in the 21st century. Recent reviews have reported that approximately 37% of the world's population are now overweight or obese, with an estimated 382 million individuals diagnosed with diabetes (including T2DM) [1,2]. As a consequence of this rapid increase, and the significant associated health and economic burden, researchers have sought to establish a better understanding of

metabolic illness and the role of suspected risk factors for disease. The development and implementation of effective public health interventions, guided by such research, is considered critical if the burden of metabolic disease is to be curbed.

Sleep disorders represent one such risk factor that possesses a relationship with both metabolic disease and obesity. Emphasizing the complexity of this triad of illness conditions, studies have suggested that poor sleep quality and sleep disorders may represent risk factors in the development of both obesity and T2DM [3,4]. Sleep quality may therefore represent a risk factor in the development of two highly prevalent and burdensome disease conditions.

Disrupted or insufficient sleep is thought to possess a number of adverse effects on metabolic and neuroendocrine mediators of health; most likely through promoting increased appetite and consequent caloric consumption [4,5]. The quality and quantity of sleep can range from sleep disorders, sub threshold

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symptomatology to persistent chronic disturbances. In the US, it has been estimated that 50–70 million suffer from chronic sleep disturbances, including insufficient sleep, insomnia, and obstructive sleep apnea [6]. Critically, sleep hygiene (promotion of better sleep practices) represents an important and cost-effective treatment for sleep disturbances, and thus sleep problems represent modifiable risk factors for both primary and secondary prevention of metabolic disease.

A number of epidemiological studies describe a connection between T2DM, and sleep disorders [5]. Studies suggest that a high proportion of T2DM sufferers also manage comorbid sleep apnea, particularly males and those overweight. Estimates from recent studies range from 18% to 36%, suggesting the importance of addressing sleep disorders among this patient group [7–9]. A large-scale survey study found that sleep problems were reported by up to 40% of individuals with T2DM, with sleep apnea, and restless legs symptoms the most likely among sufferers [10]. A further comprehensive report by the International Diabetes Federation Taskforce on Epidemiology and Prevention highlighted the frequent co-occurrence of diabetes and sleep disordered breathing, noting that the high degree of comorbidity requires that health professionals routinely assess for this condition among diabetic patients [11].

Further research has sought to explore the complex causal relationship that may exist between disrupted sleep and T2DM [12]. Tang and colleagues reported insufficient sleep quality and quantity as a risk factor of developing T2DM and poor glycemic control among sufferers [13]. Similar results were reported in a German study by Taub and colleagues, with the authors hypothesizing that future research should examine insulin resistance as a potential mechanism by which these two highly prevalent conditions may be associated [14]. Sleep duration has also been associated with higher risk of developing T2DM [15,16], as well representing a strong predictor of hemoglobin A1c (HbA1c), with sleep loss being associated with increased HbA1c [17].

Attention to the potentially negatively reinforcing relationships that may exist between sleep disturbance, obesity and T2DM is growing [18]. Critically however, there exists a paucity of literature assessing all three conditions, and the relationship between them, in large-scale representative populations. The current study will

seek to contribute to this critical area of study and report on the rates and interrelationships between sleep disorders and symptoms, obesity and T2DM. This study will examine the prevalence of sleep disorders and symptoms and their association with risk factors among adult patients diagnosed with T2DM in the US.

2. Materials and methods

2.1. Sample source

This study included patients with self-reported physician diagnosis of T2DM, identified from the 2012 US National Health and Wellness Survey (NHWS; N=71,157). The NHWS is a self-administered, Internet-based questionnaire from a sample of adults (aged 18 or older). The NHWS collects individual demographic characteristics, medical history, healthcare utilization, behaviors, attitudes and outcomes from all respondents. A stratified random sample (with strata by gender, age and race/ethnicity) was implemented to ensure that the demographic composition of the sample is identical to that of the corresponding adult population as measured by the US Bureau of Census. Respondents are recruited through the Lightspeed Research (LSR) Internet panel, using opt-in e-mailing, co-registration with LSR partners, e-newsletter campaigns, and online banner placements. Informed consent is obtained from the respondents, who are compensated with LSR points that can be accumulated and exchanged for small prizes. Several peer-reviewed publications have previously compared the NHWS with other governmental sources [19–21].

NHWS protocol and questionnaire was reviewed and approved by an independent ethical committee (Essex Institutional Review Board in Lebanon, New Jersey, USA) and all respondents provided informed consent to participate.

2.2. Measures

2.2.1. Demographics

Survey respondents reported their age, gender, race/ethnicity, marital status, annual household income, education, insurance status, and employment status.

Table 1

The prevalence of sleep disorders and symptoms among T2DM Respondents.

	T2DM (N = 7239)
Diagnosed sleep disorder	1765 (24.38%)
Diagnosed narcolepsy	53 (0.73%)
Diagnosed insomnia	909 (12.56%)
Diagnosed sleep breathing disorder	899 (12.42%)
Diagnosed parasomnia	6 (0.08%)
Diagnosed circadian rhythm sleep disorder	39 (0.54%)
Diagnosed other sleep disorder	1478 (20.42%)
Experienced at least one sleep symptom regularly	5557 (76.76%)
Experienced difficulty falling asleep regularly	2209 (30.52%)
Experienced waking during the night and not being able to get back to sleep regularly	1957 (27.03%)
Experienced waking up several times during the night regularly	1906 (26.33%)
Experienced waking up too early (such as before the alarm clock) regularly	1603 (22.14%)
Experienced sleep apnea (temporary absence of breathing) regularly	1260 (17.41%)
Experienced leg cramps/leg problems regularly	1387 (19.16%)
Experienced waking up to go to bathroom regularly	3170 (43.79%)
Experienced night sweats/hot flashes regularly	861 (11.89%)
Experienced pain regularly	1308 (18.07%)
Experienced poor quality of sleep regularly	1477 (20.40%)
Experienced daytime sleepiness regularly	1938 (26.77%)
Experienced difficulty staying awake regularly	731 (10.10%)

Note: T2DM = type 2 diabetes mellitus.

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