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Research Briefs

Effect of nocturia on next-day sedentary activity in adults with type 2 diabetes☆

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ABSTRACT

Purpose: Nocturia, a common cause of disturbed sleep quality and next-day fatigue, may contribute to difficulty with diabetes self-management. The purpose of this study was to examine the effect nocturia has on next-day subjectively measured mental and physical energy and objectively measured physical activity.
Methods: This secondary analysis utilized sleep diaries over one week which measured nocturia frequency and other sleep quality indicators (wake after sleep onset, sleep quality and sleep duration) along with next-day reports of mental and physical energy. Next-day physical activity was measured with the BodyMedia Sensewear armband.
Results: Sleep quality and sleep duration were associated with next-day physical and mental energy. Nocturia frequency (≥2 times per night) was associated with increased next-day sedentary activity.
Conclusion: These results suggest that nocturia could negatively affect next-day physical activity in people with diabetes.

1. Introduction

Nocturia, the need to void at night, is a common but burdensome problem for older adults. Seventy percent of adults over the age of forty are estimated to void at least once per night and approximately one-third of these adults void two or more times per night (Madhu et al., 2015). Factors associated with increased frequency of nocturia include reduced bladder capacity in women, enlarged prostate with urinary retention in men, use of diuretic medications, congestive heart failure, untreated obstructive sleep apnea (OSA), and poor glycemic control in persons with diabetes (Madhu et al., 2015). Prior research suggests that waking up one or more times a night to void may lead to next-day physical and mental fatigue (Ancoli-Israel, Bliwise, & Nørgaard, 2011). While voiding one time per night is commonly considered non-pathological, it is the increased frequency of nocturia, two or more night time voids, that results in sleep fragmentation, difficulty in returning to sleep, and may result in excessive daytime sleepiness or fatigue (Asplund, 2005; Cornu, Abrams, Chapple, et al., 2012; Madhu et al., 2015).

In people with diabetes, next day fatigue may create an additional burden making it more difficult to complete essential tasks associated with self-care. Until now, studies in persons with diabetes examined only the overall effect of sleep quality on functional outcomes, but have not specifically examined the effect of the proceeding night's sleep on the next day's physical activity and mood (McClain, Lewin, Laposky, Kahle, & Berrigan, 2014). The purpose of this brief report was to examine the association of nocturia, categorized as low (0 or 1 times per night) or high (≥2 times per night), with subjectively measured sleep quality, next-day subjective mental and physical energy, and objectively measured time in sedentary activity in adults with type 2 diabetes.

2. Method

2.1. Design

This study used data from the baseline assessments of adults who were screened for participation in the clinical trial (R21-HL089522: E. Chasens, PI) *OSA, Activity and Glycemic Control in Adults with Type 2 Diabetes*. The purpose of the parent study was to examine the outcomes of glucose control, physical activity, and daytime sleepiness when participants with diabetes and OSA were treated with continuous positive airway pressure (CPAP) compared to those on a sham-CPAP device. The current study is a cross-sectional secondary analysis that correlated

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the participant's nighttime experiences with their next-day physical activity levels and subjective experiences of mental and physical fatigue.

2.2. Sample

The sample was recruited from the greater Pittsburgh, Pennsylvania area. Participants were recruited from a research registry, community partners (churches, schools and other organizations), and diabetes clinics or doctor's offices. Potential participants were telephone screened. Informed consent was obtained prior to any research activity at the baseline assessment. Eligibility criteria for the baseline assessment included age 30 years or older, self-reported diagnosis of type 2 diabetes, no acute illnesses requiring hospitalization in last 3 months, subjectively sleepy on telephone screen [Epworth Sleepiness Scale (ESS) ≥10)], able to read and write English, and being ambulatory. Potential participants were excluded if they had previous CPAP use, a near-miss or automobile accident due to sleepiness, employed in a safety sensitive occupation, or were unwilling to be randomized to sham CPAP.

2.3. Instruments

2.3.1. Sleep diary

Each day for seven days, participants completed a sleep diary in the morning and evening. Questions about nocturia [yes/no], number of nighttime voids, minutes awake after sleep onset [WASO], and total sleep duration (not including WASO), were recorded each morning. Participants evaluated their previous night sleep quality on a 100 mm visual analog scale from "poor" to "excellent." Before bedtime the next-day, participants evaluated on 100 mm visual analog scales their subjective mental energy from "alert" to "sluggish" and their physical energy from "exhausted" to "energetic". The diary is similar to ones used in other clinical trials evaluating sleep (Weaver, Mancini, Maislin, et al., 2012).

2.3.2. Activity monitor

Objective activity measurements were obtained using the BodyMedia Sensewear® armband, a reliable and valid measure of human energy expenditure (Jakicic, Marcus, Gallagher, et al., 2004), which collects information on participant's metabolic activity measured by metabolic equivalents (METS). Sedentary activity, operationally defined as less than 1.5 METS, is the amount of energy expended lying down or sitting quietly, as in watching television or playing/working on a computer (Mansoubi et al., 2015). METS 1.5 to 3 are considered light activity; examples are casual walking and light housework. Other categories of activity include moderate (3 to 6 METS), and vigorous (>6 METS).

2.3.3. Pittsburgh Sleep Quality Index (PSQI) & Epworth Sleepiness Scale (ESS)

The PSQI is a validated questionnaire that has seven components (sleep duration, efficiency, quality, latency, disturbances, medication use, and daytime dysfunction). The higher the score, the poorer the global sleep quality; scores greater than 5 indicate poor sleep quality (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The ESS measures subjective daytime sleepiness in 8 soporific situations. Scores range from 0 to 24; a score higher than 10 indicates a participant is excessively sleepy during waking hours (Johns, 1991).

2.3.4. Clinical evaluation

Anthropomorphic measures obtained at the baseline visit include height and weight to calculate body mass index (BMI, kg/m^2). Glycemic control was evaluated with an A1C which estimates the average glucose level over the last 3 months.

2.4. Data collection

Participants came to the Clinical Translational Research Center for informed consent followed by the clinical evaluation and serum collection for A1C. Questionnaires (PSQI and ESS) were given to be completed at home; return mailers were provided. The sleep diary was completed at home for seven days upon awakening and before bedtime. The BodyMedia armband activity monitor was worn on either upper arm with instructions to remove it less than one hour per day, such as when showering. Data collection with the BodyMedia armband was concurrent with the seven days the sleep diary was completed.

2.5. Analysis

Data analyses were performed using IBM® SPSS® Statistics v23. Statistical significance was set at $p < .05$ for two-sided hypothesis testing. Descriptive statistics included mean, standard deviations, frequencies, and percentages. To assess for differences between high and low frequency categories of nocturia, two sample t-tests were used for age AIC, BMI, PSQI and ESS and the chi-square test of independence for race (white or non-white) and marital status (single or married/partnered). To account for longitudinal data clustering within each individual, linear mixed modeling was used to predict the next day's subjective mental and physical energy and the objectively assessed percent of time in sedentary physical activity as a function of daily self-reported nocturia, WASO, perceived sleep quality, and sleep duration. It assumed that the time spent in very low activity (as defined by a number of METS ranging between 0 and 1.5) was sleep up to a maximum of eight hours, and excluded that time from the calculation of percent of time in sedentary activity. Model assessment of residuals supported the underlying assumption of normality.

3. Results

The sample ($N = 109$) was middle-aged (Mean ± SD = 52.41 ± 9.5 years, range = 31–82), 71% of the sample had suboptimal (A1C ≥ 6.5%) glucose control (Mean A1C = 7.3 ± 1.5 range = 5.1–13.9) according to the most recent consensus diabetes guidelines (Garber et al., 2016), and was well distributed by sex, race, and marital status (58% female, 53% non-Caucasian, 42% married/partnered). Forty percent of the sample averaged 2 or more voids per night (Range 0–7). There were no significant group differences in daytime sleepiness (ESS), global sleep quality (PSQI), A1C, BMI, or marital status between the "high" and "low" nocturia groups (all p-values ≥ .05). Non-whites were significantly more likely to experience high nocturia ($p = .037$).

Table 1
Results of linear mixed modeling between nocturia and sleep predictor variables and selected next-day outcome variables.

Parameter	b	Standard Error	df	p-value
Next-day subjective mental energy				
WASO	0.02	0.02	264	.38
Sleep duration (hours)	−0.05	0.01	295	<01
Sleep quality	0.31	0.06	299	<01
Nocturia (≥2 episodes/night)	0.67	2.8	297	.81
Next-day subjective physical energy				
WASO	<0.01	0.02	296	.83
Sleep duration (hours)	−0.03	0.01	299	<01
Sleep quality	0.35	0.05	299	<01
Nocturia (≥2 episodes/night)	0.23	2.47	298	.93
Next-day objective time in sedentary activity (minutes)				
WASO	0.02	0.01	255	.21
Sleep duration (hours)	<0.01	0.01	277	.36
Sleep quality	0.04	0.03	299	.27
Nocturia (≥2 episodes/night)	−3.28	1.65	290	<05

WASO = wake after sleep onset (minutes); b = estimated adjusted regression coefficient from a linear mixed model; sedentary activity = METS <1.5.