Published in final edited form as:

Appl Nurs Res. 2016 November ; 32: 44–46. doi:10.1016/j.apnr.2016.04.006.

Effect of Nocturia on Next-Day Sedentary Activity in Adults with Type 2 Diabetes

Jonna L. Morris, BSN, RN,

Doctoral Student, School of Nursing, University of Pittsburgh

Susan M. Sereika, PhD,

Professor, School of Nursing and Graduate School of Public Health, University of Pittsburgh

Martin Houze, PhD, and

Staff Statistician, School of Nursing, University of Pittsburgh

Eileen R. Chasens, PhD, RN, FAAN

Associate Professor, School of Nursing, University of Pittsburgh

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.¹ 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.¹ Prior research suggests that waking up one or more times a night to void may lead to next-day physical and mental fatigue.² 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.^{1,3,4}

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.⁵ 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

Corresponding Author: J. L. Morris, jlm356@pitt.edu, Phone: 717-877-8035.

Disclosures: This research was supported by a grant from the National Institutes of Health, National Heart Lung and Blood Institute HL 089522 (E. Chasens) and through grants UL1 RR024153 and UL1TR000005.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

subjectively measured sleep quality, next-day subjective mental and physical energy, and objectively measured time in sedentary activity in adults with type 2 diabetes.

METHOD

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

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.

Instruments

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's 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.⁶

Activity Monitor—Objective activity measurements were obtained using the BodyMedia Sensewear® armband, a reliable and valid measure of human energy expenditure,⁷ 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, 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).

Pittsburgh Sleep Quality Index (PSQI)—This validated questionnaire 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.⁸ 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.⁹

Clinical Evaluation—Anthropomorphic measures obtained at the baseline visit include height and weight to calculate body mass index (BMI, kg/m²). Glycemic control was evaluated with an A1C which estimates the average glucose level over the last 3 months.

Data Collection

Participants came to the Clinical Translational Research Center for informed consent followed by the clinical evaluation and serum collection of 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.

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. T-tests determined if there were any significant differences between the high and low categories of nocturia in age, race (white or non-white), marital status (single or married/partnered), A1C, BMI, PSQI, and ESS. All assumptions of normality were satisfied. 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, which took into account longitudinal data clustering within each individual. According to a priori assumptions, the activity period for all participants was calculated for the lagged variables as 16 hours.

RESULTS

The sample (N=109) was middle-aged (Mean $\pm$ SD = 52.41 $\pm$ 9.5 years, range = 31–82), 71% of the sample had suboptimal (A1C $\geq$ 6.5%) glucose control (Mean A1C = 7.3 $\pm$ 1.5 range = 5.1–13.9) according to the most recent consensus diabetes guidelines,¹⁰ 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, ($p = .037$).

Based on the linear mixed modeling, perceived nightly sleep quality and sleep duration were independently associated with the next-day's subjective physical and mental energy (Table 1). There was no significant association between subjective sleep quality, WASO, or sleep duration with objectively measured next-day activity levels. Nocturia (2 times per night) was independently associated with increased time in sedentary next day physical activity, $F(1, 290.6) = 3.95$, $p = .048$). Participants who had zero or one void per night spent an average of 73.13% of their next day waking time in sedentary activity, while those who voided 2 times per night spent an average of 76.4% of their next-day waking time in sedentary activity.

DISCUSSION AND CONCLUSION

The major finding of this study was that nocturia was significantly associated with increased time in objectively measured sedentary activity. Subjective evaluation of impaired sleep quality was predictive of next-day physical and mental fatigue; it was not statistically significant in predicting objectively measured physical activity. Increased frequency of nocturia did not predict mental or physical fatigue the next-day, possibly indicating that participants did not view it as a problem of their sleep.

Limitations include the cross-sectional design that precludes attributing causality and the modest sample size not based on a power analysis that may result in a type 2 error. Potential reasons for nighttime voiding (i.e. diuretic medications, oral intake, glycosuria, bladder disorders, or OSA severity) were not evaluated.

In conclusion, waking to void at night is a non-specific symptom that needs careful evaluation to determine the underlying cause and to implement a focused treatment plan. Nocturia, especially voiding 2 or more times per night, is associated with increased next-day sedentary activity in people with diabetes. This suggests that nighttime voiding can negatively affect functional outcomes such as maintaining an active lifestyle, an important component to achieving optimal glycemic control for persons with type 2 diabetes. It is still unclear if the effect of nocturia on next-day physical energy worsens as the number of voids increases incrementally. In addition, future research should explore novel interventions for nocturia that specifically target people with diabetes.

References

1. Madhu C, Coyne K, Hashim H, Chapple C, Milsom I, Kopp Z. Nocturia: risk factors and associated comorbidities; findings from the EpiLUTS study. *Int J Clin Pract*. Sep.2015 doi: 10.1111/ijcp.12727
2. Ancoli-Israel S, Bliwise DL, Nørgaard JP. The effect of nocturia on sleep. *Sleep Med Rev*. 2011; 15(2):91–97. DOI: 10.1016/j.smrv.2010.03.002 [PubMed: 20965130]
3. Cornu J-N, Abrams P, Chapple CR, et al. A contemporary assessment of nocturia: definition, epidemiology, pathophysiology, and management—a systematic review and meta-analysis. *Eur Urol*. 2012; 62(5):877–890. DOI: 10.1016/j.eururo.2012.07.004 [PubMed: 22840350]
4. Asplund R. Nocturia: Consequences for sleep and daytime activities and associated risks. *Eur Urol Suppl*. 2005; 3(6):24–32. DOI: 10.1016/S1569-9056(05)80004-1

5. McClain JJ, Lewin DS, Laposky AD, Kahle L, Berrigan D. Associations between physical activity, sedentary time, sleep duration and daytime sleepiness in US adults. *Prev Med (Baltim)*. 2014; 66:68–73. DOI: 10.1016/j.ypmed.2014.06.003
6. Weaver TE, Mancini C, Maislin G, et al. Continuous positive airway pressure treatment of sleep patients with milder obstructive sleep apnea: results of the CPAP Apnea Trial North American Program (CATNAP) randomized clinical trial. *Am J Respir Crit Care Med*. 2012; 186(7):677–683. DOI: 10.1164/rccm.201202-0200OC [PubMed: 22837377]
7. Jakicic JM, Marcus M, Gallagher KI, et al. Evaluation of the SenseWear Pro Armband to assess energy expenditure during exercise. *Med Sci Sports Exerc*. 2004; 36(5):897–904. [PubMed: 15126727]
8. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*. 1989; 28(2):193–213. [PubMed: 2748771]
9. Johns MW. A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep*. 1991; 14(6):540–545. [PubMed: 1798888]
10. Garber AJ, Abrahamson MJ, Barzilay JI, Blonde L, Bloomgarden ZT, Bush MA. AACE/ACE Consensus Statement Consensus statement by the American Association of Clinical Endocrinologists and American College of Endocrinology on the comprehensive Type 2 diabetes management algorithm – 2016 Executive Summary. 84. *Endocr Pract*. 2016; 22(1):84–113. DOI: 10.4158/EP151126.CS [PubMed: 26731084]

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