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# Prevalence of self-reported sleep duration and sleep habits in type 2 diabetes patients in South Trinidad

Rishi Ramtahal [a,b,*], Claude Khan [a], Kavita Maharaj-Khan [a], Sriram Nallamothu [a], Avery Hinds [b,d], Andrew Dhanoo [b,e], Hsin-Chieh Yeh [b,c], Felicia Hill-Briggs [b,c], Mariana Lazo [b,c]

[a] *South West Regional Health Authority, Trinidad and Tobago*
[b] *Trinidad and Tobago Health Sciences Initiative, Johns Hopkins Medicine International and Government of the Republic of Trinidad and Tobago, Trinidad and Tobago*
[c] *Department of Medicine, Division of General Internal Medicine, Johns Hopkins Medical Institutions, Baltimore, MD, USA*
[d] *Communicable Diseases and Emergency Response Department, Surveillance, Disease-Prevention and Control Division, Caribbean Public Health Agency, Trinidad and Tobago*
[e] *Department of Life Sciences, Faculty of Science and Technology, University of the West Indies, St. Augustine, Trinidad and Tobago*

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**KEYWORDS**
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Poor sleep quality

**Abstract** The present study aims to determine the prevalence of self-reported sleep duration and sleep habits and their associated factors in patients with type 2 diabetes in Trinidad. This was a cross-sectional multicenter study. There were 291 patients with type 2 diabetes studied. Sleep habits were assessed using the Epworth Sleepiness Scale (ESS) and the National Health and Nutrition Examination Survey sleep disorder questionnaire. Demographic, anthropometric and biochemical data were also collected. The sample had a mean age of 58.8 years; 66.7% were female. The mean BMI was 28.9 kg/m$^2$. The prevalence of Excessive Daytime Sleepiness (EDS) was 11.3%. The prevalence of patients with short sleep ($\leqslant$6 h) was 28.5%. The prevalence of patients with poor sleep was 63.9%. Poor sleep was associated with age, intensive anti-diabetic treatment and longer duration of diabetes. Short sleep was associated with intensive anti-diabetic treatment and BMI, while EDS was associated with increased BMI. In a sample of patients with type 2 diabetes, a high prevalence of self-reported sleep duration and unhealthy sleep habits

* Corresponding author at: #10 Chincuna Gardens, Chin Chin Rd, Cunupia 520128, Trinidad and Tobago. Tel.: +1 868 765 2114.
*E-mail address:* rishi950@gmail.com (R. Ramtahal).

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was found. There needs to be an increased awareness of sleep conditions in adults with type 2 diabetes by doctors caring for these patients.



## 1. Introduction

Sleep disorders have been associated with chronic illnesses, mental disorders, restrictions in daily functional capacity, and increases in injury and mortality [1,2]. Excessive daytime sleepiness (EDS), a common condition globally, has been found to be strongly associated with obesity, metabolic syndrome and diabetes, with diabetic patients twice as likely to report EDS as their non-diabetic counterparts [3]. It is also known that sleep-related problems adversely affect metabolic health [4]. Specifically, poor sleep and short sleep have been associated with metabolic syndrome, obesity, type 2 diabetes, hypertension and cardiovascular disease [5,6]. EDS has been shown to be a predictor of severe hypoglycemia [7]. Importantly, EDS is also associated with depression and poorer health-related quality of life (HRQOL) [3,8]. Due to these multiple adverse effects of sleep problems, sleep has become an emerging area of investigation in the area of modifiable factors affecting the management of diabetes.

Most recent International Diabetes Federation data estimate the number of persons with diabetes in the world as 382 million [9]. Trinidad and Tobago ranked sixth in the North American and Caribbean (NAC) region in the number of diabetes cases in 2012. The age-adjusted prevalence of diabetes in Trinidad and Tobago in the 20—79 year age group is 13.9% [9].

There have been no studies, to the knowledge of the researchers in the present study, examining the burden of self-reported sleep duration and sleep habits in patients with type 2 diabetes in the Caribbean. This study aims to determine the prevalence of self-reported sleep duration and sleep habits, and factors associated with these conditions, in clinic patients with type 2 diabetes in South Trinidad. This information is essential for guiding strategies for sleep-related problems prevention and intervention in diabetes patients in this region.

## 2. Materials and methods

This was a cross-sectional, multicenter study carried out at four governmental health facilities in the South region of Trinidad. All type 2 diabetic patients attending specialist diabetic outpatient clinics over a four-month period in 2013 were invited to participate in this study. During the study period, 291 total patients were eligible for the study and were invited to participate. All eligible patients who were invited agreed to participate, yielding a 100% response rate.

All participants signed an informed consent. Exclusion criteria included: type 1 diabetes, less than 18 years of age, pregnant, or refusal to sign an informed consent form. This study was approved by the Ethics Committee of the South West Regional Health Authority (SWRHA), Trinidad.

### 2.1. Sleep duration and sleep habits

#### 2.1.1. Measurements

During the office visit, physicians administered the following two existing questionnaires: the Epworth Sleepiness Scale (ESS) and the National Health and Nutrition Examination Survey (NHANES) 2007 Sleep Disorders Questionnaire. The ESS is an eight-item questionnaire that measures subjective sleepiness [10]. An ESS score of >10 indicates the presence of Excessive Daytime Sleepiness (EDS). The NHANES 2007 Sleep Disorders Questionnaire [11] is a 24-item questionnaire that assesses self-reported physician diagnosis of a sleep disorder, functional status outcomes for sleep disorders, quality, and the number of sleep hours per night. Using the answer to the question: ''How much sleep do you usually get at night on weekdays or workdays?'' patients were categorized as having short sleep if they slept less than or equal to 6 h. As it has been done in prior studies using the NHANES questionnaire [12], patients were defined as having poor sleep if they answered ''often'' or ''almost always'' (together defined as 5—30 times a month) to any of the following six questions: (1) In the past month, how often did you have trouble falling asleep? (2) How often did you wake up during the night and had trouble getting back to sleep? (3) How often did you wake up too early in the morning and were unable to get back to sleep? (4) How often did you feel unrested during the day, no matter how many hours of sleep you had? (5) How often did you feel excessively or overly

sleepy during the day? and (6) How often did you not get enough sleep? [12]. Lastly, also from the NHANES Sleep Disorders Questionnaire, snoring and individually, the following sleep-related difficulties were analyzed: (1) Do you have difficulty concentrating on the things you do because you feel sleepy or tired? (2) Do you generally have difficulty remembering things because you are sleepy or tired? (3) Do you have difficulty working on a hobby, for example, sewing, collecting, or gardening, because you are sleepy or tired? (4) Do you have difficulty getting things done because you are too sleepy or tired to drive or take public transportation? (5) Do you have difficulty taking care of financial affairs and doing paperwork (for example, paying bills or keeping financial records) because you are sleepy or tired? and (6) Do you have difficulty performing employed or volunteer work because you are sleepy or tired? The answers were reported as any (when a participant answered ''little difficulty'' or ''moderate difficulty'' or ''extreme difficulty''), and as moderate or severe (when the participant answered ''moderate difficulty'' or ''extreme difficulty'').

Finally, the combined presence of self-reported physician diagnosed sleep disorders, short sleep, and poor sleep was assessed using mutually exclusive categories.

## 2.2. Other measurements

Measurements were taken for height (m), weight (kg), blood pressure (mmHg) and waist circumference (cm). Medical charts were used to obtain laboratory results within six months of the visit. When available, values of HDL (mg/dl), LDL (mg/dl), total cholesterol (mg/dl) and triglycerides (mg/dl) were extracted. Ethnicity, age and duration of diabetes were self-reported and anti-diabetic medication use was recorded from clinical notes.

## 2.3. Statistical analyses

Descriptive statistics (means, medians or frequency) were used to characterize the study sample overall. The overall prevalence of self-reported, physician-diagnosed sleep disorder, short sleep and poor sleep, alone or in combination, was reported. To compare the characteristics of participants by the sleep duration and EDS, *T*-test and Chi-square test statistics were used for continuous and categorical variables, respectively. Statistical analyses were conducted using Stata 13 (College Station, Tx).

# 3. Results

Participant characteristics are presented in Table 1 for the total sample. Most study participants were female (66.7%), and of East Indian origin (74.6%), which is consistent with the demographics of the region. The mean age was 58.8 (SD 11.2) years, and the median duration of diabetes was 10 years. Most patients were on both oral hypoglycemic agents and insulin therapy (46.7%); 33% of patients were overweight, while 13.8% were obese.

The overall prevalence of sleep-related disorders and poor sleep habits, alone and in combination, and their median ESS are presented in Table 2. The overall prevalence of self-reported, physician-diagnosed sleep disorder was very low (1.7%); however, the prevalence of short sleep was very high (28.5%). More than two thirds of the study participants (63.9%) were categorized as having poor sleep. When the presence of

**Table 1** Characteristics of the study participants.

| | *N* = 291 (100%) |
|---|---|
| Age (years) | 58.8 (11.2) |
| *Age category, %* | |
| <50 | 19.6 |
| 50—60 | 32.7 |
| 60—70 | 32.0 |
| 70+ | 15.5 |
| Female (%) | 66.7 |
| *Race (%)* | |
| African | 21.7 |
| East Indian | 74.6 |
| Other | 3.8 |
| Duration of diabetes (years) | 10 [6—19] |
| *Medications for diabetes, %* | |
| None | 0.7 |
| Oral | 30.2 |
| Insulin | 16.8 |
| Both | 46.7 |
| BMI (kg/m$^2$) | 28.9 (5.4) |
| *WHO BMI category (%)* | |
| Underweight | 1.4 |
| Normal | 19.6 |
| Overweight | 33.0 |
| Obese | 13.8 |
| Waist circumference (cm) | 99 [92.5—109] |
| SBP (mmHg) *n* = 104 | 150.5 (27.0) |
| DBP (mmHg) *n* = 104 | 80.7 (12.8) |
| Total cholesterol (mg/dl) *n* = 243 | 186.5 (50.9) |
| HDL-cholesterol (mg/dl) *n* = 236 | 48.2 (13.2) |
| LDL-cholesterol (mg/dl) *n* = 231 | 109.2 (39.7) |
| Triglycerides (mg/dl) *n* = 185 | 131 [96—197] |

Data are presented as means (SD), medians [Percentile 25 and 75] or frequency.

**Table 2** Overall prevalence of sleep-related disorders and poor sleep habits and median Epworth Sleepiness Scale (ESS) by category.

| | *N* (%) | Median ESS |
|---|---|---|
| Self-reported, physician-diagnosed sleep disorder | 5 (1.7%) | 5 |
| Poor sleep | 186 (63.9%) | 5.5 |
| Short sleep (<6 h) | 83 (28.5%) | 6 |
| *Combination of sleep disorder, short sleep and poor sleep*[*] | | |
| Sleep disorder, short sleep and poor sleep | 2 (0.7%) | 12.5 |
| Sleep disorder and short sleep | 0 | — |
| Sleep disorder and poor sleep | 3 (1%) | 5 |
| Sleep disorder only | 0 | — |
| Short sleep and poor sleep | 66 (22.7%) | 6 |
| Short sleep only | 15 (5.2%) | 4 |
| Poor sleep only | 115 (39.5%) | 5 |
| None | 90 (30.9%) | 2 |

[*] Mutually exclusive categories.

self-reported sleep disorder, poor sleep and short sleep was combined, it was found that almost 40% had only poor sleep, short sleep was relatively uncommon in isolation (5.2%), and 22.7% reported short and poor sleep together. EES scores were higher among those with any sleep-related issue compared to those without any issues.

### 3.1. Characteristics associated with short sleep duration

The characteristics of the patients by sleep duration category are shown in Table 3. A trend was found in the association between younger age and short duration of sleep ($p$ value = 0.06). In addition, those with more intensive diabetes treatment with both insulin and oral anti-diabetic medications were more likely to report short sleep compared to those with monotherapy ($p$ value = 0.02). There was also a significant association between short sleep and increased BMI ($p$ value = 0.05). No significant associations were observed between sleep duration and ethnicity, gender or duration of diabetes or the biochemical parameters that were measured.

### 3.2. Characteristics associated with excessive daytime sleepiness

The median (percentile 25- percentile 75) ESS was 4 (2—8); 11.3% of patients reported having EDS. The characteristics of patients according to EDS status are presented in Table 4. There was a statistically significant association between EDS and higher BMI ($p$ = 0.04). However, no other significant differences were observed.

### 3.3. Sleep quality

A majority (63.9%) of patients had poor sleep quality. Sleep quality was also significantly associated with age category ($p$ value = 0.05), with patients between the ages of 50—70 years more likely to report poor sleep (66%).

Poor sleep quality was also significantly associated with more intensive medication use ($p$ = 0.05) and duration of diabetes ($p$ = 0.02). No other significant associations were observed. (Data not shown.).

### 3.4. Other sleep-related difficulties

Snoring was reported by 54.7% of patients, with 26.5% snoring for 5 or more days in the last 12 months; 17.9% of patients also reported snorting, gasping or stopping breathing while asleep in the past 12 months.

Figs. 1—3 present the prevalence of poor sleep-related quality symptoms and difficulties, as well as the distribution of the number of poor sleep-related reported symptoms.

## 4. Discussion

This is one of the first studies to provide evidence of the burden of sleep-related conditions among patients with type 2 diabetes in the Caribbean region. This study found a high prevalence of poor sleep quality (63.9%) and short sleep (28.5%), while EDS was less prevalent (11.3%). These prevalence estimates are worrisome given the increasing evidence of the role of sleep in health, in particular among patients with diabetes.

**Table 3** Characteristics of the study participants by duration of sleep.

| | Sleep duration > 6 h *N* = 208 (71.5%) | Sleep duration ⩽ 6 h *N* = 83 (28.5%) | *p* Value |
|---|---|---|---|
| Age (years) | 59.6 (10.7) | 56.7 (11.9) | 0.06 |
| Age category, % | | | 0.13 |
| <50 | 16.8 | 26.8 | |
| 50—60 | 31.7 | 35.4 | |
| 60—70 | 34.1 | 26.8 | |
| 70+ | 17.3 | 11.0 | |
| Female (%) | 69.7 | 59.0 | 0.08 |
| Race (%) | | | 0.24 |
| African | 23.6 | 16.9 | |
| East Indian | 73.6 | 77.1 | |
| Other | 2.9 | 6.0 | |
| Duration of diabetes (years) | 10 [6—17] | 10 [6—20] | 0.18 |
| Medications for diabetes,% | | | 0.02 |
| None | 0.5 | 1.3 | |
| Oral | 37.1 | 19.2 | |
| Insulin | 14.7 | 25.6 | |
| Both | 47.7 | 53.9 | |
| BMI ($kg/m^2$) | 28.4 (5.1) | 30.1 (5.9) | 0.05 |
| WHO BMI category (%) | | | 0.58 |
| Underweight | 1.6 | 1.5 | |
| Normal | 24.3 | 18.2 | |
| Overweight | 38.9 | 36.4 | |
| Obese | 35.1 | 43.9 | |
| Waist circumference (cm) | 99 [93—109] | 99.5 [92—110] | 0.95 |
| SBP (mmHg) *n* = 104 | 150.9 (26.5) | 149.5 (28.7) | 0.72 |
| DBP (mmHg) *n* = 104 | 80.1 (13.2) | 82.7 (11.3) | 0.11 |
| Total cholesterol (mg/dl) *n* = 243 | 185.4 (47.9) | 189.4 (58.5) | 0.62 |
| HDL-cholesterol (mg/dl) *n* = 236 | 48.4 (13.3) | 47.7 (13.0) | 0.73 |
| LDL-cholesterol (mg/dl) *n* = 231 | 109.5 (40.7) | 108.4 (37.2) | 0.84 |
| Triglycerides (mg/dl) *n* = 185 | 124 [92—197] | 150 [106—212] | 0.23 |

Data presented as mean (SD), median [IQR] or %. For percentages, column adds 100%.

Compared with other studies among patients with diabetes, it was found that the prevalence of poor sleep in Trinidad was higher. Using the same instrument as the present study, Liu et al. found the prevalence of poor sleep to be 50.5% in a selected adult population [13], and Bansil et al. found the prevalence of poor sleep to be 52.1% in an American population that consisted of 8% diabetic patients [12]. To the knowledge of the researchers of the present study, this study is the first one to use the NHANES sleep quality instrument in exclusively diabetic patients, and for this reason, it cannot be compared directly with other studies conducted among people with type 2 diabetes that used other instruments to assess sleep-related issues. Notwithstanding the lack of direct comparability, these results are in overall agreement with these studies that report a high prevalence of sleep-related issues among people with diabetes. For example, using the Pittsburgh Sleep Quality Index (PSQI), Mahmood et al. studied 114 individuals with type 2 diabetes in Ireland and found that 44.7% had poor sleep quality [14]. Medeiros et al., using the same instrument in a sample of 110 type 2 diabetic patients in Brazil, found a prevalence of poor sleep quality in 53.3% [15]. Cho et al., using the PSQI in a sample of 614 patients in Korea, found a prevalence of poor sleep quality in 49% of type 2 diabetic patients [16], while Lopes et al. found that 100 type 2 diabetic patients in Brazil had poor sleep quality in 45% of cases using the PSQI [17].

The findings of the present study regarding the prevalence of short sleep are also somewhat in agreement with prior studies [18—21]. Mahmood et al. found that 19.3% of type 2 diabetics in Ireland had short sleep (<6 h) [14]. In the general population, the prevalence of EDS is estimated to

**Table 4** Characteristics of the study participants by Excessive Daytime Sleepiness status.

| | Excessive daytime sleepiness no *N* = 258 (88.7%) | Excessive daytime sleepiness yes *N* = 33 (11.3%) | *p* Value |
|---|---|---|---|
| Age (years) | 59.1 (11.1) | 56.5 (11.7) | 0.22 |
| Age category, % | | | 0.34 |
| <50 | 18.6 | 28.2 | |
| 50—60 | 32.9 | 31.3 | |
| 60—70 | 31.8 | 34.4 | |
| 70+ | 16.7 | 6.3 | |
| Female (%) | 33.3 | 69.7 | 0.69 |
| Race (%) | | | 0.69 |
| African | 21.3 | 24.2 | |
| East Indian | 75.2 | 69.7 | |
| Other | 3.5 | 6.1 | |
| Duration of diabetes (years) | 10 [6—20] | 10 [5—15] | 0.24 |
| Medications for diabetes, % | | | 0.16 |
| None | 0.4 | 3.5 | |
| Oral | 33.3 | 20.7 | |
| Insulin | 17.9 | 17.2 | |
| Both | 48.4 | 58.6 | |
| BMI (kg/m$^2$) | 28.6 (5.4) | 30.8 (4.9) | 0.04 |
| WHO BMI category (%) | | | 0.15 |
| Underweight | 1.8 | 0 | |
| Normal | 24.7 | 7.1 | |
| Overweight | 37.7 | 42.9 | |
| Obese | 35.9 | 50.0 | |
| Waist circumference (cm) | 99 [92—109] | 102 [97—112] | 0.09 |
| SBP (mmHg) *n* = 104 | 150.8 (25.2) | 148.2 (38.9) | 0.72 |
| DBP (mmHg) *n* = 104 | 80.4 (12.6) | 83.5 (14.7) | 0.27 |
| Total cholesterol (mg/dl) *n* = 243 | 185.7 (50.9) | 193.9 (51.4) | 0.46 |
| HDL-cholesterol (mg/dl) *n* = 236 | 48.1 (12.2) | 49.0 (20.5) | 0.83 |
| LDL-cholesterol (mg/dl) *n* = 231 | 108.3 (39.6) | 118.2 (40.9) | 0.30 |
| Triglycerides (mg/dl) *n* = 185 | 126.5 [94—196] | 159 [104—212] | 0.31 |

Data presented as mean (SD), median [IQR] or %. For percentages, column adds 100%.

range from 5% to 20% [3,22—24]. Cho et al. showed that the prevalence of EDS in type 2 diabetic patients was 8.5% using the ESS [16], while Lopes et al. found EDS in 26% of type 2 diabetic patients using the ESS [17]. The highest prevalence was seen in a study by Medeiros et al., which found that diabetic patients had EDS in 55.5% of cases, also using the ESS [15].

The present study showed the prevalence of EDS was 11.3%, as defined using the ESS questionnaire. This is in the lower range compared with global data. This may be due to cultural differences, and validated ESS may be needed in this population.

EDS can be associated with obstructive sleep apnea (OSA) and its negative metabolic consequences [1]. In addition; EDS may result in sleep-related difficulties that eventually lead to decreased job productivity and loss of employment. It can also lead to negative consequences, such as while driving or operation of heavy equipment. Further studies need to be done to fully assess the impact of EDS in this population.

It was found that younger age was associated with short and poor quality sleep. One of the reasons for these findings may be due to voluntary sleep restriction. The advancement in technology has been associated with an increase in leisure activities, such as increased gaming activity on mobile phones and laptop computers, online shopping, use of social media and watching online videos. The use of sleep education programs, cognitive behavioral therapy, and medical treatment may improve sleep hygiene in these patients and may be one of the targets of treatment of type 2 diabetic patients with poor sleep duration and quality.

This study also highlights a high prevalence of functional disability (poor concentration, difficulty remembering and difficulty in performing daily

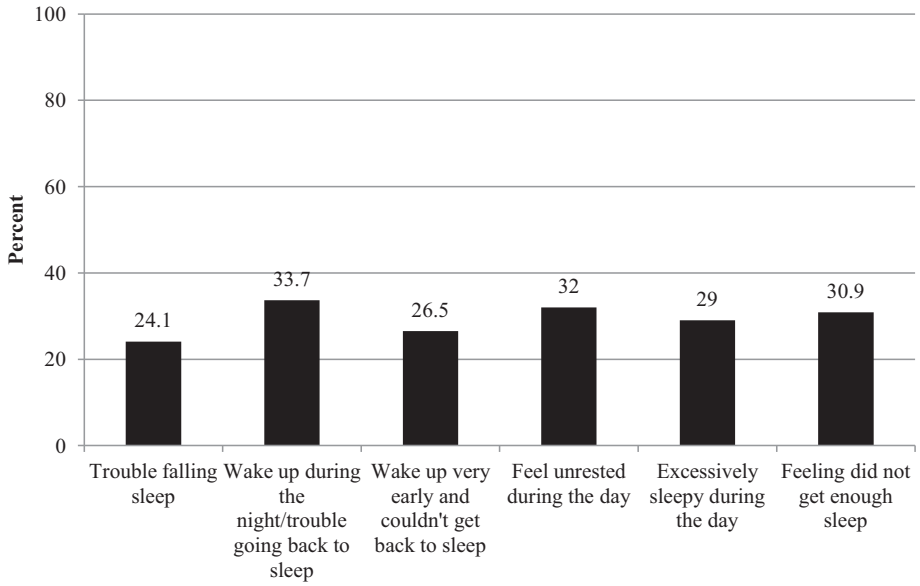


**Fig. 1** Prevalence of poor sleep quality symptoms.

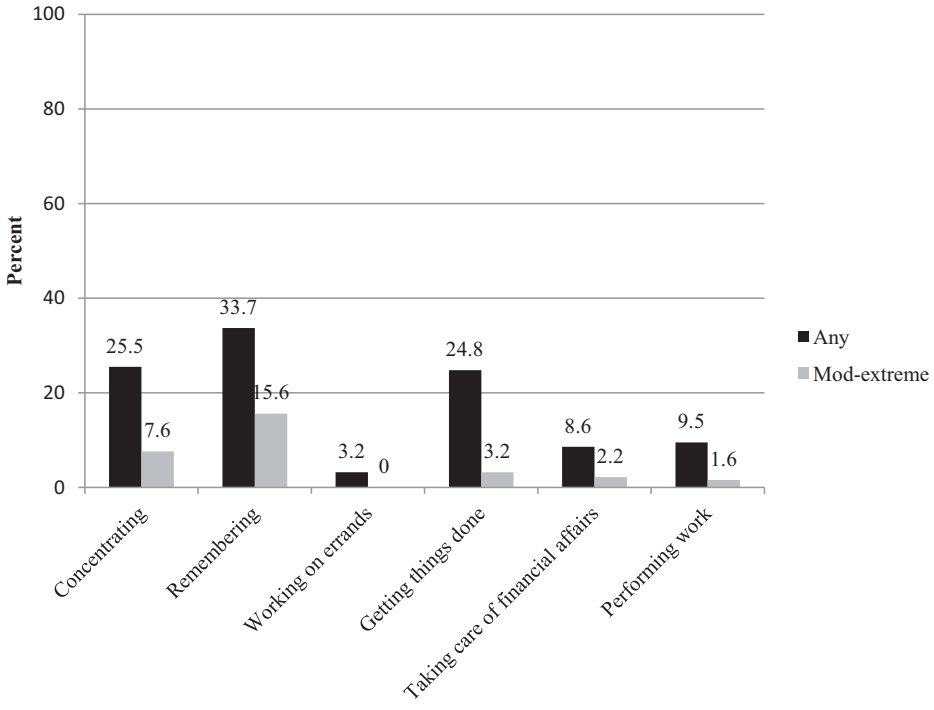


**Fig. 2** Prevalence of sleep-related difficulties.

activities) due to sleepiness or tiredness. To the knowledge of the researchers in the present study, no study has thoroughly assessed the extent of sleep functional disability-related difficulties in patients with type 2 diabetes. These results demonstrate the high burden of these conditions and highlight the need for more awareness, treatment and research.

This study also showed a high prevalence of snoring (54.7%). This is higher than estimates obtained in the American population (48%) [25]. Snoring is important as it is considered a marker for OSA [1], and OSA has significant negative metabolic effects. Given that there are existing therapeutic methods to improve OSA [1], more studies using state-of-the art methods to diagnose OSA

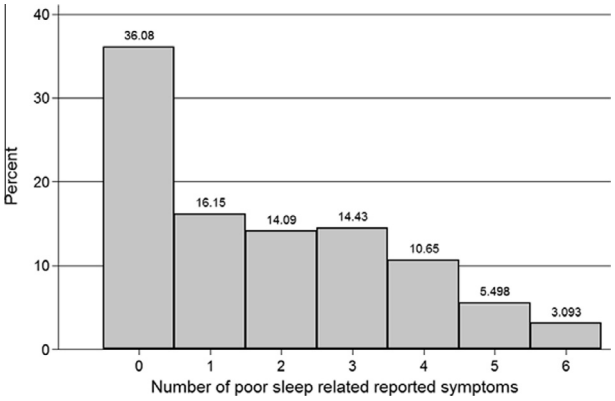


**Fig. 3** Distribution of poor sleep-related reported symptoms.

are needed to confirm the high prevalence of OSA in patients with type 2 diabetes and to target treatment.

Significant associations were found between short sleep duration, poor sleep quality and use of anti-diabetic medication. These findings may indirectly support the hypothesis of an association between worse glycemic control and sleep disturbances. HbA1c is the gold standard biomarker of glycemic control. However, challenges to the current availability and accuracy of HbA1c data in Trinidad have been observed and documented [26]. In the present study, only non-standardized HbA1c assays were available in a subset of individuals and, therefore, these data could not be used in the analyses.

Limitations of this study included the use of questionnaire-based assessments to characterize sleep-related issues. Clearly, future studies are needed with state-of-the-art assessments. Questionnaires developed in other study populations were also used which have not been validated in Trinidad. The present study used a non-representative sample in which only patients in the south of Trinidad were studied, so the results may not be generalizable to all type 2 diabetics in the country. Standardized laboratory data were lacking in order to examine the correlation between glycemic control and sleep disorders. Strengths of this study included being one of the first studies in the region to thoroughly characterize sleep disorders and difficulties in a sample from different communities in Trinidad.

These findings suggest a high prevalence of sleep disorders in patients with type 2 diabetes in the Caribbean region and highlight the need for subsequent studies. Future studies should evaluate the metabolic and cardiovascular consequences of these conditions and also address the awareness of the disease. Nevertheless, this study recommends that questions related to sleep habits be a part of the routine history taking in these patients and symptoms regarding sleep habits be actively enquired about.

## 5. Conclusion

Poor sleep quality, unhealthy sleep habits and sleep-related difficulties are highly prevalent among patients with type 2 diabetes in Trinidad. Sleep-related problems are associated with increased cardiovascular and metabolic consequences, and thus it is important to detect them. There needs to be increased awareness and surveillance of these sleep-related problems.

## Conflict of interest

No conflict of interest to declare.

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## References

[1] Institute of Medicine. Sleep disorders and sleep deprivation: an unmet public health problem. Washington, DC: The National Academies Press; 2006.
[2] Ram S, Seirawan H, Kumak SK, Clark GT. Prevalence and impact of sleep disorders and sleep habits in the United States. Sleep Breath 2010;14:63—70.
[3] Bixler EO, Vgontzas AN, Lin HM, Calhoun SL, Vela-Bueno A, Kales A. Excessive daytime sleepiness in a general population sample: the role of sleep apnea, age, obesity, diabetes, and depression. J Clin Endocrinol Metab 2005;90:4510—5.
[4] Luyster FS, Strollo Jr PJ, Zee PC, Walsh JKBoards of Directors of the American Academy of Sleep Medicine and the Sleep Research Society. Sleep: a health imperative. Sleep 2012;35:727—34.
[5] Hall MH, Muldoon MF, Jennings JR, Buysse DJ, Flory JD, Manuck SB. Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. Sleep 2008;31(5):635—43.
[6] Buxton OM, Marcelli E. Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. Soc Sci Med 2010;71:1027—36.

[7] Inkster B, Riha RL, van Look L, Williamson R, McLachlan S, Frier BM, et al. Association between excessive daytime sleepiness and severe hypoglycemia in people with type 2 diabetes, the Edinburgh type 2 diabetes study. Diabetes Care 2013;36(12):4157—9.
[8] Wu S, Wang R, Ma X, Zhao Y, Yan X, He J. Excessive daytime sleepiness assessed by the Epworth Sleepiness Scale and its association with health related quality of life: a population-based study in China. BMC Public Health 2012;12:849.
[9] International Diabetes Federation, Diabetes Atlas6th Edition 2013. Available at: http://www.idf.org/diabetesatlas Accessed August 10, 2014.
[10] Johns MW. Reliability and factor analysis of the Epworth Sleepiness Scale. Sleep 1991;15(4):376—81.
[11] National Health and Nutrition Examination Survey data. Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS). Available at: http://www.cdc.gov/nchs/data/nhanes/nhanes_07_08/slq07_08_eng.pdf. [accessed August 1, 2014].
[12] Bansil P, Kuklina EV, Merritt RK, Yoon PW. Associations between sleep disorders, sleep duration, quality of sleep, and hypertension: results from the National Health and Nutrition Examination Survey, to 2008. J Clin Hypertension 2005;2011:739—43.
[13] Liu R, Liu X, Zee PC, Hou L, Zheng Z, Wei Y, Du J. Association between sleep quality and C-reactive protein: results from national health and nutrition examination survey, 2005—2008.PLoS One 2014;9(3):e92607. Doi:10.1371/journal.pone.0092607. [eCollection].
[14] Mahmood WAW, Yusoff MSD, Behan LA, Di Perna A, Tun TK, et al. Association between sleep disruption and levels of lipids in caucasians with type 2 diabetes. Int J Endocrinol 2013:1—7, http://www.hindawi.com/12876414.
[15] Medeiros C, Bruin V, Férrer D, Paiva T, Montenegro Jr R, Forti A, et al. Excessive daytime sleepiness in type 2 diabetes. Arq Bras Endocrinol Metab 2013;57(6):425—30.
[16] Cho E-H, Lee HJ, Ryu OH, Choi MG, Kim S-W. Sleep disturbances and glucoregulation in patients with type 2 diabetes. J Korean Med Sci 2014;29(2):243—7.
[17] Lopes LA, Lins CMM, Adeodato VG, Quental DP, de Bruin PF, et al. Restless legs syndrome and quality of sleep in type 2 diabetes. Diabetes Care 2005;28:2633—6.
[18] Ford ES. Habitual sleep duration and predicted 10-year cardiovascular risk using the pooled cohort risk equations among US adults. J Am Heart Assoc 2014 Dec 2;3(6):e001454. http://dx.doi.org/10.1161/JAHA.114.001454.
[19] Ford ES, Li C, Wheaton AG, Chapman DP, Perry GS, Croft JB. Sleep duration and body mass index and waist circumference among U.S. adults. Obesity 2014 Feb;22(2):598—607. http://dx.doi.org/10.1002/oby.20558, Epub 2013 Oct 15.
[20] Ford ES, Wheaton AG, Chapman DP, Li C, Perry GS, Croft JB. Associations between self reported sleep duration and sleeping disorder with concentrations of fasting and 2-h glucose, insulin and glycosylated hemoglobin among adults without diagnosed diabetes. J Diabetes 2014;6(4):338—50. http://dx.doi.org/10.1111/1753-0407.12101, Epub 2013 Nov 27.
[21] Liu Y, Wheaton AG, Chapman DP, Croft JB. Sleep duration and chronic diseases among US adults age 45 years and older: evidence from the 2010 behavioral risk factor surveillance system. Sleep 2013;36(10):1421—7.
[22] Bixler EO, Kales A, Soldatos CR, Kales JD, Healey S. Prevalence of sleep disorders in the Los Angeles metropolitan area. Am J Psychiatry 1979;136:1257—62.
[23] Ohayon MM, Caulet M, Philip P, Guilleminault C, Priest RG. How sleep and mental disorders are related to complaints of daytime sleepiness. Arch Intern Med 1997;157:2645—52.
[24] Breslau N, Roth T, Rosenthal L, Andreski P. Daytime sleepiness: an epidemiological study of young adults. Amer J Public Health 1997;87:1649—53.
[25] Centers for Disease Control and Prevention. Unhealthy sleep-related behaviours. MMWR 2011;60:233—8.
[26] Dhanoo A, Cockburn BN, Shah N, Superville R, Hill-Briggs F. Monitoring of International Diabetes Federation-recommended clinical diabetes indicators in a public health centre in south-west Trinidad. West Indian Med J 2014;63(6). http://dx.doi.org/10.7727/wimj.2014.026.