A cross-sectional study on the sleep quality among type 2 diabetes mellitus patients and its associated factors

Norhazimah Saparwan, MBBS[1,2], Noorlaili Mohd Tohit, PhD[2], Salmiah Md Sharif, MMed Fam Med[3]

[1]Klinik Kesihatan Seremban 2, Ministry of Health Malaysia, Negeri Sembilan, Malaysia, [2]Department of Family Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Bandar Tun Razak, Kuala Lumpur, Malaysia, [3]Klinik Kesihatan Seremban, Ministry of Health Malaysia, Negeri Sembilan, Malaysia

ABSTRACT

Introduction: Poor sleep quality is common among patients with type 2 diabetes mellitus (T2DM). It has detrimental effects on physical and psychological health, as well as on quality of life. This study aimed to determine the prevalence of poor sleep quality among T2DM patients and to investigate the factors associated with this disorder.

Materials and Methods: A cross-sectional study was conducted at Klinik Kesihatan Seremban in Seremban district, Negeri Sembilan. Data were collected using the Malay version of the Pittsburgh Sleep Quality Index (PSQI-M) with a cut-off point of >5 as poor sleep quality. The Depression Anxiety Stress Scale-21 (DASS-21) was used to measure level of psychological distress. Data were collected between July 2022 until January 2023.

Results: A total of 319 patients with T2DM participated. Their mean age was 63 (11) years, 58% were women and 42.9% were of Indian ethnicity. The mean total score of PSQI was 4.04 (2.21) and 23% of the participants had poor sleep quality. Multivariate logistic regression analysis revealed that poor sleep quality was significantly associated with Indian ethnicity (Adj. OR = 2.25; 95%CI: 1.05, 4.82; *p* = 0.037), separated or widowed (Adj. OR = 2.16; 95%CI = 1.15, 4.05; *p* = 0.016), having nocturia (Adj. OR = 2.13; 95%CI = 1.18, 3.84; *p* = 0.012) and depressive symptoms (Adj. OR = 3.41; 95%CI: 1.01, 11.48; *p* = 0.048).

Conclusion: Poor sleep quality was prevalent in almost a quarter of T2DM patients studied. Indian ethnicity, separated or widowed, having nocturia, and depressive symptoms were independently associated with poor sleep quality. Despite lower prevalence of poor sleep quality compared to other studies, identification of those at higher risk warrants further exploration in lifestyle management of patients with T2DM.

KEYWORDS:
type 2 diabetes mellitus, sleep quality, psychological distress

INTRODUCTION

Sleep is a physiological need for all human beings as it is important for both physical and psychological health. Its benefits for vital functions at cellular, metabolic, neurological, cardiovascular, cognitive and emotional level are extensively studied.[1] Despite individual variability with age across lifespan, recommended optimal healthy sleep duration for adults is 7 to 9 hours a day.[1] Some indicators for good sleep quality are shorter sleep latency, fewer awakenings, less time needed to wake after sleep onset, and higher sleep efficiency.[2] Short sleep duration (< 6 hours per 24-hour) and long sleep duration (> 9 hours per 24-hour) are associated with multiple morbidities.[1,3] Poor sleep quantity and quality are implicated for the development and control of type 2 diabetes mellitus (T2DM) and obesity.[3-5] Inadequate sleep causes hormonal imbalance in the body, which induces increases in appetite, blood sugar and insulin resistance resulting in obesity and poor glycaemic control.[3] Hence, higher prevalence of sleep problem is expected among T2DM patients with obesity and poor glycaemic control.

Prevalence of sleep problems among the general adult population in Asia Pacific region ranged from 15 to 45%.[6-9] Meanwhile, approximately 33 to 81% of T2DM patients reported sleep problems[5,8,10,11] and the proportion was comparatively higher than the general population.[8] Diabetes mellitus (DM) is a growing public health concern worldwide. Globally in 2021, International Diabetes Federation reported around 537 million people live with diabetes[12], while in Malaysia it was estimated that 3.9 million (18.3%) of the adult population had deranged glycaemic index in 2019; compared to only 13.4% in 2015.[13] These numbers are forecasted to expand further in the future. Studies showed that higher age, female gender, high BMI, poor glycaemic control, longer duration of diabetes, diabetic complications and psychological factors increased the risk for poor sleep quality among T2DM patients.[5,8,10,11,14] Some of the factors are modifiable with multiple benefits such as weight management, glycaemic control and better mental health. In Malaysia, there is a dearth of information reported on sleep quality and its associated factors among T2DM patients. This study aimed to identify the prevalence of poor sleep quality and determine its associated factors among patients with T2DM.

MATERIALS AND METHODS

Study design, location, and population

This is a cross-sectional study conducted from July 2022 until January 2023 at a non-communicable diseases (NCD) clinic, Klinik Kesihatan Seremban in the Seremban district of Negeri Sembilan. Participants of this study were National Diabetes Registry (NDR) patients from the clinic. Until June 2021, this clinic had a total of 5445 registered diabetic patients

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Corresponding Author: Noorlaili Mohd Tohit
Email: laili@ppukm.ukm.edu.my

consisting of 38.7% Indians, 38.5% Chinese, 22.1% Malay and 0.7% other ethnics (unpublished data).

Sample Size

Sample size was calculated using the population proportion formula with a population size of 5445 registered T2DM patients in the clinic, 95% confidence interval, 5% margin of error and 32% population proportion from a local sleep quality study among T2DM patients.[15] Sample size needed was 316. Considering 10% non-response rate, 347 participants should be recruited. Each answered questionnaire was immediately checked for completion to reduce non-responder.

Data Collection and Sampling Method

Systematic random sampling was carried out with a sampling interval of two, based on the T2DM patient appointment list extracted from the tele-primary care (TPC) system with up to 90 patients listed per day. Each patient is numbered, and a computer-generated random number was used to select the first patient followed by every other patient in the list to intensify recruitment.

Data collection was only done for a fixed day in a week for 24 weeks as the main researcher (NS) had clinical duties in the clinic. Recruitments were challenging as some listed patients were affected by Covid19 infection or close contact or there were other reasons hindering clinic visit.

Malaysian citizens aged 18 years and above, diagnosed with T2DM of at least six months duration, having attended diabetic follow-up at Klinik Kesihatan Seremban, having latest HbA1c result within one year and literate in Malay or English were invited to participate. Those having conditions or illness that do not permit completion of the self-administered questionnaire, working in night shifts or travelling across time zones within one month, pregnant women, breastfeeding mothers, those with type 1 diabetes mellitus (T1DM), having mental illness or use of any kind of psychotropic medication, having sleep disorder diagnosed prior to diabetes, having endocrine disorders (for example thyroid disease), chronic use of glucocorticoid and having heart failure were excluded from selection. A brief introduction about the study was given to those recruited, and written informed consent was obtained. A self-administered questionnaire was given to the participants which took about 15 minutes to be completed. A researcher was available on-site for further assistance if necessary.

Study Instruments

Data was collected using a structured questionnaire consisting of four parts: sociodemographic data, clinical profile, sleep quality questionnaire and Depression, Anxiety and Stress Scale 21-Item questionnaire (DASS-21). It was available in dual language, in Malay and English.

Part I comprised of personal data of participant such as age, gender, ethnicity, marital status, educational level, employment status, and estimated household income.

Part II documented their clinical profiles such as duration of T2DM, body mass index (BMI), HbA1c level, nocturia, comorbidities and diabetic complications. Body mass index was calculated using the weight and height measured by the standardized stadiometer with a weighing scale during the day of follow-up. The most recent HbA1c levels within the past one year were documented from the electronic medical record system. Other clinical information was collected from participants' home-based follow-up cards and confirmed with the electronic medical record system.

Part III was the Pittsburgh Sleep Quality Index (PSQI). This self-administered questionnaire developed in 1989 with the main goal of differentiating between people who slept well and poorly over the past one month.[16] It was locally translated to Malay (PSQI-M) and validated with Cronbach alpha of 0.74 for internal consistency and test-retest reliability of 0.58.[17] The PSQI is a self-reported questionnaire with 19 items from seven components that assesses subjective sleep quality. The seven components are (1) sleep quality (1 item), (2) sleep latency (2 items), (3) sleep duration (1 item), (4) sleep efficiency (3 items), (5) sleep disturbance (9 items), (6) sleep medication (1 item) and (7) daily dysfunction (2 items). Each component is given a value between 0 and 3, and the aggregate of the individual components results in a PSQI global score between 0 and 21. A score of 5 or less indicates "good sleepers," whereas a score of greater than 5 indicates "poor sleepers".[16]

For Part IV, depression, anxiety, and stress were measured using the Depression, Anxiety and Stress Scale (DASS 21).[18] Part IV contains 21 items divided into three subscales of depression, anxiety, and stress, with seven items allocated for each subscale. It inquired about recent experiences in the past week and the items were scored on a 4-point scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). The range of score a participant could get for each subscale varied from 0 to 21. The total scores were summed up and multiplied by 2.[18] The recommended cut-off points were used to classify participants into normal, mild, moderate, severe, and extremely severe in terms of depression, anxiety, and stress as in Table I. Participants were classified as having depressive or anxiety or stress symptoms if they scored above the cutoff point for normal in the respective subscale. The validated Malay version of DASS21 used in this study reported Cronbach's alpha of 0.84, 0.74 and 0.79 for depression, anxiety, and stress, respectively.[19]

Data Analysis

Data were analysed using the SPSS software version 27. Descriptive analysis was performed using frequencies and percentages for categorical variables and mean ± standard deviation (SD) for continuous variables. Simple and multiple logistic regression analyses were used to determine factors independently associated with sleep quality. Variables with $p < 0.25$ in the simple logistic regression and important variables from literature were further assessed in multiple logistic regression. p-value of < 0.05 was set as level of significant.

Table I: Cutoff points for DASS-21 scale [18]

Severity	Depression	Anxiety	Stress
Normal	0-9	0-7	0-14
Mild	10-13	8-9	15-18
Moderate	14-20	10-14	19-25
Severe	21-27	15-19	26-33
Extremely severe	28+	20+	34+

Table II: Socio-demographic characteristics of all participants

Factors		Sleep quality, n (%)		n (%)
		Poor sleep (n = 74)	Good sleep (n = 245)	
Age (years)*		63 (12)	62 (10)	63 (11)
Gender	Female	50 (27.0)	135 (73.0)	185 (58.0)
	Male	24 (17.9)	110 (82.1)	134 (42.0)
Ethnicity	Malay	14 (18.9)	60 (81.1)	74 (23.2)
	Indian	41 (29.9)	96 (70.1)	137 (42.9)
	Chinese	19 (17.6)	89 (82.4)	108 (33.9)
Marital Status	Single	4 (16.0)	21 (84.0)	25 (7.8)
	Married	43 (19.4)	179 (80.6)	222 (69.6)
	Separated	5 (45.5)	6 (54.5)	11 (3.4)
	Widowed	22 (36.1)	39 (63.9)	61 (19.1)
Education level	No formal education	7 (43.8)	9 (56.3)	16 (5.0)
	Primary education	17 (19.8)	69 (80.2)	86 (27.0)
	Secondary education	44 (24.4)	136 (75.6)	180 (56.4)
	Tertiary education	6 (16.2)	31 (83.8)	37 (11.6)
Employment status	Employed	16 (18.4)	71 (81.6)	87 (27.3)
	Unemployed	42 (25.3)	124 (74.7)	166 (52.0)
	Pensioner	16 (24.2)	50 (75.8)	66 (20.7)
Household income (RM) *		2122 (3008)	1778 (2300)	1858 (2481)

*Mean (SD)

Table III: Clinical characteristics of all participants

Factors		Sleep quality, n (%)		n (%)
		Poor sleep (n = 74)	Good sleep (n = 245)	
Duration of T2DM(years)*		6.8 (6.7)	7.1 (6.2)	7 (6.0)
BMI (kg/m2)*		27.4 (5.7)	27 (4.5)	27.1 (4.8)
BMI categories	Underweight/normal (BMI ≤ 22.9)	16 (26.7)	44 (73.3)	60 (18.8)
	Overweight (BMI 23-27.4)	27 (22.5)	93 (77.5)	120 (37.6)
	Obese (BMI ≥ 27.5)	31 (22.3)	108 (77.7)	139 (43.6)
HbA1c grouping	Uncontrolled (≥7 %)	42 (23.9)	134 (76.1)	176 (55.2)
	Controlled (< 7%)	32 (22.4)	111 (77.6)	143 (44.8)
Nocturia	Yes	50 (30.1)	116 (69.9)	166 (52.0)
	No	24 (15.7)	129 (84.3)	153 (48.0)
Comorbidities	No comorbidities	3 (13.0)	20 (87.0)	23 (7.2)
	Hypertension	17 (23.3)	56 (76.7)	73 (22.9)
	Dyslipidemia	13 (28.9)	32 (71.1)	45 (14.1)
	Both	42 (21.6)	152 (78.4)	194 (60.8)
Diabetic complications	No complication	58 (22.1)	205 (77.9)	263 (82.4)
	Retinopathy	0 (0.0)	4 (100.0)	4 (1.3)
	Nephropathy	9 (33.3)	18 (66.7)	27 (8.5)
	Ischemic heart disease	5 (27.8)	13 (72.2)	18 (5.6)
	Cerebrovascular accident	2 (22.2)	7 (77.8)	9 (2.8)
Depression	Normal	63 (21.0)	237 (79.0)	300 (94.0)
	Mild	5 (50.0)	5 (50.0)	10 (3.1)
	Moderate	2 (40.0)	3 (60.0)	5 (1.6)
	Severe to extremely severe	4 (100.0)	0 (0.0)	4 (1.3)
Anxiety	Normal	64 (21.2)	238 (78.8)	302 (94.7)
	Mild	4 (44.4)	5 (55.6)	9 (2.8)
	Moderate	4 (80.0)	1 (20.0)	5 (1.6)
	Severe to extremely severe	2 (66.7)	1 (33.3)	3 (0.9)
Stress	Normal	63 (20.8)	240 (79.2)	303 (95.0)
	Mild	4 (50.0)	4 (50.0)	8 (2.5)
	Moderate	5 (100.0)	0 (0.0)	5 (1.6)
	Severe to extremely severe	2 (66.7)	1 (33.3)	3 (0.9)

*Mean (SD)

Table IV: Factors associated with sleep quality among participants using simple logistic regression

Factors		ß	Crude OR (95% CI)	Wald test	*p* value
Age (years)*		0.01	1.00 (0.98, 1.03)	0.51	0.474
Gender	Female	0.52	1.69 (0.98, 2.93)	3.58	0.058
	Male		ref		
Ethnicity	Malay		ref		
	Indian	0.60	1.83 (0.92, 3.63)	2.97	0.085
	Chinese	-0.89	0.91 (0.42, 1.96)	0.05	0.820
Marital status	Married		ref		
	Single	-0.28	0.75 (0.24, 2.29)	0.24	0.618
	Separated/widow	0.91	2.48 (1.38, 4.44)	9.39	0.002
Education level	No formal/primary education	0.46	1.59(0.59, 4.26)	0.84	0.357
	Secondary education	0.51	1.67 (0.65, 4.27)	1.15	0.283
	Tertiary education		ref		
Employment status	Employed		ref		
	Unemployed/pensioner	0.39	1.47 (0.79, 2.74)	1.53	0.215
Duration of T2DM (years)*		-0.009	0.99 (0.95, 1.03)	0.16	0.687
BMI categories	Underweight/normal (BMI ≤ 22.9)		ref		
	Overweight (BMI 23-27.4)	-0.22	0.79 (0.39, 1.63)	0.38	0.537
	Obese (BMI ≥ 27.5)	-0.23	0.78 (0.39, 1.58)	0.44	0.506
HbA1c grouping	Uncontrolled (≥7 %)	0.08	1.08 (0.64, 1.83)	0.09	0.755
	Controlled (< 7%)		ref		
Nocturia	Yes	0.84	2.31 (1.34, 4.00)	9.04	0.003
	No		ref		
Comorbidities	No comorbidities		ref		
	Hypertension	-0.01	0.99 (0.53, 1.84)	<0.001	0.983
	Dyslipidemia	0.35	1.41 (0.70, 2.87)	0.94	0.331
	Both	-0.21	0.80 (0.47, 1.36)	0.66	0.415
Diabetic complications	No complication	0.34	1.41 (0.73, 2.70)	1.09	0.296
Depression	Yes	1.64	5.17 (1.99, 13.40)	11.44	0.001
	No		ref		
Anxiety	Yes	1.67	5.31 (1.94, 14.50)	10.61	0.001
	No		ref		
Stress	Yes	2.12	8.38 (2.81, 25.00)	14.53	<0.001
	No		ref		

* Mean (SD)

Ethical Approval

This study was approved by Universiti Kebangsaan Malaysia Research Ethics Committee (JEP-2021-800) and Institute of Medical Research Ethics Committee. This project was registered with the National Medical Research Registration (NMRR ID-21-01986-E44). Permission to conduct the research was also obtained from the Negeri Sembilan State of Health Department, Seremban District Health Office, and the Family Medicine Specialist in Klinik Kesihatan Seremban.

RESULTS

Response Rate

A total of 346 T2DM patients were approached, however 15 patients refused, and 12 were excluded due to T1DM (one participant), three had underlying mental problems, four had been working night shift for the past one month and another four had thyroid disorders. All 319 participants completed the questionnaire making the response rate of 100%.

Characteristics of Participants

Mean age of the participants was 63 years and more than half of them were women (58%) (Table II). Indians made up the largest ethnic group (42.9%), more than half of the participants had at least secondary education levels (56.4%), two-third were married (69.6%) and half of them were unemployed (52%). Slightly more than half of the participants had uncontrolled T2DM with HbA1c more than 7% (55.2%) and two fifth of them were obese (43.6%) (Table III). Majority were having comorbidities (97.8%) with nearly two-third of them having both hypertension and dyslipidaemia (60.8%). Most of the participants had no diabetic complications (82.4%) and about half of them (52%) experienced nocturia for the past one month. Nephropathy was the most common complication, followed by Ischemic Heart Disease, Cerebrovascular Accident, and lastly Diabetic Retinopathy. Participants with depressive, anxiety and stress symptoms were about 6%, 5.3% and 5%, respectively.

Prevalence of poor sleep quality

The total mean PSQI score among the participants was 4.04 (2.21) with 23% participants had PSQI score of >5, indicating poor sleep quality.

Factors associated with poor sleep quality

Simple logistic regression revealed $p < 0.25$ for gender, ethnicity, marital status, employment, having nocturia and psychological distress namely depression, anxiety, and stress (Table IV). All the above variables and six other important variables identified from literature, namely age, BMI category, HbA1c group, duration of T2DM, co-morbidity and diabetic complications were also included for multivariate analysis.

Table V: Factors associated with poor sleep quality using multiple logistic regression

Factors		Multiple logistic regression[a]			*p* value
		ß	Adjusted OR (95% CI)	Wald test	
Ethnic	Malay	ref		6.17	0.046
	Chinese	0.16	1.18 (0.51, 2.71)	0.15	0.701
	Indian	0.81	2.25 (1.05, 4.82)	4.37	0.037
Marital	Married	ref		7.21	0.027
	Single	-0.46	0.64 (0.19, 2.05)	0.58	0.446
	Separated/widow	0.77	2.16 (1.15, 4.05)	5.81	0.016
Nocturia	Yes	0.76	2.13 (1.18, 3.84)	6.36	0.012
	No	ref			
Depressive symptoms	Yes	1.23	3.41 (1.01, 11.48)	3.92	0.048
	No	ref			

[a]Backward stepwise likelihood ratio multiple logistic regression method was applied.
Multicollinearity and interaction terms were checked and not detected.
Hosmer–Lemeshow GOF test (p < 0.001), classification table (overall correctly classified percentage = 76.8%) were applied to check the model fitness.

In the multiple logistic regression analysis shown in Table V, Indian ethnicity, having nocturia, separated or widowed, and having depressive symptoms were significant independent factors associated with poor sleep quality. Indian participants had 2.25 times the odds (Adj. OR = 2.25; 95% CI = 1.05, 4.82) of having poor sleep quality compared to Malays. Those who were separated or widowed had two times the odds (Adj. OR = 2.16; 95% CI = 1.15, 4.05) of having poor sleep quality than those who were married. T2DM patients with nocturia had 2.13 times the odds (Adj. OR = 2.13; 95% CI = 1.18, 3.84) of having poor sleep quality than T2DM patients without nocturia. Those with depressive symptoms have more than 3 times higher risk (Adj. OR = 3.41; 95% CI = 1.01, 11.48) of having poor sleep quality compared to those without depressive symptoms.

DISCUSSION

Prevalence of Poor Sleep Quality

The results of the present study demonstrated that 23% of T2DM patients participated had poor sleep quality. This finding is the lowest prevalence compared to other studies among T2DM patients.

Internationally, studies showed prevalence of poor sleep quality among T2DM patients ranging from 33.6% in China,[10] 38.1% in Iran,[20] 47.2% in Ethiopia,[21] 47.6% in Kanagawa, Japan[5] to 81% in Jordan.[11] Another study in Japan reported 43.9% poor sleep quality among T2DM patients compared to 38.4% among control group.[8] Meanwhile in east coast Malaysia, a recent study among 350 T2DM patients in Kelantan found 32% of them having poor sleep quality.[15] Lower prevalence in our study could be attributed to different socio-demographic and clinical characteristics of the participants as seen in a study among multiethnic population in Singapore.[22] Other local studies among various population groups reported higher proportion of poor sleep quality such as in working adults (45%),[17] nurses (57.8%),[23] secondary school teachers (61%)[24] and pre-clinical medical students (63.9%).[25]

Nevertheless, more importantly the impact of both diabetes mellitus and poor sleep was associated with higher risk of all-cause mortality compared to either condition alone, as reported in UK Biobank cohort data.[26]

Associated Factors for Poor Sleep Quality

Indian ethnicity, separated or widowed, having nocturia and having depressive symptoms showed four independent factors of poor sleep quality in this study. Another local study among T2DM patients in Kelantan reported nocturia, restless leg syndrome and emotional distress were significantly associated with poor sleep.[15]

The ethnic distribution of our study participants were 42.9% Indians, 33.9% Chinese and 23.2% Malays, almost similar to the NDR proportion in the clinic. Comparison for ethnicity was limited by unavailability of local study among T2DM patients of multiethnic groups. Local studies among secondary school students and elderly population showed higher proportion of poor sleep quality among Indian participants compared to all participants, though the difference was not statistically significant.[27,28] A population study of sleep quality among Singapore residents with multiethnic representation showed Indian and Malay ethnicities were at higher odds of poor sleep quality compared to Chinese.[22] A review of sleep studies in the United States of America showed that ethnic minorities were at a disadvantage for sleep health disparities compared to White populations.[29] Psychosocial stressors, neighbourhood context, socioeconomic status and access to and utilization of health care were some factors attributed to the sleep health disparities which could possibly explained the higher prevalence of poor sleep among Indians in our study.[29]

In terms of marital status, a study in Singapore reported that those divorced/separated were at higher risks of poor sleep quality compared to married participants, which is consistent with our findings.[22] Those divorced and widowed could possibly be at socioeconomic disadvantage and under higher psychosocial stressor.[29,30]

Participants having nocturia had more than two times the odds of experiencing poor sleep compared to those without nocturia. Nocturia among T2DM patients was another independent predictor of poor sleep quality in our study consistent with a local study done among T2DM patients in Kelantan.[15] Among Asian population, another study in Singapore similarly reported nocturia as the only significantly associated factor with poor sleep quality among 199 elderly with T2DM, hyperlipidaemia and hypertension.[31] A recent large meta-analysis explored the relationship

between diabetes and nocturia, and found that diabetes itself increased the risk of nocturia by approximately 49%.[32] Poor glycaemic control has been implicated as a cause for nocturia. Nonetheless, in our study, post-hoc analysis showed less than a third of the participants (29.7%) with nocturia had poor glycaemic control, which could explain why nocturia was significantly associated with poor sleep quality but poor glycaemic control was not. Hence, the presence of nocturia should be assessed in people with poor sleep quality as it was not necessarily related to poor glycaemic control.

Psychological distress was another factor that showed significant association with poor sleep quality. National Health Morbidity Survey 2019 reported depression in 2.3% of adults in Malaysia with Negeri Sembilan had among the highest prevalence at 5%.[13] Similarly the proportion of participants with possible depression in our study was 6%. In this study, we found that those with depressive symptoms had more than three times the odds of having poor sleep quality compared to those without depressive symptoms. The association between psychological distress and poor sleep quality had been consistently reported in many other studies. Local studies on sleep quality among secondary school students and the elderly attending a primary care clinic reported psychological distress was significantly associated with sleep quality.[27,28] Studies among T2DM patients locally and abroad reported similar association.[14,15,21] A study conducted among 289 T2DM patients in outpatient diabetic clinic of a private hospital setting in Myanmar showed 27.7% of participants had depression and it was significantly associated with poor sleep quality (AOR = 7.52, 95%CI = 3.38–14.76).[33] Another study in China among 281 T2DM patients with comorbid metabolic syndromes also found depressive symptoms as an independent predictor of poor sleep quality and reported further association between depressive symptoms with long sleep latency and short sleep duration.[34] This association is understandable as insomnia or hypersomnia are established symptoms of depression in The Diagnostic and Statistical Manual of Mental Disorders (DSM-5).[35] Emotion regulation, described as various efforts to modify the experience and expression of emotions, has been implicated to sleep quality and depression.[36] Impaired emotion regulation was reported as a mediator to current and prospective relationship between poor sleep quality and depressive symptoms.[36]

Higher BMI and poor glycaemic control were two important factors that were not significantly associated with poor sleep quality in our study. We postulated, higher BMI, as one of the critical risk factors for the development of Obstructive Sleep Apnea (OSA) could be associated with poor sleep quality, in our study. NHMS 2019 reported overweight (BMI >25 kg/m²) and obesity (BMI>30 kg/m²) in about 50% of Malaysian adults.[13] In our study, using lower cut-off point we found higher proportion of overweight (BMI 23-27.4 kg/m²) and obesity with (BMI ≥27.5 kg/m²) at 37.6% and 43.6%, respectively. Interestingly both groups with overweight and obesity reported lower proportion of poor sleep quality at 22.5% and 22.3%, respectively. Consistent with our finding, a local study done among T2DM attending a primary care clinic also did not find significant association between higher BMI with poor sleep quality even though 91.7% of their participants were overweight or obese with BMI >23 kg/m².[15] Further exploration is needed to investigate sleep quality among our overweight and obese populations.

Studies reported inconsistent association between poor glycaemic control and poor sleep quality. A Japanese study found diabetes patients with higher quartile HbA1c >7.9% had significantly higher global PSQI score than the other group with better glycaemic index.[5] Studies in Jordan and Ethiopia also found poor glycaemic control was associated with poor sleep quality.[11,21] However, another local study and other studies in Japan, Iran, Myanmar, and Saudi Arabia reported no significant association.[8,14,15,33,37] A systematic review and meta-analysis highlighted that short sleep less than 5 hours and long sleep durations more than 8 hours were associated with an increased HbA1c compared to normal sleep.[38] Even though in our study more than half of participants (55.2%) had uncontrolled HbA1c >7%, it was not significantly associated with poor sleep quality. Hence, further investigation assessing amount of sleep as well as broader stratification of HbA1c could be useful to see its association with glycaemic control. Keeping continuous variables such as BMI and HbA1c for continuous analyses instead of categorical analyses could be more meaningful.[39]

One of the limitations in this study was that the sleep quality was subjectively assessed using the PSQI. Apart from its acceptance as a standardized tool, it is not an objective measure like polysomnography. Secondly, a cross-sectional design of this study can only suggest an association, not the cause and effect, for poor sleep quality. In interpreting our results, caution is needed due to the single-centered setting. Our findings would be at most, inferred from the local population attending our primary care clinic. Other than that, mode of treatment especially insulin use, nocturnal hypoglycaemia, painful neuropathy and restless leg syndrome which could be related to poor sleep quality among T2DM were not assessed in this study.

CONCLUSION

This study found that 23% of our studied population have poor sleep quality. Indian ethnicity, separated or widowed, having nocturia and depressive symptoms were independent factors significantly associated with poor sleep quality. Assessment of sleep quality should be considered in the management of T2DM patients. Improving sleep quality might involve a simple measure that does not cost much and the ultimate outcome is to maximize the care towards our diabetic patients indirectly improving their quality of life.

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ETHICAL APPROVAL

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