Sleep Quality and Associated Factors Among Type 2 Dm Patients and Non-Dm Individuals in Bahir Dar Governmental Hospitals: Comparative Cross-Sectional Study

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Abstract

Background: Multiple factors may contribute to sleep disruption in type 2 diabetic individuals. Sleep disruption in type 2 diabetic individuals is frequently associated with long-term damage, dysfunction, and failure of different organs. Nevertheless, literature in this regard is scanty in Ethiopia. Therefore, this study aimed to assess and compare the prevalence of poor sleep quality and associated factors among type 2 diabetic and non-diabetic individuals in Bahir Dar governmental hospitals.

Methods: Comparative cross-sectional study was employed among 292 individuals with type 2 diabetes and 291 non-diabetic individuals in Bahir Dar governmental hospitals from March 01- to April-01. A two-stage cluster sampling method was employed to select participants. Pittsburgh sleep quality index was used for assessing sleep quality. For analysis, descriptive and summary statistics were used to determine the prevalence and percentage of variables. Chi-square test was also used for comparison. Binary logistic regression analysis was employed to determine the associated factors of poor sleep quality.

Result: The prevalence of poor sleep was 50.7% (95% CI; 44.9-56.2) and 31.8% (95% CI 26.5-37.5) among individuals with type 2 diabetes and non-diabetic individuals respectively. Among the overall participants being type 2 diabetic patient was also found significantly associated with poor sleep quality as compared to non-diabetic individuals (AOR=1.89; 95% CI; 1.19-2.87). Comorbidity, duration of DM >10 years, Poor glycaemic control, having depression, low physical activity, and poor social support were factors significantly associated with poor sleep quality among individuals with type 2 diabetes. Among non-diabetic individual's low physical activity, poor social support, having depression, and age group (>50 years) were factors significantly associated with poor sleep quality.

Conclusion: In this study, the prevalence of poor sleep among individuals with type 2 diabetes was higher than non-diabetes individuals.

Introduction

According to a simple behavioral definition, "sleep is a reversible behavioral state of perceptual disengagement and unresponsiveness to the environment". It is also a complex combination of physiologic and behavioral processes(1).

Sleep is also significant for the regulation of body temperature, immune defense, energy conservation, survival adaptation, removal of toxins generated during awake fullness, and facilitation of overall neuronal function(2).

Sleep problems are highly prevalent and include a reduction in quantity and quality of sleep. Several factors contribute to sleep disruption including lifestyle, environmental, psychosocial, sleep disorders, and medical conditions(3). Type 2 DM is also linked with a higher prevalence of sleep disorders. Multiple factors may contribute to sleep disorder in type 2 diabetes patients including impaired glucose

metabolism, nocturia, restless leg syndrome, depression, diabetic complications, and associated comorbidities with diabetes(4).

Sleep disruption had both short and long-term consequences which include increased stress responsivity, reduced quality of life (QoL), mental health problems, and other non-communicable diseases in healthy individuals(3, 5, 6). Additionally, sleep disruption in individuals with type 2 DM results in insulin resistance, and chronic hyperglycemia which is associated with long-term damage, dysfunction, and failure of different organs(7).

A study also shows the absolute mortality rate in adults with diabetes and longer sleep duration is also high(8). As a result, the US National Sleep Foundation works to make sleep a recognized "vital sign" for health(9). In USA the CDC also declared that insufficient sleep is a 'public health epidemic(10).

Studies across the world report poor sleep quality with a wide range of prevalence among type 2 diabetic individuals. In the USA more than half of individuals with diabetes (55%) were "poor sleepers" according to the Pittsburgh Sleep Quality Index(11). The prevalence of poor sleep in the Asian continent range from 43.9-78.4%, In Africa, the magnitude of poor sleep quality among type 2 DM patients ranges from 50%-97%(12, 13). In Ethiopia, a study conducted in Jimma revealed that the prevalence of poor sleep quality among type 2 diabetes patients was 55.6% and 32.8% among relatively healthy individuals(14).

Concomitantly in recent decades, huge increases in diabetes prevalence have been shown in almost all regions of the world. The global diabetes prevalence in 2019 was 9.3% (463 million people)(15). A review in Ethiopia shows that the prevalence of undiagnosed diabetes ranged from 2.0%–6.5% (16).

Nevertheless, literature on the occurrence of poor sleep quality among individuals with type 2 DM is not well documented. In general, we can fairly say that the association between DM and sleep quality and its magnitude in Ethiopia is not well established. Therefore, this study aims to assess and compare the sleep quality of type 2 DM and non-DM individuals and identify its associated factors.

Method And Materials

Study design and period

Institutional based comparative cross-sectional study was conducted from March 01 to April 01.2021.

Study Area

This study was conducted in Bahir Dar the capital of Amhara national regional state in Ethiopia located approximately 578 km northwest of Addis Ababa. The city is *located* at the exit of the Abbay from Lake Tana at an altitude of 1,820 meters (5,970 ft) above sea level. There are three governmental hospitals in the city these are, Felege Hiwot referral hospital, Tibebe Gihon specialized hospital, and Adiss Alem hospital. It's estimated that the total number of individuals with type 2 DM in follow-up service in the three

governmental hospitals is 6,500. On average approximately 650 individuals with type 2 DM are expected to come for follow-up within one month.

Source of population

The source population are all adult type 2 DM patients attending follow-up service in Bahir Dar governmental hospitals and the comparison groups are individuals who appear healthy in Bahir Dar governmental hospitals (patient accompanies in the medical OPD).

Study population

Type 2 DM patients who were attending follow-up service in Bahir Dar city selected governmental hospitals and available during the data collection period.

The comparison groups are non-DM individuals who appear healthy (patient accompanies in the medical OPD) in Bahir Dar selected governmental hospitals and available during the data collection period.

Inclusion and Exclusion criteria

Both type 2 DM and non-DM individuals aged ≥ 30 years were included in the study and individuals who were pregnant or lactating, seriously ill, and who had night-time shifts works were excluded.

Sample size determination and sampling producer

The sample size required for the first specific objective was calculated using Epi Info version 7.2 statistical software considering the proportion of poor sleep quality among individuals with type 2 DM ($P_1 = 55.6\%$) and comparison groups ($P_2 = 33.3\%$) from another similar study(14). By using a 95% confidence level and 80% power with the ratio of 1:1. This yields an initial sample size of 172. By considering a 10% non-response rate, 189 is the total sample size.

The sample size for the second specific objective was calculated using the following assumptions; $CI=95\%$, $power=80\%$, the ratio of unexposed to exposed =1;1, percent outcome in the exposed group (P_1), and percent outcome in the unexposed group(P_2) (Table 1).

Table 1. Sample size calculation

Independent variable	AOR	P1	P2	Sample size
Female (17)	2.5	87	73	278
Comorbidity (18)	1.87	62.3	47	352
Glycaemic control (19)	3.2	69	35	110

Accordingly, the sample size calculated by using the independent variable comorbidity was found to be the highest then after adding 10% non-response rate and 1.5 design effect 583 was taken as a final sample size for the study. Using 1; 1 ratio 291 diabetic individuals and 292 non-diabetic individuals.

Two-stage cluster sampling was used. The three study hospitals were considered as clusters then from the three clusters two hospitals (Felege Hiwot referral hospital and Tibebe Gihon specialized) were selected. Individuals with type 2 DM were selected using systematic random sampling. The sampling interval was determined by dividing the expected number of diabetic individuals who come to the hospitals within one month (550) by the sample size of cases (292) then it gives a sampling interval of two then individuals were selected every 2nd unit. Non-DM individuals were also selected using a systematic random sampling technique. The expected number of patients accompanies in medical OPD within one month was 900. The sampling interval was determined by dividing the expected number of patients accompanies in medical OPD who come to the hospitals within one month (900) by the sample size of the comparison group (291) so every 3rd unit patient accompanies in OPD were interviewed.

Operational definitions

Sleep quality; The Pittsburgh Sleep Quality Index classifies a global score of > 5 as indicating clients have poor sleeping quality, whereas a global score ≤ 5 is classified as good sleeping quality(20).

Depression; A total score of PHQ-9 score ≥ 10 points indicated major depression symptoms (21).

Social support; The Oslo social support index classifies a score of 3 to 8 as "poor support", 9–11 is "moderate support" and 12–14 is "strong support"(22).

Current smoker; Someone who smoked greater than 100 cigarettes in their lifetime and had smoked in the last 28 days(23).

Alcohol consumption; Alcohol use disorder identification test (AUDIT) score > 8 indicates hazardous alcohol consumption(24).

BMI; A person was classified as underweight (BMI < 18.5 kg/m²), normal body weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²), or obese (BMI ≥ 30 kg/m²)(25).

Good glycaemic control: A 3-month average fasting blood glucose measurement of the three consecutive visits was between 70 and 130 mg/dL(26).

Poor glycaemic control; Patients whose average fasting blood glucose measurements of the three consecutive visits was above 130 or below 70 mg/dl(26).

Comorbidity; a chronic disease that coexisted with their diabetes were considered to be comorbid(27).

Data collection tools and instrument

The English version questionnaire was translated into a local language Amharic. Three clinical nurses were recruited for data collection and one BSC nurse for supervision. The data collectors and the supervisor were trained for 2 days regarding the objective of the study and data collection procedure.

Structured questionnaires comprise Socio-demographic characteristics, a clinical characteristic checklist, sleep quality assessment, depression assessment, social support assessment, and physical activity assessment tool.

Using a digital glucometer, the blood glucose level of comparison group was assessed. The blood glucose result of RBS between 70 to 110 was considered as DM free.

Sleep quality was assessed using the Amharic version of PSQI. The PSQI comprises 19 self-rated questions that generate seven component scores (subscales). Each component scores 0–3 points. A score of “0” is “no difficulty,” while a score of “3” is “severe difficulty.” The total scores of seven components are added to yield one “global score,” which ranged from 0 to 21 points (20). It is validated in Ethiopia (Cronbach alpha of 0.6) (28). The reliability of the tool was tested by similar studies conducted in Ethiopia (19, 29).

Depression symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9). The PHQ-9 contains nine self-rated questions and the total scores ranged from 0 to 27 points(21). It is validated in Ethiopia with a Cronbach alpha of 0.81 (30).

Social support was assessed by using Oslo 3-item Social Support Questionnaire. The sum of the Oslo 3-items social support score was ranged from 3 to 14 (22). It is also validated (22). The reliability of the tool is tested by another study conducted in Ethiopia(31).

The international physical activity questioners (IPAQ) were used to assess the physical exercise of participants. Using the IPAQ scoring protocol to considered participants into high, moderate, and low levels of physical activity categories(32). The reliability of the questioner tested by another study in Ethiopia(33).

Alcohol consumption was assessed using the alcohol use disorder identifier test (AUDIT). It is a 10-item questionnaire that covers the domains of alcohol consumption, drinking behavior, and alcohol-related

problems(34). The AUDIT was also validated in Ethiopia (Cronbach's $\alpha = 0.84$) (35).

BMI: participants were weighed in kg by using a digital weight scale in light clothing. Height was measured using a measuring tape; participants positioned their feet together, feet flat on the ground, with flat shoes, and it was recorded to the closer 0.5 cm. Body mass index was calculated as the ratio of weight in kilograms to the square of height in meters.

Data processing and analysis

First, the data were checked for completeness then coded and entered using EPI-data version 3.1. The data were exported to Statistical Package for Social Science (SPSS) version 20 software for analysis. The data were then re-coded and cleaned. Multicollinearity was checked using variance inflation factor (VIF) and the VIF of each variable was <5 . Model fitness was checked for the three models using the Homer–Lemeshow goodness of fit test and the p-value for all three models were <0.05 . Descriptive and summary statistics were carried out to determine the prevalence and percentage of variables. Chi-square tests were also used for comparison. Bi-variable and multivariable logistic regression analyses were used to identify associated factors. Those variables with a p-value less than 0.25 in the bi-variable analysis were entered into the multivariable analysis. In multivariable logistic regression variables with a p-value, less than 0.05 with a 95% confidence interval were considered as significantly associated with outcome variables.

Ethical approval and consent to participate

The ethical approval was obtained from the institutional review board of Bahir Dar University, college of medicine, and health science. Written informed consent was taken from participants after the purpose of the study was clearly explained. Study participants have the right to withdraw from the study at any point in time. The information collected from the participants was used for research purposes only. To keep confidentiality, the collected information was kept in a file without a personal identifier of the study participant. Individuals with poor sleep quality and Participants that found to be at risk of depressive symptoms were referred to a psychiatric evaluation in the hospital. This study was conducted following the ethical standard of the declaration of Helsinki.

Results

Socio-demographic characteristics

A total of 575 participants were included in the study. Among them, 292 type 2 diabetic individuals with a response rate of 100% and 283 non-DM individuals with a response rate of 97%. The mean age of individuals with type 2 DM was 53.24 years (SD ± 10.68 years) and that of non-DM individuals was 43.8 years (SD ± 9.12 years). The majority, 233(79.8%) of individuals with type 2 DM and 199(70.3%) of non-

DM individuals were from the urban area. Around 77 (26.4%) of individuals with type 2 DM and 88(31.1%) of non-DM individuals attend diploma and above. More than half, 232 (79.5%) of individuals with type 2 DM and 214 (75.6%) of non-DM individuals were married (Table 2).

Table 2. Socio-demographic characteristics of individuals with type 2 DM and non- DM individuals in Bahir dar city, Ethiopia, 2021 (575)

Variables	Category	Medical status			
		Non-DM		Type 2 DM	
		Freq	Perc%	Freq	Perc %
Sex	Male	151	53	161	55.1
	Female	132	46.6	131	44.9
Age group	30-39	116	41.0	37	12.7
	40-49	99	35.0	82	28.1
	≥50	68	24.0	173	59.2
Education	Diploma and above	88	31.1	77	26.4
	Secondary	53	18.7	60	20.5
	Primary	51	18.0	56	19.2
	Read and write	38	13.4	36	12.3
	Cannot read and write	53	18.7	63	21.6
Marital status	Married	214	75.6	232	79.5
	Single	38	13.4	28	9.6
	Divorced	22	7.8	13	4.5
	Widowed	9	3.2	19	6.5
Occupation	Government employee	101	35.7	86	29.5
	Farmer	45	15.9	50	17.1
	Merchant	44	15.5	55	18.8
	Housewife	57	20.1	65	22.3
	Other	36	12.7	36	12.3
Residence	Urban	199	70.3	233	79.8
	Rural	84	29.7	59	20.2
Income	Mean SD	4436.11 ±2671.3		3322.13 ±2017.2	

Notes: Other *daily labor, Self-employed,

Psychosocial and behavioral characteristics

About 93 (32.0%) of individuals with type 2 DM and 61 (21.0%) of non-DM individuals had depression. Regarding alcohol consumption 49(17.3%) of non-DM and 19 (6.6%) of individuals with type 2 DM had hazardous alcohol consumption. More than half of individuals with type 2 DM 157(53.8%) and 130(45.9%) of non-DM individuals had perceived strong social support. Around half of the non-DM individuals, 139(49.3%) but less than half 124(41.5%) of individuals with type 2 DM had moderate physical activity (Table 3).

Table 3. Psychosocial and behavioral characteristics among individuals with type 2 DM and non-DM individuals Bahir dar city, Ethiopia, 2021. (575)

Variables	Category	Medical status			
		Non-DM		Type 2 DM	
		Freq	Perce %	Freq	Perce %
Depression	No	222	78.4	199	68.2
	Yes	61	21.6	93	31.8
Social support	Strong	130	45.9	157	53.8
	Moderate	78	27.6	76	26.0
	Poor	75	26.5	59	20.2
Physical activity	Moderate	139	49.3	124	42.5
	Vigorous	46	16.3	51	17.5
	Inactive	97	34.4	117	40.1
Alcohol consumption	Non-hazardous consumption	234	82.7	273	93.5
	Hazardous consumption	49	17.3	19	6.5
Smoking	No	269	95.1	282	96.6
	Yes	14	4.9	10	3.4

Clinical characteristics of individuals with type 2 DM

Almost half of 143 (49.0%) participants diagnosed type 2 DM within the last 5 years. Among individuals with type 2 DM, 174 (59.6.7%) of the participants had a normal body mass index (BMI). The majority, 225 (77.3%) of the participants used oral hypoglycaemic medication. More than half, 167 (57.2%) of the participants had good fasting glycaemic control. Around 41% of individuals with type 2 DM had comorbidity (Table 4).

Table 4. Clinical characteristics of individuals with type 2 DM in Bahir dar, Ethiopia, 2021(292)

Variables	Category	Frequency	Percentage %
BMI	$\leq 18.5 \text{ kg/m}^2$	5	1.7
	18.5-25 kg/m^2	174	59.6
	$\geq 25 \text{ kg/m}^2$	113	38.7
Glycemic control	Good	167	57.2
	Poor	125	42.8
Duration of DM	<5 years	143	49.0
	5-10 years	84	28.8
	>10 years	65	22.3
Treatment modality	Oral	222	76.0
	Insulin	49	16.8
	Both	21	7.2
Health Education	Attend education session	200	68.5
	do not attend	92	31.5
Follow up	Regular	214	73.3
	Irregular	78	26.7
History of comorbidity	No	171	58.6
	Yes	121	41.4

Prevalence of sleep quality

The prevalence of poor sleep quality among individuals with type 2 DM was 50.7% (95% CI; 44.9-56.2); and 31.8% for non-DM individuals, (95% CI 26.5-37.5) the mean (SD) GPSQ score was 6.84(± 4.2) for type 2 diabetic individuals and 4.45(± 3.0) for non-DM individuals. Among participants, 43(14.7%) of individuals with type 2 DM and 19 (6.7%) of non-DM rated their overall sleep quality as bad and this difference was found to be significant. (Table 5).

Table 5. Components of PSQI among individuals with type 2 DM and Non-DM individuals Bahir dar city, Ethiopia, 2021 (575)

Variables	Category	Medical status				
		Non-DM		Type 2 DM		Chi-square
		Freq	Perce %	Freq	Perc%	
Subjective sleep Quality	Very good		192 68.1	124 42.6		$\chi^2=40.1$ P=0.000
	Fairly good		71 25.2	124 42.6		
	Fairly bad	20	6.7	44 14.8		
Sleep latency	<15 minutes		118 41.7	98 33.6		$\chi^2=9.011$ P=0.029
	16-30 minutes		67 23.7	65 22.3		
	30-60 minutes		51 18.0	52 17.8		
	>60 minutes		47 16.6	77 26.4		
Sleep duration	>7 hours		90 31.8	94 32.2		$\chi^2=4.06$ P=1.67
	6-7 hours		115 40.6	103 35.3		
	5-6 hours		65 23.0	69 23.6		
	< 5 hours		13 4.6	26 8.9		
Sleep efficacy	> 85%		156 55.1	113 38.7		$\chi^2=28.29$ P=0.001
	75-84 %		86 30.4	93 31.8		
	65-74%		30 10.6	43 14.7		
	< 65%		11 3.9	43 14.7		
Sleep disturbance	Never		43 15.2	14 4.8		$\chi^2=57.21$ P=0.000
	1-times a week		222 78.4	197 67.5		
	1-2 times a week		18 6.4	82 27.7		
Use of sleep medication	never use		280 98.9	287 98.3		P=.72*
	Use		3 1.1	5 1.7		

Day time dysfunction	No problem	183	64.7	117	40.1	$\chi^2=44.06$
	1-2 times a week	86	30.4	122	41.8	P=0.000
	3 times a week	14	4.9%	53	18.2	
Overall sleep Quality	Good	193	68.2%	142	49.3%	$\chi^2=21.12$
	Poor	90	31.8%	150	50.7%	P=0.000

Note: *=Fisher exact test

Factors associated with poor sleep quality among the overall participants

Those variables with a p-value less than 0.25 in the bi-variable logistic regression analysis were entered into multivariable logistic regression analysis. In multivariable logistic regression p-value < 0.05 was considered significant.

Study participants with type 2 DM were 1.89 times more likely to have poor sleep quality than non-DM individuals (AOR=1.89 CI; 1.19-2.87). Physical activity was also significantly associated with poor sleep quality among the overall participants. Those physically inactive participants were 3.89 times more likely to develop poor sleep than individuals with moderate physical activity (AOR=3.89 CI;2.47-6.14). In addition, study participants who had depression were 2.86 times (AOR=2.86 CI; 1.81-4.53) more likely to have poor sleep quality as compared to their counterparts. Moreover, Overall study participants who had poor social support were 4.4 times more likely to have poor sleep quality compared to participants who had strong social support (AOR=4.48 CI;2.63-7.62) (Table 6).

Table 6. Bi-variable and multi-variable logistic regression analysis on sleep quality among type 2 DM and non-DM individuals (overall study participants) Bahir Dar city, Ethiopia 2021.

Variables	Category	Sleep quality		95% C.I	
		Poor	Good	COR	AOR
Medical status	Type 2 DM	148	144	2.2(1.57-3.09)	1.85(1.19-2.87) **
	Non-DM	90	193	1	1
Education	Cannot read and write	65	51	2.29(1.40-3.72)	1.27(.65-2.47)
	Read and write	37	37	1.79(1.03-3.13)	1.09(.55-2.18)
	Primary	46	61	1.35(.82-2.22)	.92(.50-1.68)
	Secondary	31	82	.67(.40-1.14)	.56(.30-1.05)
	Diploma and above	59	106	1	1
Marital status	Single	17	49	.48(.26,.86)	.50(.24-1.04)
	Married	187	259	1	1
	Divorced	14	21	.92(.45-1.86)	.57(.24-1.36)
	Widowed	20	8	3.46(1.49-8.03)	1.43(.53-3.85)
Physical activity	Low	129	85	4.81(3.24-7.14)	3.89(2.47-6.14) **
	Moderate	63	200	1	1
	High	46	51	2.8(1.75-4.66)	2.43(1.28-4.61)
Depression	Yes	99	55	3.65(2.47-5.37)	2.86(1.81-4.53) **
	No	139	282	1	1
Age group	>50	145	96	3.98(2.58-6.14)	1.95(1.10-3.43)
	40-50	49	132	.92(.56-1.48)	.73(.41-1.29)
	29-39	44	109	1	1
Social support	Poor	87	47	3.98(2.58-6.14)	4.48(2.63-7.62) **
	Moderate	60	94	1.37(.91-2.06)	1.33(.83-2.15)
	Strong	91	196	1	1

Notes: *indicates statistically significant (p<0.05), **highly statistically significant (P<0.01).

Abbreviations: AOR: adjusted odds ratio, COR: crude odds ratio, CI: confidence interval

Factors associated with poor sleep quality among non-DM individuals

Those variables with a p-value less than 0.25 in the bi-variable logistic regression analysis were entered into multivariable logistic regression analysis. In multivariable logistic regression p-value < 0.05 was considered significant.

Study participants who had poor social support were 2.83 times more likely to have poor sleep quality compared to participants who had strong social support (AOR=2.83; 95% CI: 2.83-13.65). Moreover, the physical activity of the study participants was a significant predictor variable for poor sleep quality. Those physically inactive participants were 3.17 times more likely to develop poor sleep than individuals with moderate physical activity (AOR=3.17; 95% CI: 1.59–6.29). In addition, study participants who had depression were 2.26 times (AOR= 2.26; 95% CI: 1.11–4.60) more likely to have poor sleep quality as compared to their counterparts. Moreover, those study participants who were in the age group (>50 years) were 4.08 times more likely to have poor sleep than the younger age group (AOR=4.08;95% CI: 1.76–9.43) (Table 7).

Table 7.Bi-variable and multi-variable logistic regression analysis on sleep quality among non-DM individuals in Bahir Dar city, Ethiopia, 2021 (283)

Variables	Category	Overall sleep quality			
		Poor	Good	95%	
		Freq	Freq	COR (CI)	AOR(CI)
Physical activity	Low	51	55	4.05(2.26-7.27)	3.17(1.59-6.29) **
	Moderate	24	105	1	1
	High	15	32	2.05(.96-4.37)	1.03(1.03-9.16)
Depression	Yes	27	34	2.00(1.11-3.18)	2.26(1.11-4.60) *
	No	63	159	1	1
Social support	Poor	43	32	5.64(2.99-10.62)	6.22(2.83-13.65) **
	Moderate	22	56	1.65(.85-3.18)	1.48(.70-3.11)
	Strong	25	105	1	1
Age group	>50	39	29	4.22(2.22-8.03)	4.08(1.76-9.43) **
	40-50	23	76	.95(.50-1.78)	1.07(.50-2.28)
	30-40	28	88	1	1
Residence	Rural	30	54	1.28(.75-2.20)	.43(.13-1.33)
	Urban	60	139	1	1
Marital status	Single	8	30	.51(.18-1.48)	.51(.18-1.48)
	Married	69	145	1	1
	Divorced	9	13	1.0(.34-3.10)	1.03(.34-3.10)
	Widowed	4	5	.73(.11-4.47)	.73(.11-4.47)
History of chronic illness	Yes	16	8	4.98(2.04-12.15)	1.45(.47-4.47)
	No	73	181	1	1

Notes: *indicates statistically significant (p<0.05), **highly statistically significant (P<0.01).

Abbreviations: AOR: adjusted odds ratio, COR: crude odds ratio, CI: confidence interval

Factors associated with poor sleep quality among individuals with type 2 DM.

Those variables with a p-value less than 0.25 in the bi-variable logistic regression analysis were entered into multivariable logistic regression analysis. In multivariable logistic regression p-value < 0.05 was considered significant.

Study participants with comorbidity were 2.21 times more likely to have poor sleep quality compared to participants without comorbidity (AOR= 2.21; 95% CI: 1.154-4.273). Moreover, Individuals with DM duration greater than 10 years were 3 times more likely to have poor sleep than individuals with a short duration of DM (<5 years) (AOR =3.0 [95% CI: 1.28–7.04]). In addition, study participants who had depression were 2.6 times (AOR= 2.6; 95% CI: 1.29–5.54) more likely to have poor sleep quality as compared to their counterparts. Participants who are inactive or had low physical activity were 4.13 times more likely to have poor sleep quality as compared to those who had moderate physical activity (AOR= 4.13; 95% CI: 2.01 – 8.57).

Similarly, individuals with poor glycaemic control were 2.98 times (AOR = 2.98, 95% CI: 1.53–5.79) more likely to have poor sleep quality as compared with individuals with good glycaemic control. And study participants who had poor social support were 2.25 times more likely to have poor sleep than individuals with strong social support (AOR=2.25,95%CI: 1.941-5.41) (Table 8).

Table 8.Bi-variable and multi-variable logistic regression analysis on sleep quality among individuals with type 2 DM Bahir dar, Ethiopia, 2021

Variables	Category	Sleep Quality		95% CI	
		Poor	Good		
		Freq	Freq	COR	AOR
Education	Cannot read and write	47	16	4.13(1.99-8.53)	2.83(.99-8.09)
	Read and write	22	14	2.21(.98-4.96)	1.52(.52-4.44)
	Primary	26	30	1.21(.60-2.43)	1.02(.39-2.63)
	Secondary	21	39	.75(.37-1.52)	.95(.38-2.38)
	Diploma and above	32	45	1	1
Marital status	Single	9	19	.458(.19-1.05)	.40(.13-1.25)
	Married	118	114	1	1
	Divorced	5	8	.60(.19-1.90)	.52(.12-2.18)
	Widowed	16	3	5.15(1.4-18.15)	3.21(.74-13.9)
Depression	Yes	73	21	5.50(3.13-9.67)	2.68(1.29-5.54) **
	No	76	122	1	1
Smoking	Yes	6	5	1.46(.40-5.31)	1.18(.18-7.43)
	No	142	139	1	1
Comorbidity	Yes	76	45	2.32(1.44-3.74)	2.22(1.15-4.27) *
	No	72	99	1	1
Glycemic control	Poor	96	29	7.32(4.31-12.42)	2.98(1.53-5.79) **
	Good	52	115	1	1
Duration of DM	>10 years	49	16	5.69(2.94-1.03)	3.00(1.28-7.04) *
	5-10 years	49	35	2.60(1.49-4.52)	1.14(.53-2.43)
	<5 years	50	93	1	1
Age group	>=50	106	67	1.97(.95-	.74(.27-2.02)

				4.08)	
	40-50	26	56	.58(.25-1.29)	.42(.15-1.26)
	30-40	16	20	1	1
Social support	Poor	44	15	4.04(2.07-7.87)	2.25(1.94-5.41)*
	Moderate	38	38	1.37(.79-2.39)	1.38(.67-2.87)
	Strong	66	91	1	1
Physical activity	Low	83	34	6.46(3.68-11.32)	4.13(2.01-8.57)**
	Moderate	34	90	1	1
	High	31	20	4.10(2.06-8.13)	2.41(.94-6.17)

Medical status= DM

Notes: *indicates statistically significant ($p < 0.05$), **highly statistically significant ($P < 0.01$).

Abbreviations: AOR: adjusted odds ratio, COR: crude odds ratio, CI: confidence interval

Discussion

The current study compared the sleep quality of individuals living with diagnosed type 2DM and attending DM follow-up clinic and non-DM individuals in Bahir Dar governmental hospitals. The prevalence of poor sleep quality among individuals with type 2 DM was 50.7%, (95% CI; 44.9-56.2); whereas 31.8% for non-DM individuals, (95% CI; 26.5-37.5).

The prevalence of poor sleep quality among individuals with type 2DM in this study is comparable with the previous studies conducted in Canada(52%),(36) Brazilin (52%),(37)Mayamr (48.4%),(38) Kenya (53%), (12) Gondar (47.2%),(39) and Jimma (55.2%) (19).

In contrast, the finding of the study is lower than the studies conducted in India (78.4%)(40), Turkey(86.3%) (41). Trinda Tobago (63.9%),(42)and Saudi (72%) (43). The possible reasons for the difference in these studies might be due to the use of different cut points. In addition, this might be also in Turkey the study participants were hospital-admitted DM patients. In India, around 60% of participants had co-morbidity and in Trinda Tobago the sleep quality was assessed by different assessment tools.

In this study, the prevalence of poor sleep quality among non-DM individuals was found 31.8%.This finding is similar with a study in Jimma (32.3%),(19) Kenya(29.5%),(12) and Sudan(33.3%) (13).

This study reveals that among the overall participants there is a statistically significant association between being a type 2 DM patient and poor sleep quality. This might be due to the Reduction of REM sleep latency arising from activation of the hypothalamic-pituitary-adrenal axis. Because individuals with type 2 DM are reported to exhibit an increase of HPA axis through poor glycemic control this mechanism might be involved in the reduction of REM sleep latency. The reduction in deep sleep might reflect decreased REM sleep latency in individuals with type 2 DM (44).

In a multivariable logistic regression analysis duration of DM was significantly associated with poor sleep quality. This finding agrees with findings in India,(18) Saudi,(45)Iran,(46)Brazil,(47) and Ethiopia Jimma (19). This might be due to the reason Patients with all forms of diabetes of long duration, are vulnerable to complications, which cause serious morbidity and lead to sleep disruption (48).

Depression was also significantly associated with poor sleep among individuals with type 2 DM and Non-DM individuals. The finding was in argument with the study in England, (49)Maynmar,(38) China, (50) Africa,(51)and Gondar (39). This might be attributed to the reason in depressive patients, sleep complaints (eg insomnia, narcolepsy, sleep-disordered breathing, and restless legs syndrome are common in approximately 90% of patients (52). Insomnia is one of the typical and most dependable early symptoms of depression. Depression usually presents with physical symptoms, primarily fatigue, pain, or sleep disturbance (53). For diabetic individuals this might be also due to clinically significant depression, results from biochemical changes directly due to type 2 diabetes or its treatment, and the psychosocial demands caused by the illness (54). There is also an evidence that depression among individuals with type 2 diabetes is associated with poor diabetes outcomes such as glycaemic control and found that depression was significantly associated with poor glycaemic control in individuals with type 2 diabetes (55).

Being physically inactive or had low physical activity has been identified as one of the associated factors for poor sleep quality in both groups. This finding is in agreement with the finding in Europe (56).This could be due to the reason that moderate resistance training and stretching exercises are beneficial to people with insomnia. Fewer waking episodes during the night has also the benefit of long sleep duration, more sleep efficiency, and less overall anxiety (57). Additionally, for individuals with type 2 DM, this could also be because Physical exercise improves blood sugar control, the body's reaction to insulin, and decreased blood lipids (58).On top of that physical exercise had a crucial role in mood elevation which in turn improves sleep quality (59).

Moreover, Poor Glycaemic control was also significantly associated with poor sleep quality among individuals with type 2 DM. This finding was in line with a study in Japan,(60) Jordan,(61)Indonesia,(62), and Gondar (39).This might be due to the reason rapid changes in blood glucose levels during the night leading to hypoglycaemic and hyperglycaemic episodes and nocturia. Also, poor glycaemic control for a long duration leads to restless leg syndrome and diabetic complications (10).

Similarly, in this study having poor social support was found to be associated with poor sleep quality for both study groups. This is in line with the finding in the USA (63, 64)and Maymar (38). This could be

attributed to a direct, significant relationship between perceived social support and mental health (65). Social support provides physical and psychological advantages for people challenged with stressful physical and psychosocial events and is considered as a factor reducing the psychological distress when faced with stressful events (66). Social support tends to matter for psychological distress and depression independent of stress level (67).

Comorbidity was also significantly associated with poor sleep quality among individuals with type 2 DM. This finding is consistent with the study in India (18) and Gondar (39). This might be due to disturbed sleep is likely a disruptive symptom and outcome of many co-morbid medical conditions, and it may be an illness that individuals face as a side-effect of treatment for their illness. Pain due to the illness can also disturb one's sleep, and similarly, disturbed sleep may increase pain (68).

Limitation of the study

This study uses a subjective sleep quality assessment tool it doesn't use a sleep diary and objective sleep quality assessment tools. The limitation of the study is related to the cross-sectional nature of the study, which makes it difficult to find whether the exposure precedes the outcome.

Conclusion

In this study, the prevalence of poor sleep among individuals with type 2 DM is higher than non-DM individuals. Among overall participants being type 2 DM patient has a significant association with poor sleep quality as compared to non-DM individuals. Variables such as poor glycaemic control, comorbidity, longer duration in DM (>10 years), having depression, poor social support, and having low physical activity were found to be associated with poor sleep quality among individuals with type 2 DM. For non-DM participant's low physical activity, poor social support, having depression, and older age was associated with poor sleep quality. Promoting social support at any aspect of health care service is important to minimize poor sleep quality. Individuals with type 2 DM need to control their blood glucose to improve their sleep quality. Additionally, regular physical exercise is needed to prevent poor sleep quality.

Abbreviations

BMI: Body Mass Index

CDC: Centre for Disease Control and Prevention

DM: Diabetes Mellitus

FPG: Fasting Plasma Glucose Level

HbA1c: Glycated Haemoglobin

HPA: *Hypothalamic–Pituitary–Adrenal Axis*

IPAQ: International Physical Activity Questionnaire

MDD: Major Depressive Disorder

OSA: Obstructive Sleep Apnea

PHQ-9: *Patient Health Questionnaire*

PSQI: Pittsburgh Sleep Quality Questionnaire index

QoL: Quality of Life

REM: Random Eye Movement

SD: Sleep Disorder

T2DM: Type 2 Diabetes Mellitus

Declarations

Ethical approval and consent to participants

Ethical approval was obtained from Ethical Review Committee of Bahir Dar University. Written consent was taken from the participants for their voluntary participation. Confidentiality was maintained throughout the study process.

Consent for publication

Not applicable

Availability of the data

The data used to support the findings of this study are available from one of the corresponding authors on rational request.

Competing interest

The authors declare that there is no any competing interest.

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