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# 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 among individuals with type 2 diabetes mellites. Sleep disruption among individuals with type 2 diabetes mellites 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 diabetes mellites patients and non-diabetes individuals in Bahir Dar governmental hospitals.

**Methods:** Comparative cross-sectional study was employed among 292 individuals with type 2 diabetes mellites 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 sleeps quality index was used for assessing sleep quality. For analysis, descriptive statistics and binary logistic regression models were used.

**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 mellites and non-diabetic, respectively. Among the overall participants, type 2 diabetes mellites patients were also significantly associated with poor sleep quality than non-diabetic individuals (AOR = 1.89; 95% CI; 1.19–2.87). Comorbidity, duration of DM > 10 years, Poor glycaemic control, depression, low physical activity, and poor social support were factors significantly associated with poor sleep quality among individuals with type 2 diabetes mellites. Among non-diabetic individuals, low physical activity, poor social support, depression, and age group (> 50 years) were factors significantly associated with poor sleep quality.

**Conclusion:** In this study, poor sleep among individuals with type 2 diabetes mellites was higher than in non-diabetes individuals.

**Keywords:** Sleep quality, Type 2 DM, Non-DM, Ethiopia

## 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 (Carskadon and Dement 2005).

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Sleep disruption has short- and long-term consequences, including increased stress responsivity, reduced quality of life (QoL), mental health problems, and other non-communicable diseases in healthy individuals (Matricciani et al. 2018; Medic et al. 2017; Chokroverty 2010). Additionally, sleep disruption in individuals with type 2 DM results in insulin resistance and chronic hyperglycemia, associated with long-term damage, dysfunction, and failure of different organs (AlDabal and BaHammam 2011).

A study also shows the total mortality rate in adults with DM and longer sleep duration is also high (Wang et al. 2020). As a result, the US National Sleep Foundation works to make sleep a recognized "vital sign" for health (Ojile 2017). The CDC also declared that insufficient sleep is a 'public health epidemic' (Liu et al. 2016).

Studies worldwide report poor sleep quality with a wide range of prevalence among individuals with type 2 DM. In the USA, more than half of individuals with DM (55%) were "poor sleepers," according to the Pittsburgh Sleep Quality Index (Luyster and Dunbar-Jacob 2011). The prevalence of poor sleep in the Asian continent ranges from 43.9–78.4% (Htut et al. 2020; Cunha et al. 2008; Merin and Antony 2020). In Africa, poor sleep quality among type 2 DM patients ranges from 50%–97% (Sokwalla et al. 2017; Mirghani 2015). In Ethiopia, a study conducted in Jimma revealed that poor sleep quality among type 2 diabetes patients was 55.6% and 32.8% among relatively healthy individuals (Jemere et al. 2019a).

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

Nevertheless, literature on poor sleep quality among individuals with type 2 DM is not well documented. 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 individuals with type 2 DM and non-DM individuals and identify its associated factors.

## Method and materials

### Study design and period

An institutional-based comparative cross-sectional study was conducted from March 01 to April 01, 2021.

### Study area

This study was conducted in Bahir Dar city governmental hospitals (Felege Hiwot referral hospital, Tibebe Gihon specialized hospital, and Adiss Alem hospital).

### Source of population

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

### Study population

Individuals with type 2 DM attending follow-up service in Bahir Dar city selected governmental hospitals and were available during the data collection period.

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

### Inclusion and exclusion criteria

The study included both type 2 DM patients and non-DM individuals aged  $\geq 30$  years in the study.

Individuals who were pregnant or lactating 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 (Jemere et al. 2019a). Using a 95% confidence level and 80% power with the ratio of 1:1. This yields an initial sample size of 172. 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).

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

Two-stage cluster sampling was used. The three study hospitals were considered clusters, then from

**Table 1** Sample size calculation

Independent variable	AOR	P1	P2	Sample size
Female (Barakat et al. 2019)	2.5	87	73	278
Comorbidity (Gara et al. 2019)	1.87	62.3	47	352
Glycaemic control (Jemere et al. 2019b)	3.2	69	35	110

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). It gives a sampling interval of two; then, individuals were selected for every 2<sup>nd</sup> unit. Non-DM individuals were also selected using a systematic random sampling technique. The expected number of patients accompanied in medical OPD within one month was 900. The sampling interval was determined by dividing the expected number of patients accompanied in medical OPD who come to the hospitals within one month (900) by the sample size of the comparison group (291). Hence, every 3<sup>rd</sup> unit patient accompanied in OPD was 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 of  $\leq 5$  is classified as good sleeping quality (Buysse et al. 1989).

**Depression;** A total PHQ-9 score  $\geq 10$  points indicated major depression symptoms (Kroenke et al. 2001).

**Social support;** The Oslo social support index classifies a score of 3 to 8 as "poor support," 9–11 as "moderate support," and 12–14 as "strong support" (Abiola et al. 2013).

**Current smoker;** Someone who smoked greater than 100 cigarettes in their lifetime and had smoked in the last 28 days (Sahile and Bekele 2020).

**Alcohol consumption;** Alcohol use disorder identification test (AUDIT) score  $> 8$  indicates hazardous alcohol consumption (Babor et al. 1992).

**BMI;** A person was classified as underweight (BMI  $< 18.5$  kg/m<sup>2</sup>), normal body weight (BMI 18.5 – 24.9 kg/m<sup>2</sup>), overweight (BMI 25–29.9 kg/m<sup>2</sup>), or obese (BMI  $\geq 30$  kg/m<sup>2</sup>) (Weir and Jan 2019).

**Good glycaemic control;** A 3-month average fasting blood glucose measurement during the three consecutive visits was between 70 and 130 mg/dL (Demoz et al. 2019).

**Poor glycaemic control;** Patients whose average fasting blood glucose measurements of the three consecutive visits were above 130 or below 70 mg/dl (Demoz et al. 2019).

**Comorbidity;** a chronic disease that coexisted with their diabetes was considered comorbid (Pantalone et al. 2015).

#### Data collection tools and instrument

The English version questionnaire was translated into a local language Amharic. 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 the comparison group was assessed. The blood glucose result of RBS between 70 to 110 was considered DM-free (non-DM individuals). Sleep quality was assessed using the Amharic version of PSQI. The PSQI comprises 19 self-rated questions that generate seven component scores (subscales). It is validated in Ethiopia (Cronbach alpha of 0.6) (Salahuddin et al. 2017). Depression symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9). Social support was assessed by using Oslo 3-item Social Support Questionnaire. The international physical activity questionnaire (IPAQ) was employed for physical activity assessment. Alcohol consumption was also assessed using the alcohol use disorder identifier test (AUDIT).

**BMI;** Body mass index was calculated as the weight ratio in kilograms to the square of height in meters.

#### Data processing and analysis

First, the data were checked for completeness and then coded and entered using EPI-data 3.1. The data were exported to Statistical Package for Social Science (SPSS) version 20 software for analysis. Descriptive and summary statistics were carried out to determine the prevalence and percentage of variables. 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 who were 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.

## Result

### Socio-demographic characteristics

A total of 575 participants were included in the study. Among them, 292 individuals with type 2 DM 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 ( $SD \pm 10.68$  years), and that of non-DM individuals was 43.8 years ( $SD \pm 9.12$  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. (Table 2).

### Psychosocial and behavioral characteristics

About 93 (32.0%) individuals with type 2 DM and 61 (21.0%) of non-DM individuals had depression. 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).

### Clinical characteristics of individuals with type 2 DM

Almost half of 143 (49.0%) were diagnosed with type 2 DM within five years. Among individuals with type 2 DM, 174 (59.6.7%) participants had a normal body mass index (BMI). More than half, 167 (57.2%) of the participants had good fasting glycaemic control, and around 41% of individuals with type 2 DM had comorbidity (Table 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( $\pm 4.2$ ) for individuals with type 2 DM and 4.45( $\pm 3.0$ ) for non-DM individuals. Among participants, 43(14.7%) of individuals with type 2 DM and 19 (6.7%) of non-DM rated their sleep quality as bad. (Table 5).

**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
	$\geq 50$	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 $\pm$ 2671.3		3322.13 $\pm$ 2017.2	

Notes: Other \*daily labor, Self-employed

**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

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

Variables	Category	Frequency	Percentage %
BMI	< = 18.5 kg/m <sup>2</sup>	5	1.7
	18.5–25 kg/m <sup>2</sup>	174	59.6
	≥ 25 kg/m <sup>2</sup>	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

#### Factors associated with poor sleep quality among the overall participants

After adjusting for physical activity, depression, social support, age, educational status, marital status, and medical status; the following results were obtained:

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 than their counterparts. Moreover, Overall, study participants who had poor social support were 4.4 times more likely to have poor sleep quality than participants who had strong social support (AOR = 4.48 CI; 2.63–7.62) (Table 6).

**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	
		Freq	Perc %	Freq	Perc%
Subjective sleep Quality	Very good	192	68.1	124	42.6
	Fairly good	71	25.2	124	42.6
	Fairly bad	20	6.7	44	14.8
Sleep latency	< 15 min	118	41.7	98	33.6
	16–30 min	67	23.7	65	22.3
	30–60 min	51	18.0	52	17.8
	> 60 min	47	16.6	77	26.4
Sleep duration	> 7 h	90	31.8	94	32.2
	6–7 h	115	40.6	103	35.3
	5–6 h	65	23.0	69	23.6
	< 5 h	13	4.6	26	8.9
Sleep efficacy	> 85%	156	55.1	113	38.7
	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
	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
	Use	3	1.1	5	1.7
Day time dysfunction	No problem	183	64.7	117	40.1
	1–2 times a week	86	30.4	122	41.8
	Three times a week	14	4.9%	53	18.2
Overall sleep Quality	Good	193	68.2%	142	49.3%
	Poor	90	31.8%	150	50.7%

### Factors associated with poor sleep quality among non-DM individuals

After adjusting for physical activity, depression, social support, age, residence, marital status, and history of chronic illness; the following results were obtained:

Study participants who had poor social support were 2.83 times more likely to have poor sleep quality than 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 a poor

sleep than the younger age group (AOR=4.08;95% CI: 1.76–9.43) (Table 7).

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

After adjusting for physical activity, depression, social support, age, residence, marital status, comorbidity, glycaemic control, DM duration, and education; the following results were obtained:

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 a 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 were 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 a poor sleep than individuals with strong social support (AOR=2.25,95%CI: 1.941–5.41) (Table 8).

### Discussion

The current study compared the sleep quality of individuals living with diagnosed type 2 DM attending DM follow-up clinics 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 2 DM in this study is comparable with the previous studies conducted in Canada(52%) (Khalil et al. 2020), Brazilin (52%) (Gupta and Wang 2016), Mayamr (48.4%) (Htut et al. 2020), Kenya (53%) (Sokwalla et al. 2017), Gondar (47.2%) (Birhanu et al. 2020), and Jimma (55.2%) (Jemere et al. 2019b).

In contrast, the finding of the study is lower than the studies conducted in India (78.4%) (Merin and Antony 2020), Turkey(86.3%) (Demir 2019). Trinda Tobago (63.9%) (Ramtahal et al. 2015) and Saudi (72%) (Darraj et al. 2018). The possible reasons for the difference in these studies might be due to the use of different cut points. In addition, this might also be in Turkey; the

**Table 6** Bi-variable and multivariable 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 Poor	quality Good	95% CI	
				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)
Marital status	Diploma and above	59	106	1	1
	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)
Physical activity	Widowed	20	8	3.46(1.49–8.03)	1.43(.53–3.85)
	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

study participants were hospital-admitted DM patients. In India, around 60% of participants had comorbidity, and different assessment tools assessed the sleep quality in Trinda Tobago.

In this study, the prevalence of poor sleep quality among non-DM individuals was 31.8%. This finding is similar with a study in Jimma (32.3%) (Jemere et al. 2019b), Kenya (29.5%) (Sokwalla et al. 2017), and Sudan (33.3%) (Mirghani 2015).

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. Individuals with type 2 DM are reported to exhibit an increase in the 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 (Bruehl et al. 2007).

In a multivariable logistic regression analysis duration of DM was significantly associated with poor sleep

quality. This finding agrees with findings in India (Gara et al. 2019), Saudi (Almaiman et al. 2019), Iran (Shamshirgaran et al. 2017), Brazil (Cunha et al. 2008), and Ethiopia Jimma (Jemere et al. 2019b). 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 (Nathan 1993).

Depression was also significantly associated with poor sleep among individuals with type 2 DM and Non-DM individuals. The finding was in an argument with the study in England (Wakefield et al. 2020), Myanmar (Htut et al. 2020), China (Zhang et al. 2016), Africa (Wang et al. 2019) and Gondar (Birhanu et al. 2020). This might be attributed to the reason in depressive patients, sleep complaints (e.g., insomnia, narcolepsy, sleep-disordered breathing, and restless legs syndrome are common in approximately 90% of patients (Fang et al. 2019). 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 (Rakel 1999). For diabetic individuals, this

**Table 7** Bi-variable and multivariable 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

might also be 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 (Talbot and Nouwen 2000). There is also 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 (Lustman et al. 1992).

Being physically inactive or having 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 (Wang and Boros 2021). 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 also has the benefit of long sleep duration, more sleep efficiency, and less overall anxiety (Buman et al. 2014). 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 decreases blood lipids (Thomas et al. 2006). On top of that, physical exercise had a crucial role in

mood elevation, which improves sleep quality (Patel and Physiology 2021).

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 (Yoda et al. 2015), Jordan (Al Hayek and Al Dawish 2020), Indonesia (Amelia et al. 2020), and Gondar (Birhanu et al. 2020). This might be due to the reason rapid changes in blood glucose levels during the night lead to hypoglycaemic and hyperglycaemic episodes and nocturia. Also, poor glycaemic control for a long duration leads to restless leg syndrome and diabetic complications (Liu et al. 2016).

Similarly, in this study having poor social support was associated with poor sleep quality for both study groups. This is in line with the finding in the USA (Chung 2017; Mesas et al. 2020) and Maymar (Htut et al. 2020). This could be attributed to a direct, significant relationship between perceived social support and mental health (Riahi et al. 2011). Social support provides physical and psychological advantages for people challenged with stressful physical and psychosocial events. It is considered as a factor in reducing psychological distress when faced with stressful events



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

Variables	Category	Sleep Quality		95% CI	
		Poor	Good	COR	AOR
		Freq	Freq		
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(2.94–10.3)	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(.95–4.08)	.74(.27–2.02)
	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

(Harandi et al. 2017). Social support tends to matter for psychological distress and depression independent of stress level (Turner and Brown 2010).

Comorbidity was also significantly associated with poor sleep quality among individuals with type 2 DM. This finding is consistent with the study in India (Gara et al. 2019) and Gondar (Birhanu et al. 2020). This might be due to disturbed sleep is likely a disruptive symptom and outcome of many comorbid 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 (Leggett et al. 2017).

#### 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 in 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), depression, poor social support, and low physical activity were found to be associated with poor sleep quality among individuals with type 2 DM. For the non-DM participant, low physical activity, poor social support, depression, and older age was associated with poor sleep quality. Promoting social support in 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.

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## Authors' contributions

Dagmawit Zewdu organized the original investigation; coordinated the collection of data; analysis and writing the report. Haileyesus Gedamu, Yeshiwork Beyene contributed to the supervision in the design of the study and statistical analyses, Mahlet Tamirat, Mekdes Tadesse and Silenat Muluken contributed to the drafted and revision of the Manuscript. All authors read and approved the final manuscript.

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## Availability of the data and materials

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

## Declarations

### Ethics approval and consent to participate

Ethical approval was obtained from the 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.

## Competing interests

The authors declare that there is no competing interest.

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