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ORIGINAL ARTICLE

Sleep quality and associated factors among individuals with and without diabetes: PERSIAN Guilan Cohort Study (PGCS)

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Abstract

Purpose Poor sleep quality is a serious problem for patients with diabetes mellitus (DM). This study aimed to compare the sleep quality of individuals with and without DM, and its related factors in the Prospective Epidemiological Research Studies of the Iranian Adults (PERSIAN) Guilan cohort study (PGCS) population.

Methods This is a cross-sectional study based on the data of the PGCS including 1560 participants with and without DM aged 35 to 70 years. Demographical data and clinical characteristics of participants were recorded, and the Pittsburgh sleep quality index (PSQI) questionnaire, which includes 19 items in 7 areas of sleep, was completed for each participant. Statistical analysis was done using SPSS software (version 16) with significance level of less than 0.05.

Results Out of a total of 1560 people, 780 had DM and 780 did not have DM. The overall prevalence of poor sleep quality was 28.1% (aOR = 1.15, 95% CI 0.89–1.49) and 25.5% (aOR = 1.14, 95% CI 0.91–1.43) in individuals with and without DM, respectively ($P = 0.277$). The mean total score of sleep quality in individuals with DM was lower than in those without DM in the components of sleep ($P = 0.034$). Individuals with DM age ≥ 56 years, (aOR = 1.50, 95% CI 1.05–2.16), women (OR = 2.15, 95% CI 1.28–3.62), rural participants (aOR = 2.65, 95% CI 1.83–3.84), and having underlying diseases (aOR = 2.51, 95% CI 1.55–4.08) were associated with poor sleep quality.

Conclusion According to the results of the present study, underlying diseases in both diabetic and non-diabetic groups were associated with poor sleep quality.

Keywords Sleep quality · Type 1 diabetes · Type 2 diabetes

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Abbreviations

DM	Diabetes mellitus
BMI	Body mass index
MET	Metabolic equivalent of task
PSQI	Pittsburgh sleep quality questionnaire
non-REM	None rapid eyes movement
PERSIAN	Prospective Epidemiological Research Studies of the Iranian Adults
PGCS	PERSIAN Guilan cohort study
T2DM	Type 2 diabetes mellitus

Introduction

Sleep is a basic biologic function that is essential for life. Sleep represents an obligatory element for health and well-being which maintains cognitive performance, physiological process, emotion regulation, physical development, and quality of life (Hirshkowitz et al. 2015). It helps to modify body temperature, cardiac work,

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and hormone production, which results in an essential restorative state and proper functioning of the organism (Carter et al. 2011). According to the 2017 report of the National Sleep Foundation in the USA, good sleep quality is indicated by sleeping more time while in bed (at least 85 percent of the total time), falling asleep in 30 minutes or less, waking up not more than once per night, and being awake for 20 minutes or less after initially falling asleep (Hirshkowitz et al. 2015). Poor sleep quality is an unreported and unrecognized problem that can affect the prognosis of diseases. Approximately 1/3 of a person's life is spent in sleep, so any disturbance in the quantity, quality, or pattern of sleep can have a significant negative impact on a person's physical and mental performance (Gharaee et al. 2020).

According to the 2015 National Sleep Foundation Guideline, the recommended sleep duration is 7 to 9 hours for young adults and adults and 7 to 8 hours of sleep for older adults (Hirshkowitz et al. 2015). The quality and duration of sleep are disturbed by crowded urbanization, long work schedule, night and shift work, spending more time watching television and using the internet, and disease conditions (Harvey and Colten 2006). Chronic sleep deprivation is estimated to affect between 7.5–30 % of the general population (Bixler et al. 2002; Ancoli-Israel 2006; Vgontzas et al. 2009); however, patients with chronic illness do not mention sleep issues when they are at a health institution for a follow-up (Surani et al. 2015). People with diabetes mellitus (DM) are at greater risk of developing sleep disturbance symptoms than the general population, which may be associated with diabetes itself or with the complications that develop as the disease progresses (Surani et al. 2015). Along with the growing epidemic of DM and obesity, the magnitude of sleep disturbances and deprivation has been increasing dramatically over the past decades worldwide (Lee et al. 2017). Poor or impaired sleep has not only been associated with various diseases and conditions but has also led to poor performance and occupational accidents. Medical literature regarding sleep sciences reveals numerous studies that characterize sleep quality and determine various factors leading to impaired sleep among different patient populations (Surani et al. 2015). According to the findings of different studies, female gender, low income, longer disease duration, poor glycemic control, and presence of hypertension increase the risk of poor sleep quality among people with type 2 diabetes mellitus (T2DM) (Alshenghiti et al. 2016; Jemere et al. 2019).

Even though DM is associated with many health problems, data is scarce concerning the magnitude and determinants of poor sleep quality among people with T2DM. Therefore, we conduct this study to fill the above gap by determining the prevalence of sleep quality and its associated factors among individuals with and without DM in Prospective Epidemiological Research Studies of the Iranian Adults (PERSIAN) Guilan cohort study (PGCS).

Materials and methods

Participants

This cross-sectional study was conducted based on the PERSIAN cohort study (Poustchi et al. 2018) in Sowmeh' E Sara, Guilan, Northern Iran, and engaged 10,520 participants aged 35 to 70 years from October 2014 to January 2017 (Mansour-Ghanaei et al. 2019). The total number of PGCS participants (10,520) was divided into three groups: diabetic, non-diabetic, and pre-diabetic. Diabetes according to diagnosis criteria was defined as fasting blood sugar equal or higher than 126 mg/dL or history of diagnosis with DM or taking glucose lowering medication (Mansour-Ghanaei et al. 2019). The individuals with psychological disorders, night-shift work in past months, and pregnancy and lactation were excluded from this study.

A total of 1560 individuals were randomly selected; 780 individuals from the diabetic group as the case group for this study, and 780 individuals from the non-diabetic group as the control group. The demographical and clinical data including age; sex; marital status; educational level; employment status; habitat; body mass index (BMI) as low weight BMI $< 18.5\,kg/m^2$), normal weight (BMI = $18.5–24.99\,kg/m^2$), overweight (BMI = $25–29.9\,kg/m^2$), and obese (BMI $\geq 30\,kg/m^2$); history of smoking; alcohol consumption; mean fasting blood sugar (FBS), and duration of illness, type of medication for diabetes, any antihypertensive drug, sedative and hypnotic drug for chronic diseases, and Metabolic Equivalent of Task (MET); and the second part of the Pittsburgh sleep quality index (PSQI) questionnaire, which includes 19 items in 7 areas of sleep, were collected by a trained questioner from October 2014 to January 2016 to assess sleep quality. It examines the sleep status of individuals during the past 1 month.

The questionnaire consists of 19 items and measures seven areas of sleep: (1) the person's perception of sleep quality (mental quality of sleep), (2) delay in starting sleep (sleep latency), (3) the duration of actual sleep (sleep duration), (4) sleep efficacy, (5) sleep disorders, (6) sleep medication, and (7) day time dysfunction. Answering the questions of 6 areas of sleep is in the form of Likert (no, once a week, twice a week, three times or more per week), and in the area of understanding the quality of your sleep in a very good, good way, bad, and very bad, which scores between zero and 3 points, respectively, and each score indicates the normal state, the existence of a mild, moderate, and severe problem, respectively. Achieving a total score higher than 5 in the questionnaire means poor sleep quality (Buysse et al. 1989).

Statistical analysis

Descriptive statistics (mean, frequency, standard deviation, etc.), inferential statistics (independent t-test, Mann–Whitney, Kruskal–Wallis, and Spearman correlation coefficient) were done by SPSS software version 16 (SPSS Inc., Chicago, IL, USA), and the level of significance was set at 0.05.

Results

Sociodemographic and clinical characteristics

About 1560 individuals from the diabetic and non-diabetic groups were studied to evaluate the quality of their sleep. The demographic and clinical characteristics of the participants are presented in Table 1.

Logistic regression analysis for the relationship between demographic/clinical factors and low sleep quality among individuals with diabetes

Logistic regression analysis was applied to identify factors associated with poor sleep quality in individuals with DM (Table 2). According to adjusted analysis, individuals with DM aged 56 and above were 1.50 times more likely to have poor sleep quality (aOR = 1.50, 95% CI 1.05–2.16, P = 0.026). Poor sleep quality was more prevalent in women compared with men (OR = 2.15, 95% CI 1.28–3.62, P = 0.004). Similarly, patients who lived in rural areas had poor sleep quality significantly more likely than patients who lived in urban areas (aOR = 2.65, 95% CI 1.83–3.84, P <0.001). Likewise, patients with underlying diseases had significantly increased odds of poor sleep quality (aOR = 2.51, 95% CI 1.55–4.08, P <0.001) compared with patients with no diseases. Other variables had no statistically significant relationship with sleep quality (Table 2).

Logistic regression analysis for the relationship between demographic/clinical factors and poor sleep quality among individuals without diabetes

According to adjusted analysis, women were 1.74 times more likely to have poor sleep quality than men (aOR=1.74, 95% CI 1.01–3.02, P = 0.047). The odds of poor sleeping quality were 2.09 times (aOR = 2.09, 95% CI 1.41–3.08, P <0.001) significantly more likely in individuals without DM who had underlying diseases than those who did not. Other

Table 1 Demographic and clinical characteristics of the participants in PGCS (n = 1560)

Variable	Total n (%)	Non-diabetic	Diabetic	*P* value
Age (years)				
36–55	820 (52.6)	412 (52.8)	408 (52.3)	0.839
≥ 56	740 (47.4)	368 (47.2)	372 (47.7)	
Sex				
Male	643 (41.2)	322 (41.3)	321 (41.2)	0.959
Female	917 (58.8)	458 (58.7)	459 (58.8)	
Marital status				
Married	1428 (91.5)	719 (92.2)	709 (90.9)	0.028
Single	37 (2.4)	22 (2.8)	15 (1.9)	
Widow	80(5.1)	10 (1.3)	5 (0.6)	
Divorced	15 (1)			
Education level				
Illiterate	279 (17.9)	108 (13.8)	171 (21.9)	<0.001
Elementary	467 (29.9)	222 (28.5)	245 (31.4)	
Middle school	301 (19.3)	142 (18.2)	159 (20.4)	
Diploma	407(26.1)	241 (30.9)	166 (61.3)	
University	106 (6.8)	67 (8.6)	39 (5)	
SES				
Low	545 (34.9)	272 (34.9)	273 (35)	0.008
Medium	517 (33.1)	234 (30)	283 (36.3)	
High	498(31.9)	274 (35.1)	224 (28.7)	
Habitat				
Urban	504 (32.3)	146 (18.7)	358 (45.9)	<0.001
Rural	1056 (67.7)	634 (81.3)	422 (54.1)	
MET				
Low	539(34.6)	256 (32.8)	283 (36.3)	0.231
Medium	523(33.5)	261 (33.5)	262 (33.6)	
High	498(31.9)	263 (33.7)	235 (30.1)	
BMI (kg/m^2)				
Normal	22 (1.4)	15 (1.9)	7 (0.9)	<0.001
Underweight	389 (24.9)	234 (30)	155 (19.9)	
Overweight	598 (38.3)	276 (35.4)	322 (41.3)	
Obese	551(35.3)	255 (32.7)	296 (37.9)	
Smoking				
No	1204 (77.2)	595 (76.3)	609 (78.9)	0.398
Yes	356 (22.8)	185 (23.7)	171 (21.9)	
Alcohol consumption				
No	1393 (89.3)	696 (89.2)	697 (89.4)	0.935
Yes	167 (10.7)	84 (10.8)	83 (10.6)	
Opium consumption				
No	1478(94.7)	738 (94.6)	740 (94.9)	0.820
Yes	82 (5.3)	42 (5.4)	40 (5.1)	
Underlying disease				
No	541 (34.7)	319 (40.9)	222 (28.5)	<0.001
Yes	1019 (65.3)	461 (59.1)	558 (71.5)	
Hypertension				
No	1107 (71)	638 (81.8)	469 (60.1)	<0.001
Yes	453 (29)	142 (18.2)	311 (39.9)	

Table 1 (continued)

Variable	Total n (%)	Non-diabetic	Diabetic	*P* value
Hypertriglyceridemia				
No	872 (55.9)	480 (61.5)	392 (50.3)	<0.001
Yes	688 (44.1)	300 (38.5)	388 (49.7)	
Increased total cholesterol				
No	345 (60.6)	461 (59.1)	484 (62.1)	0.233
Yes	296 (37.9)	319 (40.9)	615 (39.4)	

SD, Standard deviation; *BMI*, Body mass index

variables had no statistically significant relationship with sleep quality (Table 3).

Comparison of sleep quality and its components between people with and without diabetes

Among the total participants, the mean total score of sleep quality in individuals with DM (4.60 ± 3.24) was lower than individuals without DM (4.27± 2.98) in the components of sleep ($P = 0.034$). Also, individuals with DM compared to those without had lower quality of sleep in the components of sleep latency ($P = 0.013$), effective sleep duration ($P = 0.001$), and adequacy of sleep ($P < 0.001$) (Table 4). The overall prevalence of poor sleep quality among patients with DM was 28.1% (aOR = 1.15, 95% CI 0.89–1.49) and this difference was not significant ($P = 0.277$).

Discussion

Poor sleep quality is a serious problem for patients with DM because it increases the risk of insulin resistance and complications related to DM. Better sleep management can increase the likelihood of better DM management, having positive feedback on sleep quality (Chattu et al. 2019). Studies have shown that T2DM itself can interfere with sleep and cause sleep apnea among patients with DM. Thus, poor sleep is often found among patients with T2DM in comparison to healthy control groups (Resnick et al. 2003; Trento et al. 2008; Barone and Menna-Barreto 2011). Subsequently, our aim is comparing sleep quality and its related factors in individuals with and without DM. In this study, the overall prevalence of poor sleep quality among DM was found to be 28.1%, which was higher than in individuals without DM (25.5%). Sridhar et al. reported a higher prevalence of sleep disorders (33.7%) among patients with T2DM than in a control group without DM (8.2%), which was greater than our study (Sridhar and Madhu 1994). Also, the poor sleep quality among individuals with DM was lower than studies conducted in Korea (38.4%) (Shim et al. 2011), Xuzhou City of China (33.6%) (Lou et al. 2015), Northwest Iran (38%) (Shamshirgaran et al. 2017), and the USA (84%) (Chasens et al. 2016).

In the present study, individuals with DM that were aged 56 and above had 1.50 times lower sleep quality than those aged 35–55 years, which is consistent with the results of previous studies. They claimed that the low quality and quantity of sleep is related to the patient's increased age (Lopes et al. 2005; Chaput et al. 2009; Maracy et al. 2011). This association could be because of the higher prevalence of chronic medical conditions in older age. Conversely, Khosravan et al., observed that there were no significant associations between age and sleep disorder in individuals with DM (Khosravan et al. 2015).

Our findings revealed that poor sleep quality was more prevalent in women with and without DM, which is in agreement with the results of some other studies (Arber et al. 2009; Kemple et al. 2016; Poustchi et al. 2018). Tomilito et al. also indicated that fluctuations in sleep duration increase the risk of T2DM in middle-aged women but not men (Lou et al. 2012). This could be because the women in different age groups experience different periods, such as pregnancy, lactation and menopause, post-menopause, which plays an important role in the structural changes in sleep, and it may have lowered their sleep quality.

The individuals with DM who live in rural areas were 2.65 times more likely to have poor sleep quality compared with their urban populations. This finding was in line with studies done in Ethiopia and Brazilia (Edmealem et al. 2020). This may be because individuals who live in rural regions experience more difficult living conditions, underprivileged health perception, and management than individuals who live in urban regions. In addition, patients who lived in rural regions might have light sleep for a longer period since they sleep early.

Also, there was a significant relationship between poor sleep quality with the presence of underlying disease in people with DM. This was consistent with the study conducted by Khosravan et al. They implied that individuals with DM with chronic diseases such as cardiovascular diseases, kidney diseases, and blood pressure reported more cases of sleep disorder. They had a poor quality of sleep and stated more complaints of sleep complications (Khosravan et al. 2015). Likewise, individuals without DM with an underlying disease had 2.09 times more poor sleep quality than those who had no underlying disease. Similarly, Kemple et al. indicated that patients with chronic disease were observed living with poor quality of sleep. The poor quality sleep demonstrates that chronically troubled sleep can increase the disease burden on patients with chronic disease (Kemple et al. 2016). We did not find any association of sleep quality with marital status, education level, SES, MET, BMI, smoking, and other variables listed in Tables 2 and 3.

The mean total score of sleep quality in individuals with DM was significantly lower than individuals without DM. Patients with DM had higher sleep latency, lower sleep duration, and lower sleep efficacy. Sakamoto et al. showed that patients with diabetes experience lower sleep quality due to thirst, enuresis, and diabetic neuropathies, while decreased sleep time increases

Table 2 Logistic regression analyses for the relationship between demographic/clinical factors and poor sleep quality among individuals with diabetes in PGCS (n = 1560)

Variable	Poor sleep quality, n (%)	Unadjusted		Adjusted	
Age (years)		OR (95% CI)	*P*	OR (95% CI)	*P*
36–55	98 (24)	1		1	
≥ 56	121 (32.5)	1.52 (1.11–2.09)	0.008	1.50 (1.05–2.16)	0.026
Sex					
Male	62 (19.3)	1		1	
Female	17 (34.2)	2.17 (1.55–3.04)	<0.001	2.15 (1.28–3.62)	0.004
Marital status					
Married	198 (27.9)	1		1	
Single	2 (13.3)	0.4 (0.09–1.78)	0.227	0.5 (0.1–2.43)	0.386
Widow	18 (35.3)	1.41 (0.77–2.56)	0.262	0.84 (0.43–1.62)	0.597
Divorced	1 (20)	0.65 (0.07–5.81)	0.696	0.37 (0.04–3.65)	0.394
Education level					
Illiterate	50 (29.2)	1.89 (0.78–4.56)	0.157	1.38 (0.51–3.69)	0.524
Elementary	74 (30.2)	1.98 (0.84–4.68)	0.121	1.69 (0.65–4.35)	0.281
Middle school	48 (30.2)	1.98 (0.82–4.79)	0.131	1.87 (0.72–4.84)	0.197
Diploma	40 (24.1)	1.45 (0.59–3.54)	0.413	1.33 (0.52–3.41)	0.555
University	7 (17.9)	1		1	
SES					
Low	78 (28.6)	1.17 (0.79–1.75)	0.436	1.22 (0.76–1.94)	0.411
Medium	84 (29.7)	1.24 (0.83–1.83)	0.291	1.18 (0.76–1.84)	0.450
High	57 (25.4)	1		1	
Habitat					
Urban	67 (18.7)	1		1	
Rural	152 (36)	2.45 (1.75–3.41)	<0.001	2.65 (1.83–3.84)	<0.001
MET					
Low	86 (30.4)	1.36 (0.92–2.02)	0.121	0.81 (0.52–1.27)	0.366
Medium	76 (29)	1.28 (0.86–1.9)	0.233	0.89 (0.57–1.38)	0.591
High	57 (24.3)	1		1	
BMI (kg/m^2)					
Normal & Underweight	32 (19.9)	1		1	
Overweight	92 (28.6)	1.6291.03–2.5)	0.037	1.32 (0.79–2.18)	0.287
Obese	95 (32.1)	1.92 (1.22–3.03)	0.005	1.11 (0.65–1.89)	0.694
Smoking					
No	183 (30)	1		1	
Yes	36 (211)	0.62 (0.41–0.93)	0.021	1.27 (0.71–2.25)	0.417
Alcohol consumption					
No	207 (29.7)	1			
Yes	12(14.5)	0.4 (0.21–0.75)	0.005	0.57 (0.27–1.22)	0.148
Opium consumption					
No	209 (28.2)	1		1	
Yes	10 (25)	0.85 (0.41–1.76)	0.657	1.69 (0.72–3.98)	0.225
Underlying disease					
No	32 (14.4)	1		1	
Yes	187 (33.5)	2.99 (1.98–4.53)	<0.001	2.51 (1.55–4.08)	<0.001
Hypertension					
No	112 (23.9)	1		1	
Yes	107 (34.4)	1.67 (1.22–2.29)	0.001	0.93 (0.63–1.38)	0.711
Hypertriglyceridemia					
No	111 (28.3)	1		1	
Yes	108 (27.8)	0.98 (0.71–1.33)	0.881	0.98 (0.69–1.4)	0.930
Increased total cholesterol					
No	143 (29.5)	1		1	
Yes	76 (25.7)	0.82 (0.59–1.14)	0.244	0.85 (0.59–1.22)	0.373

BMI, Body mass index; *MET*, Metabolic equivalent of task; *SES*, Socioeconomic status; *OR*, Odds ratio; *CI*, Confidence interval

Table 3 Logistic regression analyses for the relationship between demographic/clinical factors and poor sleep quality among individuals without diabetes in PGCS (n = 1560)

Variable	Prevalence, n (%)	Unadjusted		Adjusted	
Age (years)		OR (95% CI)	*P*	OR (95% CI)	*P*
36–55	108 (26.2)	1		1	
≥ 56	91 (24.7)	0.92 (0.67–1.28)	0.635	0.93 (0.62–1.38)	0.705
Sex					
Male	57 (17.7)	1		1	
Female	142 (21)	2.09 (1.48–2.96)	<0.001	1.74 (1.01–3.02)	0.047
Marital status					
Married	179 (24.9)	1		1	
Single	6 (27.3)	1.13 (0.44–2.94)	0.8	1.05 (0.38–2.92)	0.923
Widow	12 (41.4)	2.13 (1–4.54)	0.051	1.44 (0.64–3.22)	0.375
Divorced	2(20)	0.75 (0.16–3.58)	0.723	0.5 (0.1–2.5)	0.399
Education level					
Illiterate	34 (31.5)	1.59 (0.79–3.22)	0.195	1.29 (0.56–2.97)	0.55
Elementary	61 (27.5)	1.31 (0.69–2.5)	0.408	1.1 (0.52–2.3)	0.8007
Middle school	36 (25.4)	1.18 (0.59–2.34)	0.642	1.04 (0.48–2.23)	0.926
Diploma	53 (22)	0.98 (0.51–1.870	0.945	0.87 (0.43–1.74)	0.691
University	15 (22.4)	1		1	
SES					
Low	75 (27.6)	1.09 (0.75–1.59)	0.661	0.94 (0.59–1.49)	0.793
Medium	53 (22.6)	0.84 (0.56–1.26)	0.394	0.8 (0.51–1.26)	0.341
High	71 (25.9)	1		1	
Habitat					
Urban	40 (27.4)	1		1	
Rural	159 (25.1)	0.89 (0.59–1.33)	0.563	0.79 (0.51–1.23)	0.303
MET					
Low	72 (28.1)	1.45 (0.97–2.16)	0.702	1.21 (0.77–1.89)	0.403
Medium	71 (27.2)	1.38 (0.92–2.06)	0.115	1.25 (0.81–1.94)	0.317
High	56 (21.3)	1		1	
BMI (kg/m^2)					
Normal & Underweight	56 (22.5)	1		1	
Overweight	67 (24.3)	1.1 (0.74–1.66)	0.630	0.96 (0.62–1.48)	0.846
Obese	76 (29.8)	1.46 (0.98–2.18)	0.063	1.01 (0.64–1.59)	0.979
Smoking					
No	164 (27.6)	1		1	
Yes	35 (18.9)	0.61 (0.41–0.92)	0.019	1.16 (0.64–2.09)	0.631
Alcohol consumption					
No	187 (26.9)	1			
Yes	12 (143)	0.45 (0.24–0.85)	0.014	0.68 (0.33–1.41)	0.304
Opium consumption					
No	188 (25.5)	1		1	
Yes	11926.2)	1.04 (0.51–2.11)	0.918	1.56 (0.72–3.39)	0.256
Underlying disease					
No	54 (16.9)	1		1	
Yes	145 (31.5)	2.52 (1.58–3.2)	<0.001	2.09 (1.41–3.08)	<0.001
Hypertension					
No	155 (24.3)	1		1	
Yes	44 (31)	1.4 (0.94–2.09)	0.099	0.92 (0.59–1.44)	0.721
Hypertriglyceridemia					
No	111 (23.1)	1		1	
Yes	88 (29.3)	1.38 (1–1.91)	0.053	1.17 (0.81–1.69)	0.389
Increased total cholesterol					
No	103 (22.3)	1		1	
Yes	96 (30.1)	1.5 (1.08–2.070	0.015	1.26 (0.88–1.8)	0.208

BMI, Body mass index; *MET*, Metabolic equivalent of task; *SES*, Socioeconomic status; *OR*, Odds ratio; *CI*, Confidence interval

Table 4 Comparison of sleep quality and its components between people with and without diabetes in PGCS population

Sex/Age group	Non-diabetic Mean (SD)	Diabetic	*P* value
Mental quality of sleep	1.08 (0.62)	1.11 (0.65)	0.426
Sleep latency	0.85 (1.08)	0.98 (1.08)	0.013
Sleep duration	0.69 (0.75)	0.82 (0.84)	0.001
Sleep efficacy	0.13 (0.48)	0.26 (0.68)	<0.001
Sleep disorders	0.86 (0.55)	0.8 (0.55)	0.042
Use sleep medication	0.21 (0.73)	0.24 (0.79)	0.304
Day time dysfunction	0.45 (0.74)	0.38 (0.69)	0.047
Overall sleep quality	4.27 (2.98)	4.6 (3.34)	0.034

cortisol, interleukin 6 (IL-6), and tumor necrosis factor α (TNF-α) levels. As a result, it stimulates the sympathetic nervous system, which strengthens insulin resistance and exacerbates the disease (Sakamoto et al. 2018). Lina et al. investigated sleep complaints in men with diabetes; they reported that short sleep duration (≤5 hours per night) has been seen in individuals with diabetes and is the most important cause of poor sleep quality in these patients (Mallon et al. 2005). Furthermore, in the current study, sleep latency was higher in individuals with DM, which is consistent with Hayashino et al.'s findings that indicated people with diabetes had lower sleep quality than people without diabetes due to high frequencies of difficulty initiating sleep at night (Hayashino et al. 2007). Similar to our results, another study found that people with diabetes with poor sleep quality had lower sleep efficacy compared to people without diabetes (Knutson et al. 2006). The limitation of this study could be its cross-sectional method on certainty about the duration of diabetes and also recall biased due to the questionnaire being answered over the phone because of the COVID-19 pandemic. One limitation that could be mentioned in the present study is that we did not collect information on caffeine intake, medications, and breathing disorders, which might have an effect on patients' sleep. Also, the cross-sectional nature of the study limited the causal relationship between variables.

Conclusions

Poor sleep quality was higher in both diabetic and non-diabetic groups in people with underlying diseases. Poor sleep quality could increase the severity of diseases, it seems this aspect of public health has to be attended by the policymakers and managers and other health services-related researchers within the health care setting. Consequently, the efficacy of sleep improvement programs should be analyzed and regarded in the program of patients' health care.

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Authors' contributions SSKH, AGH, SM, AI, and ZAR cooperated in data collecting and analyzing. FJ and FMGH designed and supervised the study. TZ and NF wrote the manuscript. All contributed to the editing and refinement of the final version of the manuscript. The authors read and approved the final manuscript.

Data availability The study protocol and the datasets analyzed are available from the corresponding author upon request.

Declarations

Ethics approval and consent to participate Written consent was taken after informing the purpose and importance of the study to each participant. To ensure confidentiality of participant's information, codes were used whereby the name of the participant and any identifier of participants was not written on the questionnaire. Informed consent was obtained from all individual participants. This study is in accordance with the ethical code of Guilan University of Medical Sciences, Rasht, Iran (IR.GUMS.REC.1399.605).

Informed consent This study was approved by the ethics committees at the Ministry of Health and Medical Education, the Digestive Diseases Research Institute of Guilan University of Medical Sciences. Informed consent was obtained from all individual participants.

Conflict of interest The authors declare that they have no competing interests in this work.

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