Biomedical Research 2010; 21 (4): 333-340

Sleep quality and excessive daytime sleepiness in a Arab diabetic population

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Abstract

The aim of this cross-sectional study was to examine the sleep quality, excessive daytime sleepiness (EDS) and its patterns in a Diabetic population sample. The survey was carried out at the outpatient diabetic clinics of the Hamad General Hospital and Primary Health Care (PHC) centres. A total number of 1050 T2DM patients aged above 20 years of age were selected by a systematic sampling procedure from diabetic clinics of the hospitals and PHC centres and 847 cases agreed to participate in the study with a response rate of 80.7%. The study included information about socio-demographic characteristics including age, sex, marital status, education level, occupation, height, weight and parental consanguinity, medical history, smoking habit, physical activity and sleeping habits during the past month. We have used both instruments Epworth sleepiness scale (ESS) score and the Pittsburgh sleep quality index (PSQI). Of the studied diabetic patients, 46.9% were males and 53.1% females. Majority of the diabetic patients were in the age group (40 – 59) years old (59.3%). More than half of the diabetic women were housewives (56.9%) and most of the men were in sedentary and professional jobs (38.1%). ESS score revealed that diabetic women (64.4%) were significantly more sleepier than men (55.2%) during the daytime (p=0.034). Overall, 60.1% of the diabetic patients were very sleepy during the daytime with 43% men and 57% women and a significant difference was observed between both the genders (p<0.001). There was a significant association observed between both the genders in all the situations of the Epworth Sleepiness Scale, especially while watching TV (18.4% vs 23.8%,p=0.024), sitting in the public place (4% vs 10.4%; p=0.003) and sitting talking to someone (1.5% vs 6.4%, p<0.001) and sitting in a car in the traffic (3.8% vs 7.1%; p<0.001). Obesity was significantly higher in diabetic women who had high chances of EDS (51.7%) than men (39.3%) (p=0.007). Physical activity was significantly lower in diabetic women with poor sleep (38.6%) compared to men (50.2%) (p=0.012). The present study findings observed that sleep quality was very poor in diabetic population. Also, Excessive day time sleepiness was observed more in diabetic population.

Key words: Diabetes mellitus, Sleep disturbance, Risk factors .Epworth Sleepiness Scale. Pittsburgh Scale

Accepted August 13 2010

Introduction

Type 2 Diabetes Mellitus (T2DM) is on the rapid increase throughout the world and it is being described as "modern disease" caused by lifestyle, diet and obesity. In the year 2000, the World Health Organization (WHO) reported that 177 million people were affected by diabetes worldwide but by 2025, this figure is projected to rise to over 300 million [1]. In both developed and developing countries, there is an epidemiologic trend in which metabolic disorders have been recognized as a serious issue. Of the various metabolic diseases, type 2 Diabetes was rare at the beginning of the 20th century [2], but has become a major hurdle for health care worldwide, and is likely to remain so.

The increased prevalence of metabolic disorders in our society is aggravated by endemic voluntary postponement of bed time and by the current sedentary lifestyle, leading to epidemic proportions of obese people. Sleep disorders is commonly found in patients with type 2 diabetes [3]. Diabetes and chronic loss of sleep share the fact that both affect millions and one is detrimental to the other. As-

sociated with the endemic condition of diabetes in our society, chronic sleep loss is increasingly common in industrialized societies and affects about 45% of all adults [4]. Sleep is a complex behavioural state that occupies one third of the human life span. However, there is increasing evidence that sleep also modulates the metabolic, endocrine and cardiovascular systems [5]. Sleep disturbances are common and can be detrimental to the health, mood, and quality of life of people with diabetes.

A study revealed a marked reduction in glucose tolerance and insulin sensitivity after 8 nights of 5-hour bedtimes compared with 8-hour bedtimes [6]. Various mechanisms have been explored and suggested that there is a potential link between poor sleep patterns and negative health outcomes like impaired glucose regulation and subsequent increased risk of type 2 DM [7]. Evidence from cross-sectional studies suggests that a diabetic condition may involve a reduction in sleep duration or an impairment of sleep quality [8].

In the developed and rapidly modernizing countries, there has been an increasing concern about the impact of T2DM on health services [9]. The state of Qatar is a rapidly developing country with a change that influenced the lifestyle of the people towards urbanization, particularly over the recent decades. The prevalence of diabetes varies widely among populations according to race, life style and urbanization [10]. Few previous studies of Bener et al reported that T2DM is a major chronic disease with high morbidity, mortality in Qatar [11-13] and numerous studies have documented worldwide on the association between sleep disturbances and diabetes [3-7]. To our knowledge, no study has been conducted to examine the sleep quality and excessive daytime sleepiness in diabetic population. Excessive daytime Sleepiness (EDS) is commonly assumed to be the result of disturbed or inadequate sleep in the night [14]. It is important to study the existence of sleep loss in type 2 DM population because not only do these 2 chronic disorders co exist but there is also growing evidence that they exacerbate each other.

Hence, this study aimed to examine the sleep quality, excessive daytime sleepiness and its patterns in diabetic Arab population residing in the State of Qatar.

Subjects and Methods

This is a cross-sectional study which was conducted among the adult Arab population above 20 years of age, residing in the State of Qatar, over a period from March 2009 to August 2009. The study was approved by the IRB at the Hamad Medical Corporation prior to commencing the data collection.

T2DM is a major chronic disease with high prevalence rate in Qatar [12-15]. The power calculation was actually based on reported the prevalence rate of T2DM [12] as 16.7%, allowing an error of 5%, level of significance (type-1 error) of 1% and with 95% confidence limits, it was computed that 1050 subjects as a sample size needed to achieve the objective of our study. Of the 22 primary health care centres available, we have selected 11 health centres at random. Of these, eight were located in urban and three in semi-urban areas of Qatar. Finally, subjects were selected systematically 1-in-2 using a systematic sampling procedure. Each participant has been provided with brief information about the study and was assured of strict confidentiality.

A well designed and pilot tested questionnaire was used to collect the data. The designed questionnaire was tested among 50 cases as a pilot study for the validity of the questionnaire. The investigators have made the necessary corrections and modifications after considering the minor differences and discrepancies that have been found during the pilot study. The first part included information about socio-demographic characteristics including age, sex, marital status, education level, occupation, height, weight and parental consanguinity. The second section collected information about medical history, smoking habit and physical activity. The third section included items about sleeping habits during the past month and the Epworth sleepiness scale (ESS) score [13]. The Epworth sleepiness scale is a brief, valid, reliable measure used to assess the likelihood that an individual will fall asleep in a series of situations such as watching TV, sitting and reading, sitting in a car…etc. The scoring of the answers is 0-3, with 0 being "would never doze", 1 for "slight chance of dozing", 2 for "moderate chance of dozing" and 3 for high chance of dozing". A score lower than 6 distinguishes as getting enough sleep, 7-8 as tends to be sleepy and greater than 9 as very sleepy and they should seek medical advice. Pittsburgh sleep quality index (PSQI) [16] was used to check the sleep habits of diabetic patients. For each of the questions of the questionnaire, response was classified as "not during the last month", "less than once a week", "Once or twice a week" and "three or more times a week".

Selection of Type 2 Diabetic (T2DM) Subjects

Subjects reporting a history of T2DM and currently taking oral medications for diabetes were considered to have Diabetes Mellitus. T2DM was defined according to the WHO expert group [15,17], i.e. fasting venous blood glucose concentration $\geq$ 7.0mmol/l. A total number of 1050 T2DM patients aged above 20 years of age were selected by a simple random sampling procedure from diabetic clinics of the primary health care centres and 847 cases agreed to participate in the study with a response rate of 80.7%. These patients were interviewed by the trained Research Assistants and completed the questionnaires.

Physical examination and measurements were performed by a trained nurse. Height was measured in centimeters. Weight was measured in kilograms. The subjects were asked to stand on the weight scale bare feet with light clothing. BMI was calculated as the ratio of weight (kilogram) to the square of height (meters). Obesity and overweight were classified according to WHO criteria [15-17]. A person was considered obese if the BMI value was >30 kg/m^2, overweight if BMI was (25-30 Kg/M^2).

Blood pressure measurement was carried out by trained practical nurses according to World Health Organization (WHO) standardized criteria [15]. Blood pressure was recorded to the nearest millilitre of mercury (mmHg). Systolic blood pressure (SBP) was recorded at the appearance of the first Korotkoff sound and diastolic blood pressure (DBP) at the disappearance of the fifth Korotkoff sound. The mean value obtained from three readings was used in the analysis. Hypertension was defined according to WHO criteria as SBP $\geq$ 140 mmHg and/or DBP $\geq$ 90 mmHg and/or the use of antihypertensive medication [12]. Fasting blood venous samples were collected from all participants for determination of total cholesterol.

Smoking habits was classified in terms of current smoker, ex-smoker and non-smoker. A current smoker was defined as one who regularly smoked at least one cigarette per day, an ex-smoker was one who has given up smoking for at least 6 months, and non smoker was one who has never smoked regularly. Patients were classified as physically active if they reported participating in walking or cycling for more than 30minutes/day.

Student-t test was used to ascertain the significance of differences between mean values of two continuous variables and confirmed by non-parametric Mann-Whitney test. Fisher's exact and Chi-square tests were performed to test for differences in proportions of categorical variables between two or more groups. The level $p<0.05$ was considered as the cut-off value for significance.

Results

Table 1 shows the socio-demographic characteristics of the studied diabetic patients according to gender. Of the studied diabetic patients, 46.9% were males and 53.1% females. Majority of the diabetic patients were in the age group (40-59) years old (59.3%). 20.1% of the studied diabetic patients were illiterate and only 16.6% were graduates. More than half of the women were housewives (56.9%) and 38.1% of men were in sedentary and professional jobs. A significant difference was observed between males and females in terms of age group ($p=0.003$), marital status ($p<0.001$), monthly income ($p=0.047$) and occupation ($p<0.001$).

Table 1. *Socio-demographic characteristics of the studied diabetic patients by gender (N=847)*

Variables	Male N=397 N (%)	Female N=450 n(%)	P Value
Age group			
<30	52 (13.1)	54 (12.0)	0.003
30-39	95 (23.9)	63 (14.0)	
40-49	89 (22.4)	108 (24.0)	
50-59	129 (32.5)	176 (39.1)	
60+	32 (8.1)	49 (10.9)	
Nationality			0.064
Qatari	214 (53.9)	271(60.2)	
Other Arab nationals	183(46.1)	179 (39.8)	
Marital Status			
Single	34 (8.6)	19 (4.2)	<0.001
Married	339 (85.4)	350 (77.8)	
Divorced	24 (6.0)	81(18.0)	
Household monthly income			0.047
5000-9999	129 (32.5)	183(40.7)	
10000-14999	155 (39.0)	157(34.9)	
>15000	113 (28.5)	110 (24.4)	
Education level			
Illiterate	82 (20.7)	88 (19.6)	0.118
Primary	79 (19.9)	76 (16.9)	
Intermediate	90 (22.7)	94(20.9)	

Secondary	76 (19.1)	121(26.9)	
University	70(17.6)	71(15.8)	
Consanguinity			
Yes	160 (40.3)	157 (34.9)	0.104
No	237 (59.7)	293 (65.1)	
Occupation			
House wife	0 (0)	256 (56.9)	<0.001
Sedentary & Professional	151 (38.1)	75 (16.7)	
Manual	137 (34.5)	50 (11.1)	
Businessman	80 (20.2)	41(9.1)	
Army Police	29 (7.3)	28 (6.2)	

Table 2. *Comparison in sleeping quality using Epworth sleepiness Scale (ESS) according to gender (N=847)*

Variables	**Male** N=397 n(%)	**Female** N=450 n(%)	**P Value**
Sitting and reading			0.738
Never fall asleep	118(29.7)	123 (27.3)	
Slight chance of falling asleep	93(23.4)	116 (25.8)	
Medium chance of falling asleep	127(32.0)	138 (30.7)	
High chance of falling asleep	59 (14.9)	73 (16.2)	
Watching TV			0.024
Never fall asleep	41(10.3)	30 (6.7)	
Slight chance of falling asleep	87(21.9)	76 (16.9)	
Medium chance of falling asleep	196 (49.4)	237 (52.7)	
High chance of falling asleep	73 (18.4)	107 (23.8)	
Sitting, inactive in a public place like a theatre or meeting			0.003
Never fall asleep	84(21.2)	89(19.8)	
Slight chance of falling asleep	129(32.5)	121(26.9)	
Medium chance of falling asleep	168(42.3)	193(42.9)	
High chance of falling asleep	16(4.0)	47(10.4)	
As a passenger in a car for an hour without a break			0.005
Never fall asleep	242 (61.0)	224 (49.8)	
Slight chance of falling asleep	89 (22.4)	114 (25.3)	
Medium chance of falling asleep	55 (13.9)	89 (19.8)	
High chance of falling asleep	11(2.8)	23 (5.1)	
Lying down to rest in the afternoon when circumstances permit			
Never fall asleep	74 (18.6)	78 (17.3)	0.035
Slight chance of falling asleep	128 (32.2)	119 (26.4)	
Medium chance of falling asleep	169 (42.6)	201(44.7)	
High chance of falling asleep	26 (6.5)	52 (11.6)	
Sitting and talking to someone			<0.001
Never fall asleep	289(72.8)	266 (59.1)	
Slight chance of falling asleep	73 (18.4)	89 (19.8)	
Medium chance of falling asleep	29 (7.3)	66 (14.7)	
High chance of falling asleep	6 (1.5)	29 (6.4)	
Sitting quietly after lunch without alcohol			0.013
Never fall asleep	66 (16.6)	103(22.9)	
Slight chance of falling asleep	100 (25.2)	130 (28.9)	
Medium chance of falling asleep	174 (43.8)	174 (38.7)	
High chance of falling asleep	57 (14.4)	43 (9.6)	
In a car, while stopped for a few minutes in traffic			<0.001

Never fall asleep	312 (78.6)	258 (57.3)	
Slight chance of falling asleep	53(13.4)	81(18.0)	
Medium chance of falling asleep	17 (4.3)	79 (17.6)	
High chance of falling asleep	15 (3.8)	32 (7.1)	
ESS Score results			0.034
Getting enough sleep (1-6)	96 (24.2)	72 (16.0)	
Average (7-8)	82 (20.7)	88 (19.6)	
Very sleepy (9+)	219 (55.2)	290 (64.4)	

Table 2 shows the comparison in sleeping quality in studied subjects using Epworth sleepiness scale (ESS). Female diabetic patients had significantly high chances of falling asleep during the day time than men; sitting and reading (16.2% vs 14.9%), watching TV (23.8% vs 18.4%;p=0.024), sitting inactive in a public place (10.4% vs 4%;p=0.003), as a passenger in a car (5.1% vs 2.8%;p=0.005), lying down to rest in the afternoon (11.6% vs 6.6%;p=0.035), sitting and talking to someone (6.4% vs 1.5%;p<0.001), and in a car while stopped for few minutes in traffic (7.1% vs 3.8%);p<0.001. ESS score results showed that diabetic women were significantly sleepier (64.4%) than men (55.2%) during the daytime (p=0.034).

Table 3 shows the sleeping quality, excessive day time sleepiness and its patterns in the diabetic population using the Pittsburgh sleep quality index (PSQI). The sleep loss was very high in diabetic patients (60.1%). Most of the diabetic patients with sleep disturbances experienced pains (79%), legs jerking while sleeping (48.9%) and had bad dreams (67%) compared to their counterparts.

Table 4 reveals the baseline characteristics and risk factors for diabetes according to sleeping status and gender using Epworth Sleepiness Scale. ESS score revealed that 60.1% of the diabetic patients were very sleepy during the day time with 43% males and 57% women and there was a significant difference between men and women who were very sleepy(p<0.001). A significant difference was observed in the mean age of DM patients who were sleepy according to gender (p=0.014). Obesity was significantly higher in diabetic women who had high level of daytime sleepiness (51.7%) than men (39.3%) (p=0.007). Physical activity was significantly lower in diabetic women with EDS (38.6%) compared to men (50.2%) (p=0.012). Risk factors like hypertension (42.6%), high cholesterol (56.7%), heart disease (15.2%), and respiratory problems (20.2%) were more frequent in diabetic women with excessive daytime sleepines

Table 3. *Sleeping quality and its patterns in the diabetic population using Pittsburgh sleep quality index (PSQI) (N=847)*

Variables	**Patients with disturbed sleep** N=509 n(%)	**Patients with good sleep** N=338 n (%)	**P-value**
During the past month, how often have you taken medicine to help you sleep			0.018
Never	77(15.1)	76(22.5)	
Once a Week	315(61.9)	198(58.6)	
More than once a Week	117(23.0)	64(19.0)	
Wake up in the middle of the night or early morning.			
Never	88(17.3)	64(18.9)	0.311
Once a Week	296(58.2)	206(60.9)	
More than once a Week	125(24.5)	68(20.2)	
Cannot get to sleep within 30 minutes			
Never	111(21.8)	62(18.3)	
Once a Week	292(57.4)	221(65.4)	
More than once a Week	106(20.8)	55(16.3)	
Have to get up to use the bathroom.			0.695
Never	41(8.1)	30(8.9)	
Once a Week	353(69.4)	225(66.6)	
More than once a Week	115(22.6)	83(24.6)	
Had bad Dreams			0.198

Never	168(33.0)	131(38.8)	
Once a Week	243(47.7)	152(45.0)	
More than once a Week	98(19.3)	55(16.3)	
Have Pain			0.077
Never	107(21.0)	92(27.2)	
Once a Week	280(55.0)	163(48.2)	
More than once a Week	122(24.0)	83(24.6)	
Legs twitching or jerking while you sleep			0.004
Never	260(51.1)	208(61.5)	
Once a Week	36(7.1)	12(3.6)	
More than once a Week	213(41.8)	118(34.9	

Table 4. *Baseline characteristics and risk factors for diabetes according to sleeping status and gender using Epworth Sleepiness Scale (ESS) (N=847)*

Variables	**Sleeping status**					
	Getting enough & average sleep in the night (n=338)		P Value	Very sleepy during the day (n=509)		P Value
	Male n(%)	Female n(%)		Male n(%)	Female n(%)	
Study sample	178(52.7)	160(47.3)	0.166	219(43.0)	290(57.0)	<0.001
Mean Age	45.01±12.8	46.74±11.7	0.195	44.27±11.5	46.85±11.9	0.014
BMI						
Overweight (25-30 Kg/M^2)	68(38.2)	53(33.1)	0.390	93(42.5)	111(38.3)	0.387
Obese (30+ Kg/M^2)	83(46.6)	97(60.6)	0.014	86(39.3)	150(51.7)	0.007
Physical Activity	95(53.7)	69(43.1)	0.053	110(50.2)	112(38.6)	0.012
Smoking Habit	37(20.8)	12(7.5)	0.001	61(27.9)	14(4.8)	<0.001
Hypertension	48(27.6)	51(32.5)	0.331	59(27.1)	123(42.6)	<0.001
High Cholesterol	97(55.7)	88(55.7)	0.993	106(48.6)	164(56.7)	0.070
Heart Disease	21(12.1)	23(14.6)	0.490	26(11.9)	44(15.2)	0.287
Kidney Disease	15(8.6)	11(7.0)	0.586	29(13.3)	37(12.8)	0.868
Respiratory Problem	27(15.6)	27(17.2)	0.697	31(14.3)	58(20.2)	0.084

Discussion

Diabetes mellitus is a major public health problem, causing significant morbidity and mortality. Across different populations, several studies have found sleep disturbances in patients with diabetes mellitus in relation with their quality of life [18,19]. However, the relationship between sleep disorders and diabetes mellitus is less understood and less studied in the Middle East region. The current study is one of the few studies using the Epworth sleepiness scale (ESS) and Pittsburgh sleep quality index (PSQI) to examine the sleep quality and excessive daytime sleepiness (EDS) in the diabetic population. Recent literature suggest that it may also be associated with the metabolic syndrome for example obesity, diabetes, Insulin resistence[20]. Even in the present study, the data revealed that there is a strong association between EDS and diabetes. This finding suggests that diabetes should be

considered whenever a complaint of EDS is present in individuals.

The results of the study have demonstrated a high proportion of sleep loss (60.1%) in Arab diabetic population residing in the State of Qatar. Among the studied diabetic patients, female diabetic patients (57%) were likely to have more sleep loss than male (43%) in the Arab population in our country. It was reported in a study by Suarez that Sleep quality and symptoms of poor sleep have been linked to increased risk of type 2 DM with recent evidence suggesting stronger associations in women [21]. On the contrary, a study by Mallon and colleagues [22] reported an association between sleep disturbances and diabetes that was probably easier to demonstrate in men because of the higher incidence in men and women developing DM reported good sleep in this study.

In the present study, diabetic patients (60.1%) reported high chances of daytime sleepiness. This is in line with two studies conducted among male and female populations in the US [23] and Japan [24]. A 10 year follow up survey of women aged 30-55 years enrolled in the Nurses Health Study in the US [23] has shown that sleep loss increased the risk of symptomatic diabetes after multivariate adjustment for standard risk factors. Another study done in Japan [24] among male population, Kawakami et al reported a high incidence of diabetes in male subjects reporting sleeping disturbances after controlling for other factors relevant to type 2DM. These studies identify sleep as a potential factor influencing glucose control in a specific population of patients with type 2 DM.

In this study, quality of sleep varied substantially by gender in diabetic patients. There was a significant difference observed in ESS scores between both sexes ($p=0.034$). This is in contrast with another study [25] that no significant difference was observed in ESS scores between both genders. Female diabetic patients (64.4%) had high chances of falling sleep during the daytime than men (55.2%) especially while sitting and reading (16.2% vs 14.9%), watching TV (23.8% vs 18.4%), sitting in a public place (10.4% vs 4%), sitting and talking to someone (6.4% vs 1.5%) and as a passenger in a car (5.1% vs 2.8%). Another study [26] by Meisinger et al demonstrated that the men and women who reported a high frequency of sleep loss had a significantly higher risk for type 2 DM. Thus, poor diabetes control could contribute both to a higher perceived sleep debt and lower sleep quality. Sleep disturbances with DM could be caused by either physical or psychological discomfort due to the disorder. This shows that quality of life is vital for health and well being in persons with type 2 DM.

In the present study, there was a significant association found between poor sleep and different co-morbid factors. Obesity was significantly higher in Diabetic women with high chances of falling sleep during daytime (51.7%) than in men (39.3%). This result supports the study finding of another study that sleep disorders correlates highly with obesity in diabetic population. Physical activity was significantly less in women (38.6%) compared to men (50.2%) which supports the result that obesity was more common in studied diabetic women. Co-morbid factors such as hypertension (42.6% vs 27.1%), high cholesterol (56.7% vs 48.6%), heart disease (15.2% vs 11.9%) and respiratory problem (20.2% vs 14.3%) were more prevalent in diabetic women with excessive daytime sleepiness than men. The high prevalence of co-morbid conditions in women could be another cause for the increase in sleep loss among diabetic women. It was reported[3] that men and women with sleep disturbances were more likely to be obese, to have a history of hypertension, and less likely to be physically active. Hence, the alarming rise in sleep loss among women is due to the rising problem of obesity and chronic diseases in female study population.

The notion that sleep disturbances exert detrimental metabolic effects may help explain the increasing prevalence of the insulin resistance in the general population. It is important to realize the impact that sleep has an outcome of DM. For this reason, all people with DM should be evaluated for sleep complaints and health outcomes. This may improve well-being and quality of life but may also improve glycemic control, which in turn will decrease negative long-term consequences of DM. Health care providers must acknowledge that symptoms of sleep are not to be ignored but discussed, and treatment options should be considered.

Conclusion

The present study findings observed that disturbed sleep was more prevalent in the diabetic population. Also, excessive daytime sleepiness was observed more in diabetic patients, especially in women. Sleep loss varied significantly by gender in diabetic patients. A significant difference was observed in ESS scores between both genders. Obesity was more common among diabetic women with poor sleep than men, while physical activity was significantly less in women compared to men.

Acknowledgement

This project generously funded and supported by the Qatar Diabetics Association and Qatar Foundation. Authors would like to thank Hamad Medical Corporation for their ethical approval of this study (HMC Research Protocol No.8268/08).

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