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Association of Sleep Quality & Glycemic Control in Type 2 Diabetes Mellitus

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Abstract

There is a high degree of association of sleep quality and glycosylated haemoglobin(HbA1c) in type 2 diabetic patients. The purpose of this prospective cross sectional study was to observe whether sleep quality had an effect on the glycemic control in type 2 diabetic patients of 30-60 years without any other comorbidity. The study was conducted after the IEC approval & taking informed consent of the participants in the diabetic clinic from 1st July 2019-31st august 2019 at MGM hospital NaviMumbai. Sleep quality was assessed by PSQI where the score 0-5 was Good sleep and Score of >5 was considered Poor sleep .25 % of participants had a PSQI score of less than 5 indicating good sleep quality (mean±SD : 3.80±1.29) & 75% had a score of more than 5 were poor sleep quality (mean±SD : 9.47±2.56).Based on the values of HbA1c in the participants 16% had normal control (4-6) with a mean±SD 5.5± 0.23 , 18% had Good control (6-7) with a mean ± SD 6.48±0.28 , 16% had Fair control (7-8) with a mean ± SD 7.59±0.31 & 50% had poor control (>8) with a mean ± SD 10.35± 1.69

A correlation was done of sleep quality & HbA1c levels . There was significant correlation between sleep quality &glycemic control with a p value of .002.There was no difference in the sleep quality between males (54%)& females (46%) nor there was a difference in different age groups 30-40 years(30%), 41-50 years (39%) , 51-60 years (32%) .Similarly there was no difference in the glycemic control in males & females & in different age groupsOur study included 101 participants of type 2 diabetes between 30-60 years of age without any other comorbidity .It was seen that 75 % participants with poor sleep quality with mean ±standard deviation of 9.47±2.5, had a higher level of glycosylated hemoglobin (>8 HbA1c)with mean ±standard deviation of 8.9±2.44.This shows that poor sleep

quality results in poor glycemic control in type 2 diabetic patients.

Keywords

Diabetes, Sleep, HbA1c, PSQI.

Introduction

Lifestyle changes have increased the incidence of non communicable diseases like Diabetes mellitus, Hypertension, Cancer etc. Diabetes mellitus is a metabolic disease with high morbidity and poor quality of life. Individual with type 2 diabetes are also associated with high risk of mortality.(1) Over 90% of all cases of Diabetes mellitus are of type 2 diabetes mellitus as per Centre of disease control and prevention 2014.

In patients of type 2 diabetes mellitus it is important to keep a record of glycemic control for the better management of the condition.Glycemic control is best evaluated by Glycosylated hemoglobin(HbA1c) as per American diabetes Association 2017.HbA1c provides information about the degree of long term glucose control(3 months).(2)It is 4-6 in normal individuals ,increases in diabetic patients . Higher value (>8) indicates poor glycemic control and poor management of diabetes.

Sleep has an influential role in regulation of health - physical, mental and it also determines the quality of one's life.Poor sleep is prevalent in type 2 diabetes and inversely associated with quality of life.(9) Hence it a predisposing factor for poor glycemic control.

A number of studies show strong associations of sleep deprivation and development of diabetes mellitus and also that poorly controlled diabetes is usually followed by sleep disorders.Increased diabetes mellitus prevalence and an impaired glucose tolerance test was seen in individuals (< 60 years) who had a sleep duration of 5 hours or less

Japanese patients with type 2 diabetes were found to have poor subjective sleep quality independently of potential confounders, especially those with inadequate glycemic controlHbA1c ≥ 7.9%. Impairment of sleep quality was associated with both increased sleep latency and a shorter duration of sleep.(32)Impairment of sleep results in insulin resistance, less leptin, and elevated by smoking, sedentary lifestyle, and alcohol predisposing to both diabetes and obesity and cardiovascular diseases (30,18,21)

A study conducted between night shift workers and non night shift workers both with type 2 diabetes mellitus it was seen that night shift workers had significantly higher HbA1c compared to others.(3)A sleep study conducted on 614 patients with type 2 diabetes49% were poor sleepers and 28.5% had depression(5)

The sleep duration and quality were significant predictors of HbA1c, a key marker of glycemic control. Evidence linking sleep loss to increased diabetes risk, the data suggest that optimizing sleep duration and quality should be tested as an intervention to improve glucose control in patients with type 2 diabetes.(7)Individuals affected with type2 diabetes are likely to experience sleep problems, characterized by disturbance in sleep maintenance and poor quality of life.(8). Hence there is a bidirectional association of sleep & diabetes status. Hence better management of diabetes would help the patient sleep better.

Sleep is modifiable risk factor for many chronic diseases.It increases the morbidity & affects the quality of life. It also results in poor management of the disease leading to high mortalty. Sleep is one factor which is usually compromised. Diabetic

patients modify their diet , do exercises,meditaion or adopt a different lifestyle to manage the condition better.We need to. To observe the extent of sleep quality on levels of HbA1c we conducted this study .This would help us create awareness among the patients & emphasize on the importance of good quality sleep. An sleep intervention program can be planned to see the positive effects on diabetic patients.

In this prospective cross sectional study we included participants of type 2 diabetes mellitus in the age group of 30-60 years who did not suffer from any other chronic illness. We assessed the sleep quality using PSQI questionnaire.A score of less than 5 indicates good sleep quality & greater than 5 indicates poor sleep quality .The HbA1c was then be estimated using High performance liquid chromatograph (HPLC) , model -D-10 of Bioradcompany.The correlation of sleep quality with the glycosylated haemoglobin was done.

Material and Methods

Study design

1. This is a prospective ,observational ,cross-sectional study which will be carried out in the Diabetic clinic of MGM hospital, Kamothe, Navi Mumbai after the approval by institutional ethics committee
2. Sample size: 100 participants

Inclusion Criteria of Subjects

The study will be conducted on type 2 diabetes patients in the age group of 30-60 years.

Exclusion Criteria of Subjects

Excluding the individuals who have co morbid conditions like sleep disorders, chronic illness other than type 2 diabetes and on drugs for treatment of any disorder.

Material

1. To assess the diabetic status through glycosylated haemoglobin (HbA1C)

The equipment used is High performance liquid chromatograph (HPLC) , model -D-10 of Bioradcompany.The assay is standardized according to approved IFCC method . The interpretation of the HbA1C of the blood sample of participant is done as follows. HbA1C Value of 4-6(Normal), 6-7 (good control), 7-8 (fair control), >8 (Poor control)

PSQI - The Pittsburgh Sleep Quality Index Questionnaire

It is for subjective assessment of sleep & has the reliability coefficient (Cronbach's alpha) of 0.83 for its 7 components (19 items). The 7 components are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction in the previous month. Participant needs to rate each of these 7 areas. Scoring is based on 0-3 scale, 3 indicates negative extreme on likert scale. A global sum of all the components is calculated. It yields an overall score ranging from 0-21.

Participants with score of < 5 are good sleepers and a score > 5 are taken to be poor sleepers. (8)

Method

Study procedure

Approval by institutional ethics committee will be obtained .Written informed consent obtained from the participant(sample size 100). It will be obtained in the local languages of the participants.

Participant fills in

1. Study form
2. PSQI questionnaire is filled by the participant (will be provided in local languages)
3. The 7 components will be analyzed and the global

PSQI score will be calculated

4. Participants are then categorized into 2 groups

a. Global PSQI score 0-5 - Good sleep

b. Global PSQI Score of >5 -Poor sleep

5. HbA1C will be estimated using HPLC ,model -D-10 of Biorad.

6. Based on the HbA1C values participants are then categorized into

1. Normal : 4-6
2. Good control : 6-7
3. Fair control : 7-8
4. Poor control : >8

7. Association of the sleep quality (Global PSQI score) with the HbA1C values is done

Statistical Tests for Analysis

1. Independent sample t test
2. ANOVA test
3. Multiple regression analysis

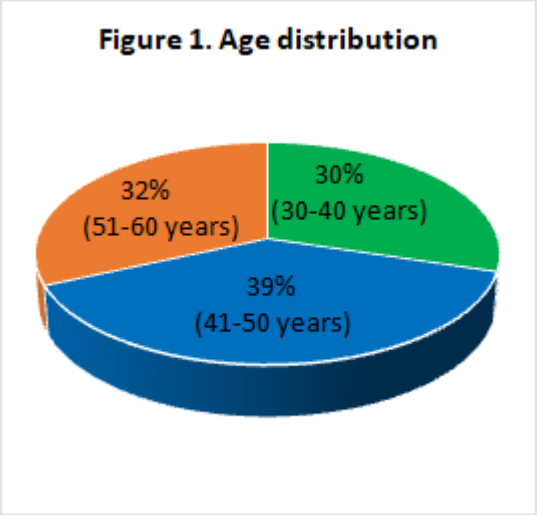
Observation and Results

1. Age Distribution of Participants

In this study, a total of 101 participants were assessed.(Table.1, Figure 1) shows the age wise distribution of participants into 30-40 years(30%), 41-50 years(39%) and 51-60 years(32%) with mean and standard deviation of 34.93±3.52, 46.41±2.47 and 56.18±2.76 respectively.

Table 1: Age distribution of Participants

S. No	Age group	Total Number (n)	Percentage (%)	Mean ± SD
1.	30-40	30	30%	34.93±3.52
2.	41-50	39	39%	46.41±2.47
3.	51-60	32	32%	56.18±2.76

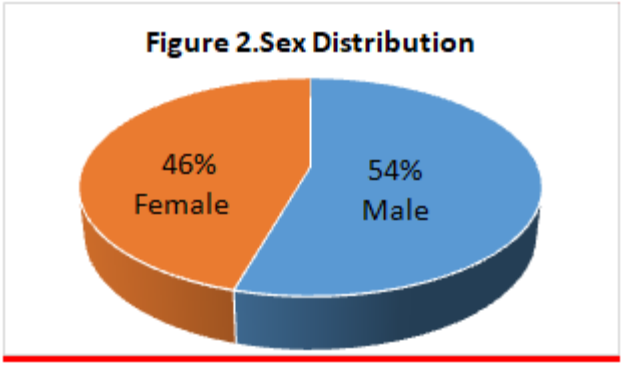


2. Sex Distribution

In this study a total of 101 participants were assessed among which, females were 46(46%) and males were 55(54%).(Table 2, Figure 2)

Table 2: Sex distribution of Participants

S. No	Sex	Total Number (n)	Percentage (%)
1.	Male	55	54%
2.	Female	46	46%

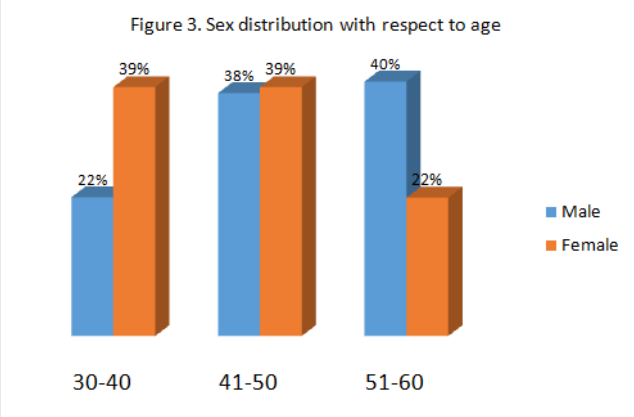


3. Sex Distribution in Each Group

Out of 101 participants, in the age group of 30-40 years the number of males were 12(39%) and females were 18(22%) , among 41-50 years the number of males were 21(39%) and females were 18(38%) and 51-60 years the number males were 22(22%) and females were 10(40%) (Table 3, Figure 3)

Table 3: Sex Distribution in Each Age Group

S. No	Age group	Total Number (n)		Percentage (%)	
	In years	Male	Female	Female	Male
1.	30-40	12	18	22%	39%
2.	41-50	21	18	38%	39%
3.	51-60	22	10	40%	22%

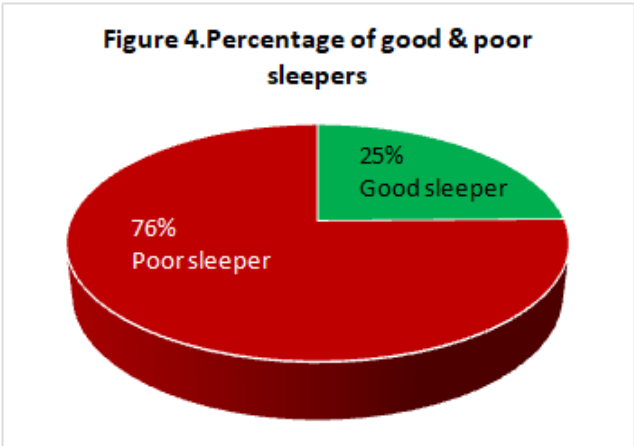


4. Sleep Quality Observation

Out of 101 participants, 25 individuals were good sleepers(25%) with a PSQI score of 5 or below 5 and mean standard of 3.80±1.29 whereas 76 individuals were poor sleepers(75%) with PSQI score above 5 and mean standard 9.47±2.56(Table 4, Figure 4)

Table 4: Quality of Sleep Based on PSQI

S. No	PSQI score	Total Number (n)	Percentage (%)	Mean ±SD of PSQI score
1.	< 5 Good sleepers	25	25%	3.80±1.29
2.	>5 Poor sleeper	76	75%	9.47±2.56

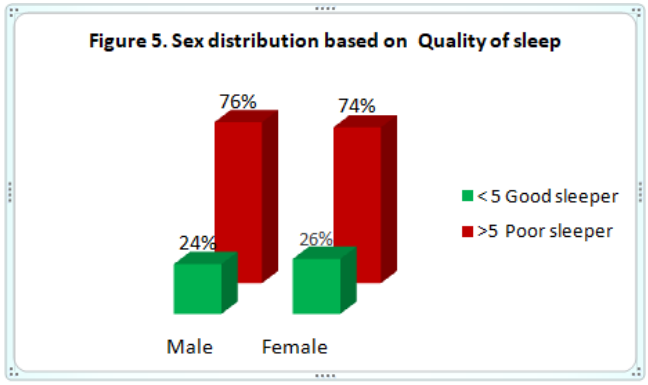


5. Sex Distribution Based on Quality of Sleep

The individuals were divided into good sleepers(PSQI SCORE<5) and poor sleepers(PSQI SCORE>5).In the good sleepers the males were 13(24%) in number and females were 12(26%) in number. In the poor sleepers the males were 42(76%) in number and the females were 34(74%) in number.(Table 5.1, Figure 5)

Table 5.1: Sex distribution based on Quality of sleep based on PSQI

S. No	PSQI score	Total Number		Percentage (%)	
		Male (n)	Female (n)	Male	Female
1.	< 5 Good sleepers	13	12	24%	26%
2.	>5 Poor sleepers	42	34	76%	74%



Chi square test

We conducted a chi square test to determine whether there is any significant relation between gender and quality of sleep.(Table 5.3.).The p value is 0.1398.It concludes that there is no significant relation between gender and sleep quality.

Table 5.2:

PSQI score	Number			Percentage (%)	
	Male	Female	Total	Male	Female
< 5 Good sleeper	8	6	14	15%	13%
>5 Poor sleeper	47	40	87	85%	87%
	55	46	101		

Table 5.3:

Chi Sq	2.18	
p value	0.1398	not significant

Result - Not significant

Conclusion – Accept the hypothesis: Gender & Quality of sleep are independent

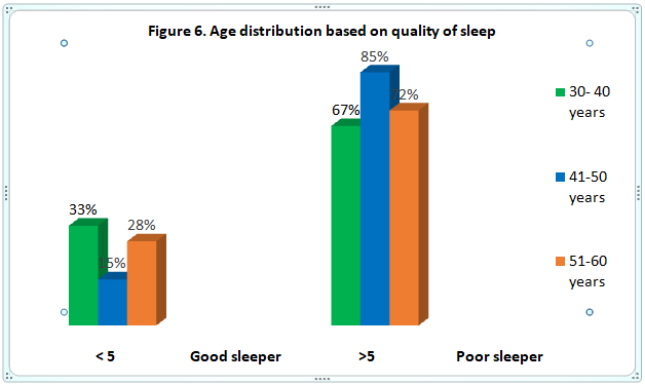
(Quality of sleep does not depend on gender)

6. Quality Of Sleep And Age Groups

The sleep quality was measured in individuals of different age groups. Among the 30-40 years 10(33%) were good sleepers and 20(67%) poor sleepers. In 41-50 years age group 6(15%) were good sleepers and 33(85%) poor sleepers . In 51-60 years 9(28%) good sleepers and 23(72%) poor sleepers.(Table 6, Figure 6)

Table 6.Quality of sleep based on PSQI in relation to age groups

S. No	PSQI score	Age group in years: Total Number (n)			Age group in years: Percentage (%)		
		30-40	41-50	51-60	30-40	41-50	51-60
1.	< 5Good sleepers	10	6	9	33%	15%	28%
2.	>5Poor sleepers	20	33	23	67%	85%	72%



7. Relation of Glycosylated Haemoglobin and Sleep Quality

In total 101 participants, 25 were good sleepers(PSQI SCORE<5) with mean and standard deviation of PSQI score of 3.80±1.29 and mean and standard deviation of glycosylated haemoglobin (Hb1Ac) of 7.14±1.30 , 76 were poor sleepers(PSQI SCORE>5) with mean and standard deviation of PSQI score of 9.47±2.56 and mean and standard deviation of glycosylated haemoglobin (Hb1Ac) of 8.9±2.44(Table 7)

Table 7: Glycosylated Haemoglobin (HbA1c) in Relation to Sleep Quality

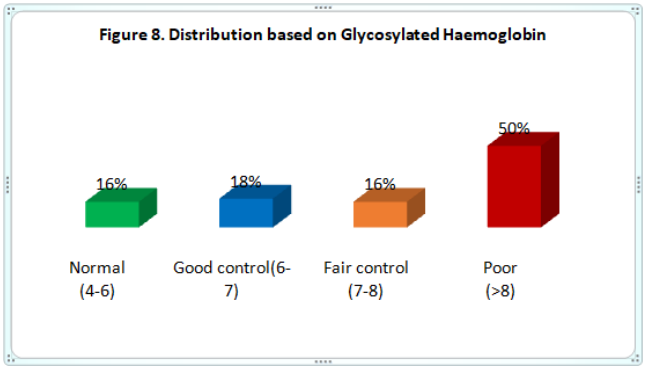
S. No	PSQI score	Number (n)	Mean ±SD of PSQI score	Mean ±SD HbA1C
1	< 5 Good sleepers	25	3.80±1.29	7.14±1.30
2	>5 Poor sleepers	76	9.47±2.56	8.9±2.44

8. Distribution of Individuals Based On Glycemic Status

The participants were divided into four groups based on the values of their glycosylated haemoglobin (HbA1c) as normal(value:4-6), good control(value:6-7), fair control(value:7-8) and poor(value:>8). 16 individuals (16%) had normal glycosylated haemoglobin with mean and standard deviation of 5.5± 0.23, 18 individuals (18%) had good control with mean and standard deviation of 6.48±0.28, 16 individuals (16%) had fair control with mean and standard deviation of 7.59±0.31and 51 individuals(50%) had poor with mean and standard deviation of 10.35± 1.69 (Table 8,Figure 8)

Table 8: Distribution of participants based on glycemic status

S. No	Glycosylated Hb(HbA1c)	Total Number (n)	Percentage (%)	Mean ± SD
1.	Normal (4-6)	16	16%	5.5± 0.23
2.	Good control(6-7)	18	18%	6.48±0.28
3.	Fair control (7-8)	16	16%	7.59±0.31
4.	Poor control (>8)	51	50%	10.35± 1.69



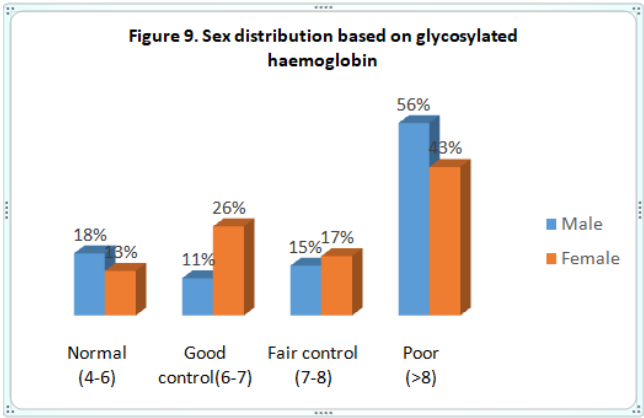
9. Sex Distribution and Glycosylated Haemoglobin

Based on the glycosylated haemoglobin (HbA1c) levels the sex distribution was as in the normal HbA1cof (4-6) there were 10(18%) males and 6(13%) females, good control of HbA1c(6-7) there were 6(11%)males and 12(26%)females, fair control of HbA1c(7-8) there were 8(15%)males and 8(17%)females , in the poor control of HbA1c(>8) there were 31(56%)males and 20(43%)females.

(Table 9, Figure 9)

Table 9: Sex distribution based on glycosylated haemoglobin

S. No	Glycosylated Hb	Sex :Total Number (n)		Sex: Percentage (%)	
		Male	Female	Male	Female
1	Normal (4-6)	10	6	18%	13%
2	Good control(6-7)	6	12	11%	26%
3	Fair control (7-8)	8	8	15%	17%
4	Poor control (>8)	31	20	56%	43%



10. Age Wise Distribution Based On Glycosylated Haemoglobin

Glycosylated haemoglobin was checked in different age groups.

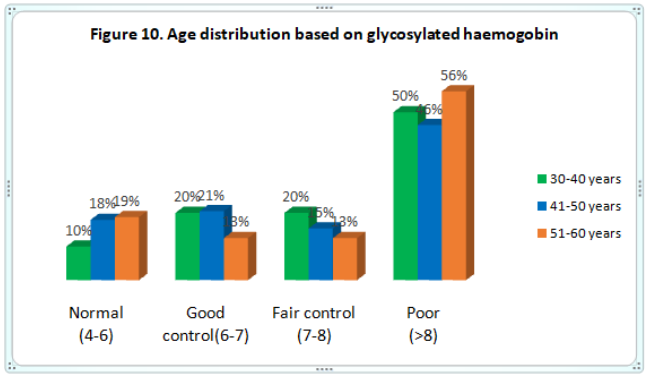
In age group 30-40 normal was seen in 3 individuals(10%), good control was seen in 6 individuals(20%), fair control was seen in 6 individuals(20%) and poor control was seen in 15 individuals(50%).

In age group 41-50 normal was seen in 7 individuals(18%), good control was seen in 8 individuals(21%), fair control was seen in 6 individuals(15%) and poor control was seen in 18 individuals(46%).

In age group 51-60 normal was seen in 6 individuals(19%), good control was seen in 4 individuals(13%), fair control was seen in 4 individuals(13%) and poor control was seen in 18 individuals(56%).(Table 10, Figure 10)

Table 10: Age wise distribution based on glycosylated haemoglobin

S. No	Groups based HbA1c	Age group in years: Total Number (n)			Age group in years: Percentage (%)		
		30-40	41-50	51-60	30-40	41-50	51-60
1.	Normal (4-6)	3	7	6	10%	18%	19%
2.	Good control (6-7)	6	8	4	20%	21%	13%
3.	Fair control (7-8)	6	6	4	20%	15%	13%
4.	Poor (>8)	15	18	18	50%	46%	56%



11. Glycosylated Hemoglobin in Good Sleepers and Poor Sleepers

The mean and standard deviation of glycosylated haemoglobin,HbA1c for normal(4-6) is 5.5± 0.23, for good control(6-7) HbA1c is 6.48±0.28, for fair control(7-8) HbA1c is 7.59±0.3, for poor(>8) HbA1c is 10.35± 1.69

The mean standard of PSQI score in good sleepers(PSQI score <5) is 3.80 ± 1.29 And in poor sleepers(PSQI score >5) is 9.47 ±2.56

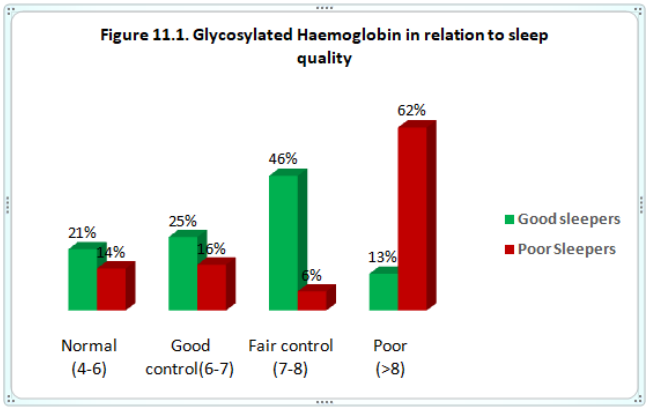
In relation to HbA1c, in good sleepers it was observed that 5(21%) individuals had normal,

6(25%)had good control, 11(46%)had fair control and 3(13%)had poor control.

In poor sleepers it was observed that 11(14%) individuals had normal ,12(16%) had good control, 5(6%) had fair control and 48(62%) had poor control.(Table 11,Figure 11.1)

Table 11.1: Glycosylated haemoglobin in good & poor sleepers

S.No	HbA1C	Mean ±SD HbA1C	Good sleepers (n)	Good sleepers (%)	Poor sleepers Total number(n)	Poor sleepers (%)
			PSQI score <5		PSQI score >5	
			Mean ±SD (PSQI score)- 3.80 ± 1.29		Mean ±SD (PSQI score)- 9.47 ±2.56	
1.	Normal (4-6)	5.5± 0.23	5	21%	11	14%
2.	Good control(6-7)	6.48±0.28	6	25%	12	16%
3.	Fair control (7-8)	7.59±0.31	11	46%	5	6%
4.	Poor (>8)	10.35± 1.69	3	13%	48	62%



Chi square test

We conducted a correlation to determine whether there is any significant relation between Glycosylated haemoglobin(HbA1c) and quality of sleep (PSQI score).(Table11.2.)The r value was 0.360339 . The p value was 0.002 which is highly significant. This indicates a significant correlation between sleep quality & glycosylated haemoglobin. As the sleep quality decreases the HbA1c increases.

Thus the hypothesis of HbA1c and PSQI shows significance.

Table 11.2:

Hypothesis	r(HbA1c, PSQI)	t	p	Result	Conclusion
HbA1c & PSQI are correlated	0.360339	3.84	0.002	Significant	Accept hypothesis : HbA1c & PSQI correlated

Conclusion

Our study included 101 participants of type 2 diabetes between 30-60 years of age without any other co-morbidity .It was seen that 75 % participants with poor sleep quality with mean ±standard deviation of 9.47±2.5, had a higher level of glycosylated hemoglobin (>8 HbA1c) with mean ±standard deviation of 8.9±2.44.This shows that poor sleep quality results in poor glycemic control in type 2 diabetic patients.

There was a highly significant correlation between sleep quality &glycemic control with a p value of .002.There was no difference in the sleep quality between males (54%)& females (46%) nor there was a difference in different age groups 30-40 years(30%), 41-50 years (39%) , 51-60 years (32%) .Similarly there was no difference in the glycemic control in males & females & in different age groups.

The references 3,4,5,6 and 7 shows that there is a strong association of sleep and glycemic control and thus influencing the lifestyle of the patients.

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