A cross-sectional study to evaluate the correlation of depression and anxiety symptoms to glycemic control in recent onset type II diabetes mellitus- research from south India

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Abstract
Introduction: A bidirectional relationship between depression and diabetes is well established. WHO predicts India will lead in the number of persons with diabetes by 2030. Therefore, factors that can alter the glycemic control (evaluated by glycated hemoglobin levels-HbA1c) needs to be targeted to promote health in diabetes, hence the need for this study.
Objectives: To assess the correlation of depression and anxiety with HbA1c in recent-onset Type II Diabetes Mellitus (T2DM).
Materials and Methods: A cross-sectional study was conducted in the outpatient of an urban tertiary care hospital on 94 consenting patients with an established diagnosis of Type 2 DM for >1year and<10years duration without complications. Hospital Anxiety and Depression scale (HADS) and Mini International Neuropsychiatric Interview (MINI) plus were used to evaluate sub-syndromal and syndromal depressive and anxiety symptoms. Recent HbA1c and blood glucose levels were noted.
Results: In this sample HADS found 43% (n=40) with anxiety and 33% (n=31) with depressive symptoms. 80% (n=75) sample had abnormal HbA1c (>7) (mean=8.53±1.68). A trend towards positive correlation was noted between HbA1c and total depressive (r=0.1194/p=0.2518) and anxiety (r=0.0006/p= 0.9953) symptoms, however, not statistically significant. 26 of these individuals qualified for the syndromal diagnosis of anxiety spectrum and depression on MINI plus. No correlation found with Obesity and HADS.
Conclusion: In this study in patients with recent onset diabetes, no correlation was found between HbA1c levels and depressive or anxiety symptoms. However, it was noted that subclinical symptoms of anxiety and depression were more common than the syndromal diagnosis.

Keywords: Depression, Glycemic control, Anxiety, South India.

Introduction
A bidirectional relationship between depression and diabetes is well established.[1,2] This was speculated way back in the 17th century by Thomas Willis who stated diabetes was caused by "long sorrow and other depressions". Diabetes is a prototype of non-communicable diseases (NCD) and has a steadily increasing prevalence worldwide. India amongst all is expected to be the “diabetes capital” of the world by 2030 with an estimated prevalence of 79.4 million.[1] The growing risk of developing diabetes mellitus is attributed to the Asian phenotype.[3]

Similarly, like depression, anxiety is also known to occur in NCD’s like Type 2 Diabetes Mellitus (T2DM). Anxiety as add on worsens the course of chronic illnesses like T2DM while the chronic illnesses by themselves are known to cause anxiety. Literature suggests that a large number of depressed and anxious patients go undiagnosed among the diabetic population. In the Indian context, this is witnessed often due to inaccessibility of facilities and a huge treatment gap in the community.[4]

Depression and anxiety, both impact the glycemic control in T2DM.[5] Glycemic control is measured by glycosylated hemoglobin (HbA1c) which covers a substantial period (3months) prior to assessment and helps in prognostication of the illness. Though the bearing of depression and anxiety on glycemic control is significant, inconsistent associations were noted between HbA1c, depression, and anxiety.[6-8] Therefore, factors which can alter the glycemic control need to be targeted to promote health in diabetes and hence, the need for this study.

Aim
To assess the correlation of depressive and anxiety symptoms to the glycemic control (HbA1c) in recent-onset T2DM in an urban setting.

Materials and Methods
This was a hospital-based cross-sectional study done in the out-patient department of endocrinology and medicine of a tertiary hospital in Bangalore, India. Convenient sampling was used and only consenting subjects were recruited into the study. Approval from the institutional ethics review board was obtained. Data was collected over 1½ years from April 2011 to September 2012. 400 patients were screened of which 94 fulfilled the inclusion criteria.so the final sample was 94 T2DM patients aged between 30-65years.

Inclusion Criteria
T2DM patients (Diagnosis based on ICMR Guidelines for Management of Type 2 Diabetes- 2005 Criteria) including both genders, aged 30-65years with T2DM for 1-10 years duration were included. Comorbidities like dyslipidemia or hypertension if present were included. In addition, only those with recent (<1month) HbA1c, FBS, and PPBS values were recruited in the study.

Exclusion Criteria
a) The patient who received any form of psychiatric treatment (pharmacological or non-pharmacological). b) Co-morbid history of cerebrovascular accident, Ischemic heart disease, thyroid dysfunction, and other endocrine disorders. c) Patients with severe complications of diabetes like vascular events, renal disease, etc.

Tools

Hospital Anxiety and Depression Scale (HADS) is a self-report scale designed by Zigmond and Snaith in 1983 to detect depressive and anxiety symptoms among patients in a hospital-based sample. It has 14 questions, seven on anxiety and seven on depression with a final score ranging from 0-21 for each and questions are rated along a 0 to 3 point scale. A score ranging 0 to 7 is "normal"; from 8 to 10, "light or borderline abnormal"; from 11 to 14 "moderate" and from 15 to 21 "serious". For the purpose of analysis in this study we have used the primary scoring system suggested by Zigmond and Snaith.[9] We have combined the categories of borderline/mild; moderate and severe i.e. anyone with a score more than 7 for comparable numbers and to focus on presence or absence of depressive anxiety symptoms in this population. The scale takes 2-5min for completion and assesses anxiety and depressive symptoms over the past week. Studies that compared HADS depression subscale scores with gold standard clinical assessments in medically ill patients, the sensitivity estimated ranged from 56% - 100% and specificity from 73%-94%.[10]

Mini-International Neuropsychiatric Interview PLUS: The M.I.N.I. plus was designed as a brief structured interview for the major Axis I psychiatric disorders in DSM-IV and ICD-10. The scale was developed in 1998 by David Sheehan, Y. Lecrubier and collaborates.[11,12] Validation and reliability studies have been done comparing the M.I.N.I. to the SCID-P for DSM-III-R and the CIDI,[13] It takes approximately 30-45 minutes to administer the scale and it uses decision tree logic to assess axis I. It elicits all symptoms listed in the symptom criteria for DSM IV and ICD-10 for 24 major Axis I diagnostic categories, one Axis II disorder and for suicidality. In this study, it has been used to further qualify the depressive and anxiety symptoms obtained from HADS to generate ICD 10 and DSM IV diagnosis. For analysis, the M.I.N.I plus diagnosis has been categorized as anxiety spectrum disorders, depressive disorders, and others.

Patients were first screened from the out-patient department for eligibility based on inclusion and exclusion criteria. Consent was then taken from eligible subjects. A general structured proforma consisting demographic details, illness details, examination findings (weight, height and blood pressure) and investigations (like FBS, PPBS, HbA1c, Lipid profile, Creatinine and Urine albumin done over the previous month) apart from diet and exercise history was recorded. Hospital Anxiety and Depression Scale (HADS) followed by M.I.N.I. plus 5 (major Axis I psychiatric diagnosis) was then administered to all subjects. The interview ended by giving feedback to the patient. In case of any significant depressive or anxiety symptoms found the treating clinician was informed accordingly.

Statistical Analysis

Descriptive statistics have been reported using number and percentages for categorical variables and mean and standard deviation for continuous variables. Chi-square or Fisher exact test was done to find the association between HbA1c (normal and abnormal) with demographical and clinical variables. Pearson's correlation or Spearman's rank correlation coefficient was done to assess the relationship of continuous variables with HbA1c as appropriate. P-value <0.05 was considered as statistically significant. All the analysis was carried out using STATA version 12 and SPSS version 20.

Results

Of the 31 with depressive symptoms 12 of them had a severely abnormal score (HADS Depressive subscale >10) and 19 on the borderline score (HADS Depressive subscale >7). In the anxiety subgroup, 26 out of 40 of them were in the borderline category (HADS anxiety subscale score > 7) and 14 in the abnormal category (HADS Anxiety subscale score >10) (Table 1). The HADS mainly targets at identifying generalized anxiety symptoms and 'depression' largely as a reflection of anhedonia.[14] Therefore it assesses depressive/anxiety symptoms amounting to the syndromal and sub-syndromal level depending on the score. Hence, for the purpose of this study, the statistical analysis has been done by combining the borderline and abnormal categories.

MINI 5 plus confirmed only 7 out of the 31 i.e.22.6% to have syndromal depressive spectrum disorders (Table 2). Among the 40 people with anxiety symptoms on HADs 12 i.e. 30% had anxiety spectrum disorders like adjustment disorder, generalized anxiety, panic disorder, social phobia, mixed anxiety and depression using MINI plus. Other diagnoses were substance dependence in one, 4 with harmful alcohol use and one with hypochondriasis on MINI plus.

Those with T2DM (n=62) i.e. ≤ 5years duration of diabetes, 35% (n=22) had depressive symptoms (HADS depressive subscale >7) and 44% (n=27) had anxiety symptoms (HADS anxiety subscale >7) whereas those with T2DM >5 years and upto 10 years (n=32), 27.3% (n=9) had depressive symptoms while 39.4% (n=13) had anxiety symptoms.

Table 1: Descriptive Statistics: N=94

Demographic and Study Variables : N=94	Categories	Number / Frequency	Percentage
Age	30 – 45 years	n=30	31.91%
	46 – 60 years	n=53	56.38%
	>60 years	n=11	11.70%
Gender Distribution	Male	n=47	50%
	Female	n=47	50%
Education Profile	Uneducated	n=13	13.8%
	Primary + Middle School	n=11	11.7%
	High School	n=23	24%
	Intermediate	n=14	14.9%
	Graduates and above	n=33	28%
Occupational Profile (*classification based on Kuppuswamy's occupation category*)	Unemployed (includes housewives)	n=34	36.20%
	Unskilled + Semi-skilled + Skilled	n=8	8.50%
	Clerk	n=24	25.50%
	Semi profession + Profession	n=28	29.80%
Rural vs Urban Background	Rural	n=14	15%
	Urban	n=80	85%
Duration of T2DM	≤ 5 years	n=62	65.96%
	> 5years	n=32	34.04%
Insulin use	Yes	n=21	22.6%
	No	n=73	77.66%
HADS		Normal HbA1c (≤7)	Borderline + Abnormal HbA1c (>7)
	Depressive symptoms	63 (67.02%)	31 (32.98%)
	Anxiety symptoms	54 (57.45%)	40 (42.55%)

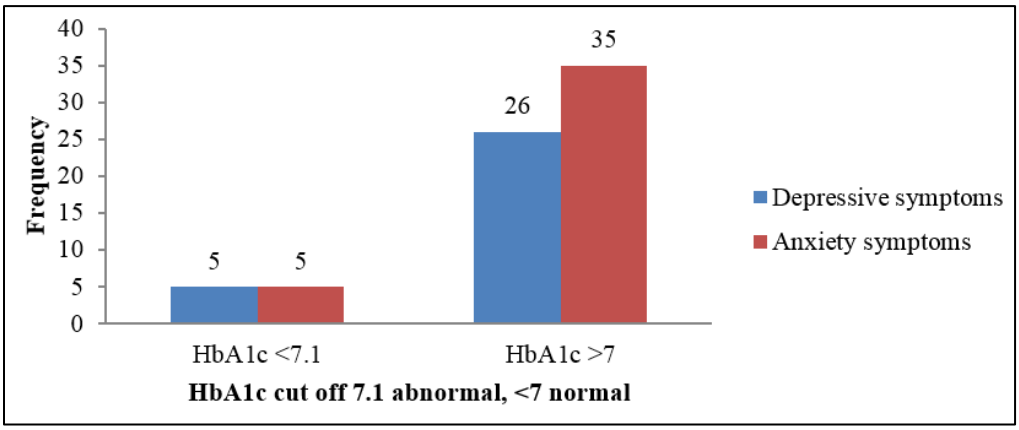

Fig. 1: Percentage of subjects with abnormal HbA1c and presence (score >7) of depressive or anxiety symptoms assessed using the HADS

Table 2: Percentage of subjects with abnormal HbA1c, anxiety and depressive symptoms (N=94) and syndromal diagnosis on MINI plus

		MINI plus Diagnosis			
		No diagnosis n=62	**Anxiety spectrum n=18**	**Depressive disorders n=8**	**Others* n=6**
HbA1c (>7 gm %)		50	16	6	3
HADS	Depressive symptom subscale score >7	14	10	7	0
	Anxiety symptom subscale score (>7)	23	12	4	1

*Others – include Substance Dependence, harmful alcohol use, and hypochondriasis.

Table 3: Correlation Statistics of HADS with HbA1c

Pearson's Chi-square test	**HbA1C**		**p-value**
	Normal (≤7)	Abnormal (≥7.1)	
Depressive symptom subscale Total on HADS			
Normal (0-7) Abnormal+ borderline (8-21)	14 (73.68%) 5 (26.32%)	49 (65.33%) 26 (34.67%)	0.489
Anxiety symptoms subscale Total on HADS			
Normal (0-7) Abnormal+ borderline (8-21)	14 (73.68%) 5 (26.32%)	40 (53.33%) 35 (46.67%)	0.109
Spearman's Correlation	HADS depressive symptoms subscale total	HADS anxiety symptoms subscale total	
HbA1c (Median=8.2)	r=0.1194 p= 0.2518	r=0.0006 p= 0.9953	

There is no significant correlation between the HbA1c value and total score of either depressive or anxiety symptoms.

Table 4: Relationship of demographic factors with depressive and anxiety symptoms on HADS subscale and HbA1c

Variables under study	**Abnormal**	**Normal**	**P-value**
Occupation - Housewife (n=34)			
HbA1c	26	8	0.547
HADS Depressive symptoms	15	19	0.084
HADS Anxiety symptoms	20	14	0.016
Education - above high school (n = 47)			
HbA1c	36	11	0.441
HADS Depressive symptoms	14	33	0.510
HADS Anxiety symptoms	19	28	0.677
Rural Background (n=14)			
HbA1c	11	3	0.902
HADS Depressive symptoms	5	9	0.813
HADS Anxiety symptoms	8	6	0.231
Gender (N=94)			
HbA1c in male	37	10	0.797
HbA1c in female	38	9	
The gender-based difference in HADS	**Female**	**Male**	**p-value**
The gender-based difference in HADS: Anxiety Subscale Score			
Normal: (≤ 7)	19 (40%)	35 (74%)	0.001
Abnormal + Borderline : (>7)	28 (60%)	12 (26%)	
Odd's ratio =4.30 (1.64 – 11.43)			
Gender Based difference in HADS :Depressive Subscale Score			
Normal(≤ 7)	**24 (51%)**	**39 (83%)**	**0.001**
Abnormal + Borderline : (>7)	**23 (49%)**	**8 (17%)**	
Odd's Ratio = 4.67 (1.65-13.60)			
Duration of T2DM ≤5years, n=62			
Pearson's Chi-Square	**Normal (≤ 7)**	**Borderline + Abnormal (>7)**	**p-value**
HADS Depressive symptoms	40	22	0.472
HADS Anxiety symptoms	35	27	0.786

Table 5: Association between fasting blood sugar (FBS) and postprandial blood sugar (PPBS) with other variables using two-sample t-test with equal variances

Blood Sugar	HADS	Normal mean± SD	Abnormal mean± SD	t-value	df	p-value
FBS	Depressive symptoms subscale	63 (142.222±50.13)	31 (135.129±42.17)	0.6781	92	0.4994
	Anxiety symptoms subscale	54 (140.185±51.27)	40 (139.475 ± 42.62)	0.0712	92	0.9434
PPBS	Depressive symptoms subscale	63 (214.06±75.51)	31 (213.19 ± 90.39)	0.0492	92	0.9609
	Anxiety symptoms subscale	54 (202.40±73.16)	40 (229.12 ± 87.50)	-1.6098	92	0.1109

 # Each cell = Number of people with normal and abnormal variable (mean of FBS / PPBS ± SD)

Anxiety symptoms alone were significantly associated with patients who were housewives by occupation.80% (n=64) from the urban background (n=80) and 79% (n=11) from a rural background (n=14) had an abnormal HbA1c (>7). 40% (n=32) of the urban population showed the presence of anxiety symptoms whereas 33% (n=26) of the urban group had depressive symptoms in this study.

The gender distribution is equal in the study sample by chance. A significant correlation is found with anxiety and depressive symptoms with gender. Odds of a female patient having these symptoms versus male is 4.3 times more for anxiety symptoms and 4.67 times more for depressive symptoms (CI 95%, p=0.001).

Neither anxiety nor depressive symptoms were found to be significantly associated with fasting or postprandial sugars

Table 6: Overweight and obesity with HADS and HBA1c

Overweight + Obesity n=87	Abnormal	Normal	p-value
HbA1c	70	17	0.567
HADS Depressive symptoms	28	59	0.563
HADS Anxiety symptoms	37	50	0.987

No significance was found between BMI and depressive or anxiety symptoms in this study

Discussion

This study aimed to identify any correlation between depressive and anxiety symptoms and glycemic control (using HbA1c) among recent onset T2DM patients in a tertiary care hospital. A total of 94 individuals consented for the study. The sample largely had individuals from middle age group i.e. 46-60years (n=53, 56.38%), who were mainly housewives (36%, n=34), clerical workers (25%, n=24) and semi-professionals (22%, n=21). Both genders were equally represented in the data (Table 1). Most of them were from an urban background (n=80, 85%), upper-middle-class profile, and better educated with an average illness duration of 4.53 years (SD= 2.53) of T2DM.

The depressive and anxiety symptoms of clinical relevance (HADS Depression /Anxiety subscale >7) identified using HADS identified 32.98% (n=31) of the sample with depressive symptoms while 42.55% (n=40) with anxiety symptoms (Table 1). Similarly, MINI plus found the occurrence of anxiety spectrum disorders (n=18) to be higher than the depressive disorders (n=8) in this study (Table 2). However, the prevalence of depression or anxiety symptoms cannot be estimated as a convenient sampling method was adopted for recruitment of the sample from a hospital setting. Nonetheless, both depressive and anxiety symptoms were found to predominantly occur together (60% co-occurrence, n=24) in this sample.

Former studies have estimated a wide prevalence range of depression in DM worldwide from 33 to83%.[2,15] Studies have used M.I.N.I, depression inventories like BDI, Patients health questionnaire (PHQ), HADS in hospital settings and clinical interviews by trained personnel to identify depression and anxiety in this population. Similar to findings in our study a Mexican study, done among 820 outpatients with T2DM had depression and anxiety rate of 48.27% and 55.10% respectively.[16] An older, Ireland study with a large sample size of 1456 diabetes (included all types of diabetes) patients showed the prevalence of anxiety symptoms (32%) to be greater than depressive symptoms (22.4%) using HADS (cut off >7).[17] Karachi based multicentric study by Khuwaja et al. also found a higher prevalence of anxiety 58% versus depression 44% in T2DM.[15,18] On the other hand, Sun N et al, 2016 in a community based study of 893 individuals in China; Yatan Pal et al, 2011in a hospital-based study of 77 individuals in India found depression (56.1%, 16.9%) more than anxiety (43.6%, 3.9%) respectively among T2DM patients while Poongothai et al 2017 in their review article highlighted 45% depression prevalence using the PHQ in DM samples from Karnataka.[5,6,19,20] No study, however, was found explicitly evaluating recent onset T2DM like in our study though they did choose patients with diabetes more than one year. A case-control study and recent review articles highlighted that the prevalence of depression/anxiety and their correlation with illness is higher among those with micro and macrovascular complications of T2DM.[20-23] Patients with complications were deliberately excluded in our sample to prevent this bias. Additionally, studies assess symptoms over the past 1 week using self-reported questionnaires which is not equivalent to the ICD 10 duration criteria for depression which is 2 weeks and generalized anxiety is 6months of symptoms. This could explain the lesser numbers on MINI plus versus HADS and the difference between sub-syndromal and syndromal symptoms in our study.

Some recent literature in T2DM has highlighted Insulin treatment associated with increased depression or anxiety (earlier studies were only on T1DM).[6,8,21,24] In our study, the number of patients on insulin were 21, of which 17 were also on oral medications. The number of patients with more than

twice a day insulin regimen was only 1 hence no analysis was possible between depressive and anxiety symptoms and number of injections per day.

HbA1c is used as a gold standard to estimate the glycemic control over 3 months. 75(80%) patients of the 94 had abnormal HbA1c i.e. HbA1c>7 and remaining 19 (20%) were within normal limits. The mean value of HbA1c was 8.453 ± SD 1.6867 in this study which is above normal (Norms: Normal range 4% to 5.6%; borderline up to 6.4%) and has a narrow range of standard deviation. For T2DM the recommended average of HbA1c is below 7.5 worldwide, India being a developing country, the lack of accessibility and affordability for the large population makes it difficult to reach the targeted average.[25] However, the mean HbA1c was within the average range for India which is 8.2 to 9.2.[26-28] HbA1c of 7 is considered as satisfactory glycemic control in T2DM, anything above increases risk of illness related complications.[25] The Indian average HbA1c range available is for newly detected T2DM only (not on treatment, diagnosis less than 6months) unlike in this data. Also, in earlier studies, HbA1c is found to be higher in those with complications. Nearly 35% (n=26) of the abnormal HbA1c group had depressive symptoms i.e. HADS >7 on depression subscale and 47% (n=35) of the abnormal HbA1c group had anxiety symptoms i.e. HADS >7 on anxiety subscale (Figure 1, Table 3). However, there was a no significant correlation between the total score of depression or anxiety with HbA1c (p=0.2518; p=0.9953) (Table 3). In both cases a tendency towards positive (r >0) correlation was noted, probably if samples were larger the study would show significant p-value. In this study, a significant correlation was found between anxiety and depressive symptom total score in those with HbA1c <7gm% implying the co-existence of anxiety with depressive symptoms in T2DM, however, this cannot be conclusive rather is an observation found in this sample.

These findings differ from the older studies which found a significant association between HbA1c and Depression or anxiety[5,29] Indian studies predominantly from Northern India found the average HbA1c to worsen by 0.94% in presence of depressive symptoms.[30] A recent study similarly established a correlation of depression and HbA1c in those with >5 years of illness compared to <5 years of T2DM and Insulin treatment.[21] Published Indian studies were done mainly in the northern parts of India whereas no studies were found from the south of India. However, our study findings were similar to the study by Rezvanfar et al. done in 2010 among 134 T2DM patients which had revealed no significant relationship between depressive scores on the Hamilton Depression Scale and HbA1c.[31]

In summary the probable explanations for average HbA1c of the sample being abnormal yet there being no correlation with depression or anxiety are: that these patients had recent onset T2DM only, they lacked any complications of T2DM (as that was exclusion criteria) unlike previous studies, high HbA1c wouldn't directly mean presence of these symptoms or vice versa, and, the sample had a larger number of educated people with stable income and social support hence assuring economic stability and treatment availing capacity unlike previous studies. However, similar to other studies anemia i.e. low hemoglobin and its impact of HbA1c was not controlled for in the study. The older studies had looked at depression and anxiety interchangeably, patients chosen were of extreme age groups with much longer duration of diabetes who are known to have a higher occurrence of depressive and anxiety symptoms due to the macro and microvascular complications of T2DM.[24]

Ideally, it would be best to study patients with a duration ranging from 1 to 5 years. In our study, it had been extended to 10years (due to inadequate sample numbers since this was a part of the thesis work and time-bound) but we had excluded patients with complications of diabetes. The mean duration of diabetes in the study population was still <5years (4.58 ± 2.53 years) with minimal deviation. Also, 62 individuals (65.95%) were having diabetes ranging from 1-5years and remaining had diabetes for 6-10years. In this study, we have also excluded those already on psychiatric treatment.

The duration of diabetes (T2DM ≤ 5 years, n=62) was positively correlated with HbA1c value almost nearing statistical significance (p=0.06). Depressive and anxiety symptoms were seen more in females than males with females having 4.67 times higher risk of developing depressive symptoms versus male with recent onset T2DM (Table 4). Depressive symptoms were more in the lower economic group whereas anxiety was more among the housewives (Table 4). These findings are similar to previous Indian and western studies.[24 32]

In developing countries affordability of HbA1c is poor as it continues to be above the average affordable range. Hence, fasting and postprandial blood glucose continue to be the standard monitoring measures in clinical practice. Studies have assessed the correlation between fasting blood glucose and postprandial blood glucose with depression and anxiety.[33] Skaff et al, 2009 reported anxiety symptom severity fluctuates with the change in the level of sugar on a daily basis. In our study mean FBS was 139.8±47.5 and PPBS was 213.7±80 which is within range other Indian studies in T2DM.[34] We found neither anxiety nor depressive symptoms to be significantly associated with fasting or postprandial sugars (Table 5).

Confounding factors like diet, exercise and medications have not been controlled for in this study. However, body mass index was measured for all. BMI was categorized using the criteria posed by the WHO for the Asia Pacific region.[35] The mean BMI was 28.504 kg/m^2 ± SD 4.445. Overweight (n=10, 11%) and obesity (n=77, ~82%) were found to be a major comorbid condition in this study. Overweight and obesity are considered to be driving the global diabetes epidemic.[36] A review on obesity and T2DM concluded that people in Asia tend to develop diabetes with a lesser degree of obesity at younger ages, suffer longer with complications of diabetes, and die sooner than people in other regions.[37] Since this study largely involved an urban population sedentary lifestyle, presence of depressive symptoms are hurdles in following physical activity schedule and diet

advice leading to a higher prevalence of obesity in this population.

In our study, nearly 80% of both overweight and obese had abnormal HbA1c (>7gm %) however no statistical significance was present. No significance was found between BMI and depressive or anxiety symptoms in this study (Table 6). However, taking the western standards for classifying obesity, Overweight and obesity were found to be significantly correlated with anxiety symptoms in this study. Anxiety in obesity could be high due to associated psychological stress and physiological alteration of parameters.

Conclusion

This study provides clinically relevant data on glycated hemoglobin and its association with depression and anxiety. In this study through the occurrence of anxiety symptoms and depressive symptoms was 43% and 33% respectively (this cannot be concluded as prevalence because convenient sampling was used and sampled from hospital setting). HbA1c was abnormal in 35% of those with depressive symptoms and 47% of those with anxiety symptoms. On the contrary, HbA1c was abnormal in 65% of those without depressive symptoms and 53% of those without anxiety symptoms. This is probably because of a larger educated sample, with more stable income and social support with access to tertiary health facilities. Females were found to be at greater risk of having depressive symptoms in T2DM versus males. Housewives predominantly participated in the study.

The HbA1c was found to have no significant correlation with depression or anxiety in this study. There is recent literature both similar and dissimilar to this finding. The factors affecting this changeable correlation are probably vascular complications, insulin treatment, and longer duration of diabetes in patients included in some studies unlike ours. [6,21,38] Also, more favorable factors are present in the socio-demographic profile of these patients in the study. Additionally, this is a cross-sectional study compared to case-control or longitudinal studies done in the literature. MINI plus identified a higher percentage of anxiety spectrum (89%) in axis I diagnosis among those with abnormal HbA1c versus depressive disorders (75%) but no correlation was found with higher HADS scores. Hence, subclinical symptoms are common in recent-onset diabetes which may not qualify for a syndrome but will alter the course of illness.

Strengths and Limitations of the Study

Strengths: This study has attempted to study the correlation of HbA1c with depression and anxiety symptoms in type 2 diabetes patients in south India in an urban population using objective self-report measures in the outpatient of a tertiary urban hospital. It observed at recent-onset diabetes eliminating the sample of newly diagnosed diabetics and those with complications, among whom depression and anxiety are well known. Inpatients were excluded to avoid spurious high values of depressive and anxiety symptoms amongst the inpatient population.

Limitations

The sampling method in our study was one of convenience and purposive type, due to which prevalence cannot be estimated. Due to the small sample size, no significant type II error was found. In patients with anemia, the glycated hemoglobin may not be an accurate estimate of glycemic control. Menstrual history was not correlated within the female population.

Clinical Utility of the Study and Future Directions

The study furthers the understanding of the complex inter-relationship between T2DM and depression and anxiety symptoms. Clinicians from multiple specialties like medicine, endocrine and psychiatry can utilize this assimilated work on a day to day basis in the management of type 2 diabetes mellitus and prevention of early occurrence of diabetic complications by promptly monitoring for glycemic index and rectifying the modifiable factors (including depressive and anxiety symptoms) impacting the HbA1c. When HbA1c is uncontrolled clinicians need to look for depressive and anxiety symptoms, both syndromal and sub-syndromal, which could add to the burden of the poor glycemic index. However, this does not hold true for recent-onset diabetes (type 2) as per this study. This study supports the evidence for the use of brief self-report scales for eliciting depressive and anxiety symptoms as these can be easily used by clinicians in busy outpatient clinics.

Estimating correlation of HbA1c with depression and anxiety in a larger sample using case-control vs community model, evaluating parameters of insulin therapy, duration of diabetes and complications of diabetes is important from the point of management and prevention of complications in recent-onset diabetes to further confirm the above findings. More robust studies using neuroendocrine and genetic markers in this population will provide a new understanding of the link between depression and T2DM. Such studies might also help us to identify potential treatment targets for these two common disorders.

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