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Prevalence and Risk Factors of Psychiatric Symptoms among Type 2 Diabetes Mellitus Patients in South India: A Cross-Sectional Study.

Suguna Utchimahali[1]; S. Kannan[2]
Ph.D. Research Scholar[1];
Ph.D. Professor, Head & Chairperson[2]
Department of Environmental Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, TN, India.

Kumaravel Velayutham[3]
MD., MSc. Diab(Lond), DNB(Endo), MNAMS,
Director & Consultant Endocrinologist,
Alpha Hospital & Research Centre Institute of Diabetes and Endocrinology,
TN, India.

Abstract:-

- ***Background:***

Type 2 diabetes mellitus poses a momentous challenge when accompanied by psychiatric symptoms like depression, anxiety, and stress, adding to the complaint's threat. Research on these factors in patients with uncontrolled chronic illnesses in India, particularly in Tamil Nadu, is limited. Hence, this study aims to determine the prevalence and risk factors of these psychiatric symptoms among Type 2 diabetes patients.

- ***Methods:***

A cross-sectional study was conducted in Alpha Hospital and Research Center in Madurai, South India, from April 2020 to March 2021, enrolling 614 participants (307 with Type 2 diabetes mellitus and 307 general population). Data were collected using Hamilton Depression Rating Scale, Hamilton Anxiety Rating Scale and Perceived Stress Scale. The IBM SPSS version 23 was used for statistical analysis.

- ***Results:***

Two-thirds of youth women with type 2 diabetes have higher fasting blood sugar levels than men when compared to general population. 82.61% of patients with uncontrolled diabetes developed severe stress, surpassing those with well-controlled and pre-diabetes. Severe depression is most prevalent among patients with neuropathic foot ulcers (54.76%) and nephropathy (61.54%). Predominant mental health risk factors include being single, high school education, poor glycemic control, comorbid hypertension, and family history. Interestingly, lifestyle factors like alcohol use and smoking positively impact mental health outcomes.

- ***Conclusion:***

This study shows the intricate connection between Type 2 diabetes and mental health problems in Madurai, emphasizing the necessity for a multidisciplinary strategy to enhance outcomes and reduce financial burden. Future research in nursing has to focus on implementing and assessing therapies aimed at reducing patients' stress, anxiety and depression.

Keywords:- *Type 2 Diabetes Mellitus, Uncontrolled Diabetes, Depression, Anxiety, Stress, Statistical Analysis.*

I. INTRODUCTION

Diabetes mellitus (DM) is a severe and chronic inherited metabolic disorder affecting 530 million people globally, with a significant prevalence of three in every four adults living in low and middle-income countries.[1] In 2019, diabetes caused 4.2 million deaths and accounted for at least 10% of the global health expenditure, amounting to USD 760 billion.[2] According to the World Health Organization (WHO) 2022, India ranks second globally, with 74.9 million adults (aged 20-79) living with diabetes, and this number is expected to rise to 124.8 million by 2045.[3] In Tamil Nadu, the prevalence of diabetes is notable, accounting for 21.9%, 20.3%, and 13.4% in cities, towns, and peri-urban villages, respectively.[4]

Type 2 diabetes mellitus (T2DM) is the most common form of diabetes in India. It is characterized by chronic hyperglycemia resulting from insulin resistance or insufficient insulin production.[5] Persistent hyperglycemia in uncontrolled diabetes mellitus can cause several complications such as cardiovascular disease, hypertension, chronic kidney disorder, neuropathy, nephropathy, and retinopathy.[6] People with T2DM have higher risks of morbidity, mortality, [7] and increased healthcare costs compared to the general population.[2]

Comorbid psychiatric symptoms like depression, anxiety, and stress (DAS) can make managing type 2 diabetes (T2DM) extremely difficult. These symptoms are the most common mental illnesses in current times, and they can either contribute to the progression of the disease or increase the risk of developing diabetes [8]. Prolonged exposure to this circumstance makes it an integral part of the patient's life. These symptoms have several detrimental effects on the patient's health, including medication non-adherence, rapid disease progression, and a generally poor prognosis.[9]

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The World Health Organization highlights the two-way relationship between physical and mental health. However, in India, the focus on treating diabetes often prioritizes the physical complications of type 2 diabetes (T2DM), with little attention to the mental well-being of these patients. Factors contributing to DAS vary across study populations and have not been adequately studied together using standard psychological tools in the population of South India, particularly in Tamil Nadu. [10,11] Additionally, there is a lack of studies investigating the prevalence of DAS in individuals with T2DM compared to the general population. The current study aims to analyze the prevalence and risk factors associated with these conditions at a tertiary care center in the Madurai district of Tamil Nadu.

II. MATERIALS AND METHODS

A. Research Design

A cross-sectional study was carried out from December 19, 2020, to December 30, 2021, with 614 participants, consisting of 307 patients with T2DM and 307 individuals from the general population. The process that was followed for the study is shown in Fig. 1. Using the probability selection method, the participants were chosen from the diabetic and endocrinology-focused Alpha Hospital and Research Centre in Madurai, Tamil Nadu, India. People had to be willing to participate in order to meet the inclusion requirements, and the study was not open to anyone with a history of serious illness or mental health disorders. As a comparison group, a general population group with comparable sociodemographic and clinical characteristics (FBS levels) was gathered. The majority of the people in this category were the patients' healthy relatives.

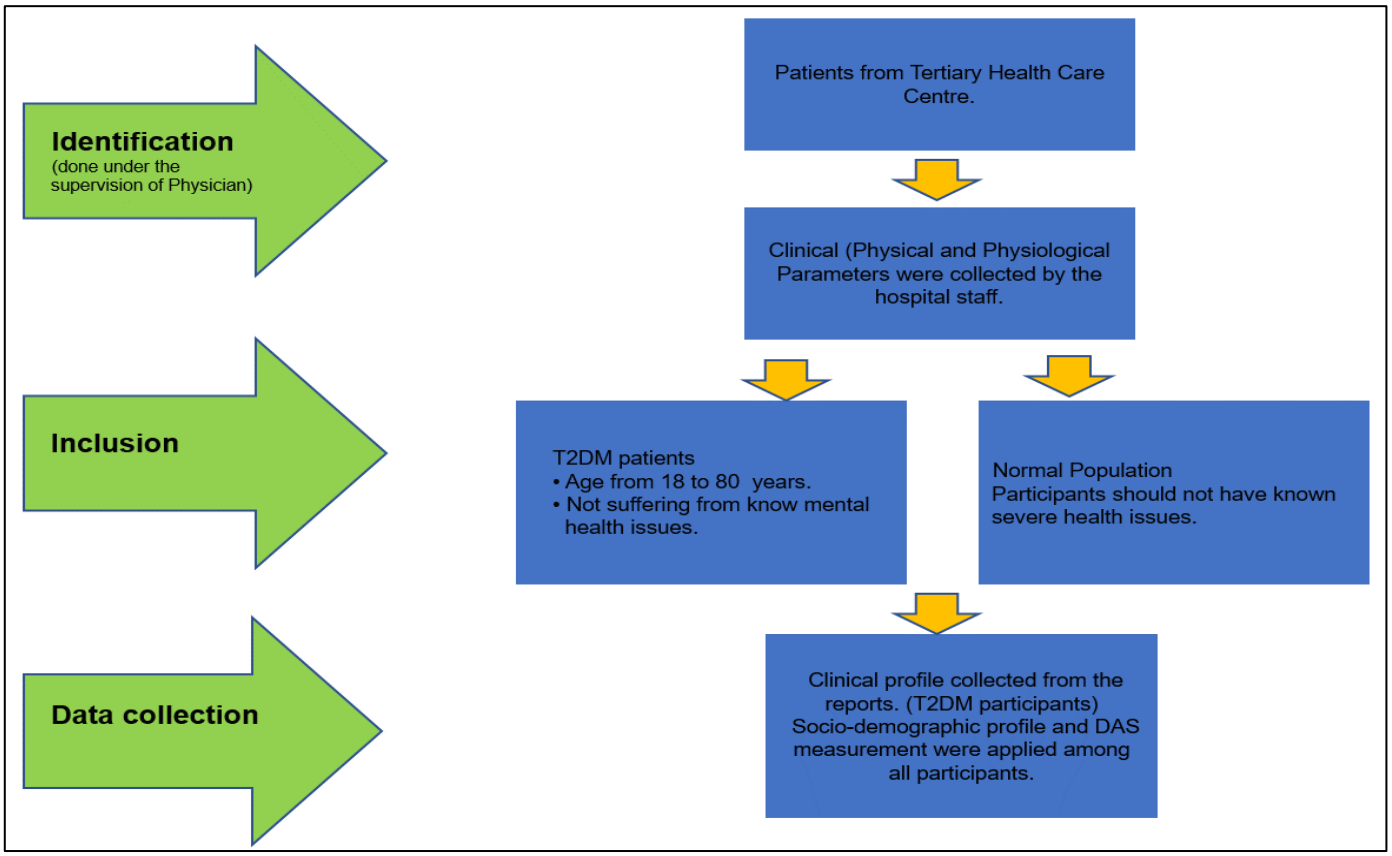

Fig 1: Selection Process Followed for the Studied Participants

B. Data Collection

➢ *Assessment of Socio-Demographic and Clinical Profile:*

The study used a structured form to gather sociodemographic information from all participants through interviews. This included age, gender, marital status, educational qualification, occupational status, monthly income, and socioeconomic status based on Kuppuswamy's modified Socioeconomic Status scales.[12] Biochemical test reports were obtained from the hospital database on the same day of the patient's visit. In addition to this, the researcher collected the clinical profiles of T2DM participants through the interview method. Lifestyle habits related to smoking, alcohol consumption, and difficulty sleeping were also investigated. Diabetes diagnosis followed the American Diabetes Association's guidelines, with patients considered diabetic if they had HbA1c levels of 6.5% or higher [6], or fasting plasma glucose levels of 126 mg/dL or higher in two separate tests.[13]

➢ *Assessment of Depression, Anxiety and Stress:*

The assessment of Depression, Anxiety, and Stress utilized three scales, the Hamilton Depression Rating Scale (HAM-D), Hamilton Anxiety Rating Scale (HAM-A), and the Perceived Stress Scale (PSS).

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HAM-D was employed to gauge the presence and severity of depression over the past week. This scale is widely acknowledged as the gold standard for assessing depression and has been extensively used in India. On the 17-item HAM-D scale, the scores between 0 and 7 suggest normalcy, 8-13 indicate mild depression, 14-18 indicate moderate depression, and a score of 19 - 54 indicates severe depression. A study by Dedeken., *et* al. found that Cronbach's alpha for the HAM-D 17 items was 0.92, indicating a high level of internal consistency.[14]

The HAM-A is a tool used to measure anxiety symptoms through 14 different items. Scores on the scale range from 0 to 56, with a score of less than 17 indicating mild severity, 18-24 indicating mild to moderate severity, and 25-30 indicating moderate to severe conditions. The scale has a high level of internal consistency, indicated by Cronbach's alpha of 0.893.[15]

Perceived Stress Scale (PSS) is used to assess perceived stress levels. This scale used a five-point Likert scale ranging from 0 (never) to 4 (very often) to gauge responses to questions such as "In the last month, how often have you felt upset?" Increases in perceived stress were correlated with higher scores on the measure. The scale showed good internal consistency with a Cronbach's alpha of 0.85.[16]

C. Sample Size Determination

In an initial pilot study, 40 participants with T2DM were (excluded from the main study) to determine the sample size. The prevalence of DAS symptoms among 11 out of the 40 T2DM patients was found to be 27.5%. Following the Central Limit Theorem by Hans Fischer [17], the sample size (n) was calculated using the formula: N = (Z^2 x p x (1-p))/d^2. In this formula, 'N' represents the desired sample size, 'Z' is the standard normal deviation at a 95% confidence interval (1.96), 'p' is the prevalence value of DAS symptoms among T2DM (0.275), and (1−p) represents the margin of error (5%). The minimum sample size calculated was 306.24, rounded up to 307 using this formula.

D. Ethical Approval and Informed Consent Statements

This study was approved by the Internal Research and Review Board (IRB), Ethical Clearance (EC), Biosafety and Animal Welfare Committee of Madurai Kamaraj University, Madurai (Registration ID: EC/MKU/20-21/039) on 11th December 2020. All participants provided written informed consent prior to enrolment in the study. This research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

E. Statistical Analysis

The data was entered into Microsoft Excel, and IBM SPSS Version 23.0.1.0 was used for data analysis. A descriptive statistical analysis was conducted for continuous and categorical variables. The normalcy was evaluated using the Shapiro-Wilk test. Non-parametric tests such as the Kruskal-Wallis H test, Mann-Whitney U test, and Chi-square test were used because it was discovered that the data was not normally distributed. Binary logistic regression models were applied to examine associations between predictor variables and the risk of DAS. In the Multivariate logistic regression model, severe depression and very severe depression cases were grouped into a "severe depression" category, leaving the other severity levels unaffected. Odds ratios (OR) with 95% confidence intervals were calculated to determine independent associations between T2DM and depression/anxiety disorders. The *P* value of 0.05 was used as the standard for statistical significance.

III. RESULTS

A cross-sectional study in Madurai, Tamil Nadu, examined the prevalence of DAS and its risk factors among T2DM patients. Out of 614 participants, 307 had T2DM, and 307 were from the general population. The study highlighted the demographic, socioeconomic, mental health, and clinical factors affecting FBS levels in T2DM patients, unlike the stable levels in general individuals.

Table 1: Characteristics of T2DM Patients and Healthy Individuals and their Association with Fasting Blood Sugar Levels

Descriptive statistics T2DM patients (n=307) Fasting Blood Sugar Levels						**Healthy Group (n=307) Fasting Blood Sugar Levels**			
Variables	**Category**	**N**	**(%)**	**Median (Q1, Q3)**	**U/H score**	**N**	**(%)**	**Median (Q1, Q3)**	**U/H Score**
Socio-demographic Profile									
Age (years)	18-23	39	(12.7)	139.21 (125.31,218.92)	2.900	19	(6.18)	98.3 (89.5,99)	2.394
	24-40	134	(43.6)	162.56 (127.7,238.58)		22	(7.16)	98.3 (89.5,99)	
	41-60	113	(36.8)	145.7 (127.86,229.12)		132	(43)	98.3 (97.3,99.11)	
	61 and above	21	(6.8)	157.3 (127.88,218.92)		114	(37)	98.2 (97,98.8)	
Gender	Male	107	(34.9)	144 (127.33,235)	10059.5	113	(36.8)	98.3 (97,99)	10447.5
	Female	200	(65.1)	157.2 (127.33,235)		194	(63. 1)	98.2 (97.2,99)	
Marital	Unmarried	54	(17.6)	159.87	1.735	55	(17.9)	98.3	0.630

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Status				(126.48,238)				(97,99)	
	Married	223	(72.6)	157.51 (127.91,235.61)		214	(69.7)	98.3 (97.4,98.9)	
	Others	30	(9.8)	136 (126.64, 218.21)		38	(12.3)	98 (96.9,99)	
Educational Qualification	No formal Education to middle school	87	(28.3)	188.13 (128.31,245.32)	[c]5.510	77	(25)	98.11 (95.52, 99)	1.713
	High School	82	(26.7)	143.11 (126.4,181.55)		85	(27.6)	98.11 (97.3,99)	
	Diploma and above	138	(45)	161 (126.94,238.58)		145	(47.2)	98.3 (97.3,99)	
Occupation	Unemployed	193	(62.9)	143.33 (127.8,221.53)	1.181	75	(24.4)	98.3 (96.9,99)	0.024
	Daily Wage and Business	48	(15.6)	147.87 (127.58,223.5)		114	(37)	98.2 (97,99)	
	Others	66	(21.5)	160.27 (126.61,247.42)		118	(38.4)	98 (97.6-99)	
Income (in Rupees)	Housewife /Student	135	(44)	160.27 (126.61,247.4)	[b] 7.295	125	(40.7)	98.3 (97.3,99)	0.770
	less than 18496	72	(23.5)	157,42 (126.52,237.16)		141	(45.9)	98.2 (97.99)	
	18497 above	100	(32.6)	144.41 (128.17,221.88)		41	(13.3)	98.3 (95.4, 99.3)	
Economic status	Upper class	34	(11.1)	128.32 (118.13-219)	1.529	22	(7.16)	98.2 (95.6,98.8)	0.331
	Middle class	78	(25.4)	160.20 (128.11,237.11)		141	(45.9)	98.3 (97,99)	
	Lower class	195	(63.5)	147.92 (126.8,230.13)		144	(46.9)	98.3 (97.3, 99)	
Mental Health Risk Factors									
Depression	Mild	72	(23.45)	188 (127,255)	2.069	256	(83.3)	98.26 (97,99)	0.838
	Moderate	74	(24.1)	146 (125.8,237.9)		49	(15.9)	98.3 (97.5,99)	
	Severe	160	(52.11)	145 (128,225.6)		2	(0.65)	95.5 (92.7,99)	
Anxiety	Mild	35	(11.4)	231 (128,276)	3.211	202	(65.7)	98.3 (97.3,99)	1.729
	Moderate	39	(12.7)	158.4 (123.6, 235.6)		96	(31.2)	98.26 (96.9,99)	
	Severe	233	(75.89)	147.9 (127.5,225)		9	(2.93)	98 (94.5,98.5)	
Stress	Mild	16	(5.21)	128.98 (123.4,217)	3.275	147	(47.8)	98.2 (97,99)	1.065
	Moderate	152	(49.51)	160 (128,235.9)		156	(50.8)	98.3 (97.3,99)	
	Severe	139	(45.27)	144.6 (127,225.8)		4	(1.3)	97.8 (91.7,98)	
Clinical Profile									
Body Mass Index (BMI)	Normal	165	(53.74)	147 (126.4,235)	535.5				
	Overweight	120	(39)	159.4 (127.9, 235)					
	Obese	22	(7.16)	150.6 (128,231.6)					
Adherence to	Yes	156	(50.8)	146.4	11559				

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Healthy Diet (ADH)				(128,228.9)					
	No	151	(49.2)	160 (126.5,237)					
Medical Condition	T2DM	244	(79.5)	152.8 (127.9, 230.8)	7515.5				
	T2DM + HTN	63	(20.5)	156.7 (125,237)					
Adherence to Physical Activity (APA)	Yes	60	(19.5)	143.9 (128,220.6)	6878				
	No	247	(80.5)	157.5 (127.2,236)					
Family History	Present	120	(39.1)	136.4 (126, 227.5)	9820				
	Absent	187	(60.9)	160 (128, 235.61)					
Menstrual Irregularities (n=200)	Present	15	(7.5)	188.2 (126,243)	347.24				
	Absent	185	(92.5)	152.3 (127.5,233)					
Smoking	Present	4	(1.3)	259 (228.8,296)	[a]203.50				
	Absent	303	(98.69)	148.5 (127,233.5)					
Alcohol use	Present	46	(15)	177.9 (126.8,236)	5655.5				
	Absent	261	(85)	147.9 (127,231.47)					
Insomnia	Present	68	(22.1)	190.5 (128.7,261)	[a]6523				
	Absent	239	(77.9)	145.7 (126.8,225)					
On Medication	OHD	212	(69.06)	157 (127.5,233)	12.362				
	IT	59	(19.21)	145.7 (126.5,255)					
	Both	36	(11.73)	148.2 (128.2,224.8)					
Complication	Present	177	(57.65)	165.57 (128.27-245.41)	445.429				
	Absent	130	(42.34)	144 (126.77-223.33)					

Note: [a]$P < 0.05$, [b]$P < 0.01$, [c]$P < 0.001$ (P = Significant Value)

Table 1 displays the sociodemographic profile, mental health well-being status, and comparison of FBS scores between T2DM patients and the general population based on the descriptive analysis and Mann-Whitney U test respectively. The median FBS levels of T2DM patients aged 24 to 40 years (44%) [162.56 (Q1: 127.7, Q3: 238.58)] and females (65%) [157.2 (Q1: 127.33, Q3: 235)] are higher than those of their counterparts. General population without DM have constant median FBS levels across age groups and genders. In T2DM patients, FBS levels were statistically significant among the lowest income category, including housewives and students (n=135) [160.27 (Q1: 126.61, Q3: 247.4), p = 0.01], and those with no formal education up to middle school (n=28) [188.13 (Q1: 128.31, Q3: 245.32), p = 0.001]. The mild, moderate and severe levels of DAS were higher in T2DM patients compared to the general population i.e. depression (23%, 24%, 52% vs. 83.3%, 16%, 0.65%), anxiety (11%, 13%, 78% vs. 65.7%, 31.2%, 2.93%), and stress (5%, 50%, 45% vs. 47.8%, 50.8%, 1.3%). In T2DM patients, mild depression [188 (Q1: 127, Q3: 255)] and mild anxiety [231 (Q1: 128, Q3: 276)] are linked to increased FBS levels, while FBS levels in healthy individuals remain consistent across mental health categories. Among T2DM patients, only 4 smoked, and 22.10% suffered from insomnia, both showing high FBS levels [259 (Q1: 228.8, Q3: 296), p < 0.05] and [190.5 (Q1: 128.7, Q3: 261), p < 0.05], respectively. Other clinical factors associated with high median FBS levels included BMI (overweight 39%), diabetic complications (57.65%), oral hypoglycemic medications (69.06%) and alcohol use (15%). Notably, 60.9% of T2DM patients without a family history of diabetes showed higher FBS levels [160 (Q1: 128, Q3: 235.61)].

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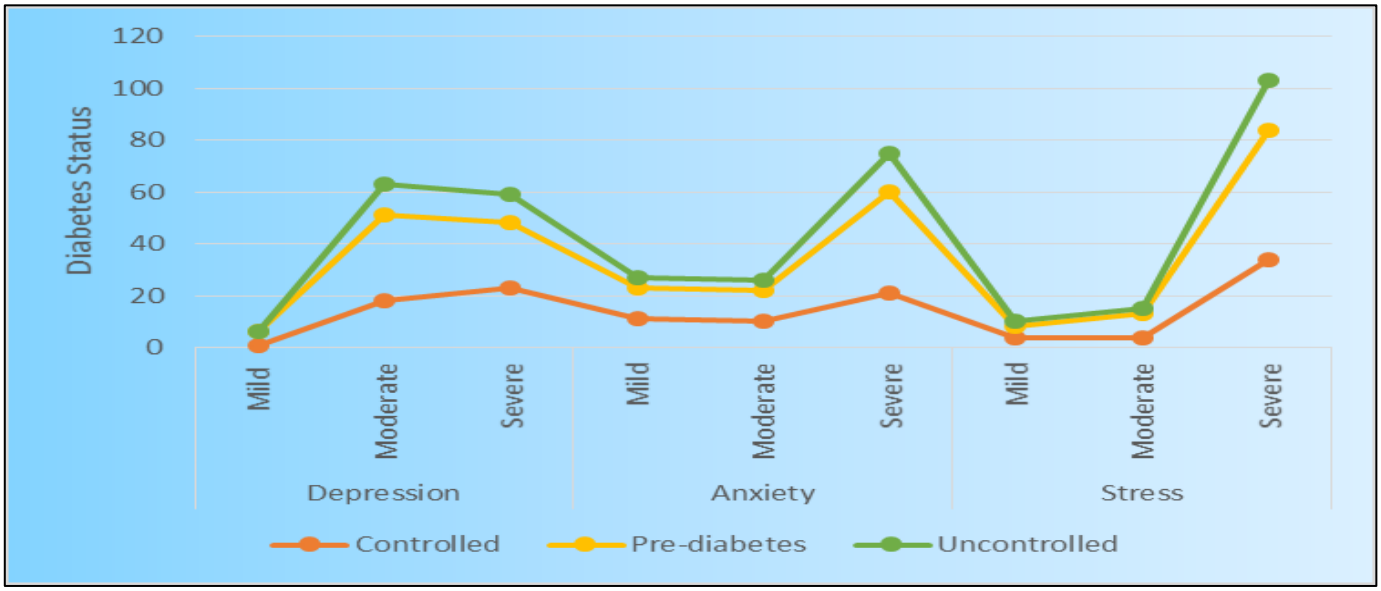

Fig 2: Impact of DAS on the Diabetes Status among the T2DM Patients

Fig. 2 demonstrates the impact of DAS on the diabetes status among patients with Type 2 Diabetes Mellitus (T2DM). It indicates that in patients with controlled type 2 diabetes, severe depression (54.76%), severe anxiety (50.00%), and severe stress (80.95%) are highly prevalent; in pre-diabetes patients, there is significant difference in moderate (52.38%) and severe (39.68%) depression, severe anxiety (61.90%), and severe stress (79.37%); in patients with uncontrolled type 2 diabetes, there is a higher likelihood of moderate (52.17%) and severe (47.83%) depression, severe anxiety (65.22%), and severe stress (82.61%).

In Table 2, the fully adjusted logistic regression analysis (Model 2), perceived stress was found to be significantly associated with participants' Married status (AOR: 0.000, p = 0.02), FBS levels (AOR: 2943.3, p = 0.009), comorbid conditions of T2DM and hypertension (AOR: 0.000, p = 0.04), APA (AOR: 0.000, p = 0.03), and family history (AOR: 17261.6, p = 0.03). Similarly, anxiety scores showed significant associations with participants' high school educational qualification (AOR: 6.185, p = 0.02), mode of treatment – "Both" with OHD and Insulin therapy (AOR: 0.209, p = 0.01) and smoking (AOR: 0.036, p = 0.03). Furthermore, depression scores were found to be significantly associated with participants' single status (AOR: 5.540, p = 0.03), high school educational qualification (AOR: 3.312, p = 0.01), and alcohol use (AOR: 0.382, p = 0.02).

Table 2: Mental Health Risk Associated with T2DM Patients

	Stress			Anxiety			Depression		
Personal Background	**[a]COR [95% [e]CI]**	**[c]Model 1 [b]AOR [95% CI]**	**[d]Model 2 AOR [95% CI]**	**COR [95% CI]**	**Model 1 AOR [95% CI]**	**Model 2 AOR [95% CI]**	**COR [95% CI]**	**Model 1 AOR [95% CI]**	**Model 2 AOR [95% CI]**
Socio-Demographic Profile									
Age 18-23 years [f]® 24-40 years	2.949 [0.752-11.52]		146.6 [0.004-587]	1.903 [0.746-4.854]		1.211 [0.262-5.599]	1.111 [0.501-2.465]		0.575 [0.171-1.932]
41-60 years	1.731 [0.478-6.265]		0.037 [0.000-155.5]	3.908 [1.313-11.628]		2.662 [0.457-15.502]	1.721 [0.741-4.00]		0.850 [0.230-3.132]
61 years and above	0.000		0.000	1.097 [0.288-4.181]		0.836 [0.101-6.940]	0.982 [0.303-3.183]		0.525 [0.104-2.652]
Gender Male® Female	0.886 [0.313-2.508]		5.097 [0.001-34007.1]	1.283 [0.624-2.639]		2.341 [0.426-12.853]	0.756 [0.429-1.332]		1.707 [0.459-6.342]
Marital Status Unmarried®	[m] 0.218 [0.073-		[l] 0.000 [0.000-	[m] 0.345 [0.161-		0.404 [0.124-	0.778 [0.402-		0.969 [0.383-

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Married	0.650]		0.276]	0.741]		1.324]	1.502]		2.453]
Others	0.454 [0.090-2.293]		0.47 [0.13, 1.64]	0.000		0.000	[k]4.583 [1.058-19.864]		[l] 5.540 [1.097-27.990]
Education Qualification No formal Education to middle school ® High School	1.975 [0.571-6.826]		14155.0 [0.640-313042.2]	[l] 4.626 [1.267-16.887]		[k]6.185 [1.310-29.210]	[m] 2.903 [1.294-6.514]		[l] 3.312 [1.252-8.765]
Diploma and above	3.392 [0.990-11.630]		51.130 [0.496-526.8]	1.100 [0.513-2.359]		1.305 [0.412-4.133]	1.061 [0.585-1.926]		0.883 [0.389-2.0]
Occupation Unemployed® Daily Wage and Business	1.297 [0.240-6.998]		0.052 [0.000-1617.6]	1.900 [0.647-5.577]		6.185 [1.310-21.210]	[l] 2.56 [1.062-6.179]		2.739 [0.677-11.080]
Others	1.017 [0.210-4.926]		0.009 [0.000-1001.7]	1.632 [0.597-4.466]		1.305 [0.412-4.133]	1.171 [0.530-2.587]		1.491 [0.298-7.468]
Economic status Upper class® Middle class	0.000		1.326 [0.000]	1.979 [0.204-19.197]		1.172 [0.068-20.294]	1.087 [0.115-10.261]		0.397 [0.029-5.484]
Lower class	0.000		0.005 [0.000]	1.966 [0.210-18.388]		2.010 [0.093-43.460]	0.688 [0.075-6.293]		0.233 [0.014-3.801]
Clinical Parameters									
Duration of Treatment	2.196 [0.692-6.973]	3.589 [0.684-18.817]	0.718 [0.002-259.146]	1.221 [0.590-2.525]	1.330 [0.593-2.983]	1.499 [0.545-4.124]	0.814 [0.479-1.382]	0.837 [0.466-1.504]	0.732 [0.363-1.478]
HbA1c	1.259 [0.395-4.012]	0.789 [0.155-4.011]	18.378 [0.072-4683.9]	1.298 [0.616-2.736]	1.023 [0.433-2.415]	0.559 [0.194-1.608]	1.035 [0.580-1.848]	1.015 [0.534-1.931]	0.740 [0.356-1.540]
FBS	[l] 3.414 [1.217-9.571]	[l] 9.73 [1.975-48.414]	[l] 2943.3 [7.075-122455.9]	1.224 [0.526-2.848]	1.175 [0.418-3.301]	1.520 [0.461-5.008]	1.179 [0.620-2.242]	1.484 [0.686-3.209]	1.723 [0.749-3.964]
SBP	2.695 [0.891-8.149]	1.821 [0.404-8.211]	59.321 [0.389-9056.1]	1.166 [0.455-2.983]	1.145 [0.400-3.273]	0.936 [0.272-3.216]	1.119 [0.547-2.288]	1.109 [0.499-2.465]	0.634 [0.254-1.580]
Medical Condition T2DM ® T2DM + HTN	[m]0.233 [0.084-0.648]	[l] 0.167 [0.043-0.647]	[k]0.000 [0.000-0.739]	0.855 [0.368-1.987]	0.792 [0.310-2.025]	0.835 [0.280-2.484]	0.728 [0.390-1.357]	0.695 [0.352-1.375]	0.523 [0.240-1.138]
T2DM Complications Absent® Present	0.604 [0.205-1.782]	0.330 [0.080-1.363]	0.264 [0.004-16.279]	0.783 [0.379-1.619]	0.849 [0.391-1.844]	0.877 [0.351-2.194]	0.935 [0.548-1.594]	0.983 [0.553-1.747]	0.766 [0.396-1.479]
Medicationmode OHD® Insulin Therapy	1.560 [0.336-7.240]	2.298 [0.379-13.940]	5478.9 [0.059-50678.0]	0.547 [0.233-1.282]	0.598 [0.238-1.499]	0.800 [0.266-2.403]	0.600 [0.318-1.132]	0.538 [0.269-1.076]	0.514 [0.234-1.128]
Both	0.602 [0.159-2.273]	0.544 [0.067-4.432]	0.001 [0.000-7.792]	0.408 [0.158-1.055]	0.391 [0.141-1.083]	[l] 0.209 [0.059-0.745]	1.180 [0.486-2.864]	[l] 1.222 [0.469-3.185]	1.173 [0.400-3.441]
BMI Normal ® Overweight	0.823 [0.290-2.334]	0.566 [0.136-2.353]	4.392 [0.039-497.4]	0.857 [0.413-1.778]	1.024 [0.466-2.252]	1.151 [0.459-2.887]	0.889 [0.516-1.531]	0.928 [0.517-1.665]	0.811 [0.427-1.543]
Obese	1.070 [0.127-	1.844 [0.108-	0.022 [0.000-	1.224 [0.264-	1.416 [0.253-	1.067 [0.163-	1.960 [0.551-	2.190 [0.576-	2.444 [0.569-

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	8.988]	31.423]	55.121]	5.676]	7.923]	6.978]	6.977]	8.334]	0.495]
[i]APA No ® Yes	0.513 [0.171-1.536]	[k]0.176 [0.029-1.068]	[k]0.000 [0.000-0.579]	0.798 [0.343-1.857]	0.652 [0.245-7.923]	0.359 [0.111-1.165]	1.031 [0.530-2.007]	0.747 [0.347-1.610]	0.558 [0.233-1.339]
[j]AHD No® Yes	1.035 [0.378-2.832]	3.184 [0.617-16.428]	281.7 [0.702-113114.2]	0.855 [0.422-1.732]	1.031 [0.453-2.347]	1.032 [0.404-2.632]	[k]1.672 [0.982-2.848]	1.795 [0.967-3.335]	1.815 [0.906-3.636]
Family History Absent® Present	2.914 [0.813-10.44]	[k]4.918 [0.948-25.5]	[k]17261.6 [1.797-165804.7]	0.645 [0.318-1.308]	0.728 [0.333-1.589]	0.526 [0.205-1.353]	1.420 [0.817-2.470]	1.762 [0.952-3.256]	1.680 [0.835-3.381]
Smoking Absent ® Present	0.000	0.058	0.000	[k] 0.1221 [0.017-0.897]	0.121 [0.11-1.291]	[k]0.036 [0.002-0.808]	0.935 [0.096-9.129]	0.708 [0.056-8.912]	0.619 [0.041-9.414]
Alcohol use Absent ® Present	2.744 [0.354-21.294]	11.614 [0.500-269.9]	511293.5	0.548 [0.232-1.295]	0.628 [0.243-1.627]	0.774 [0.251-2.384]	[k]0.466 [0.239-0.909]	[l] 0.404 [0.194-0.841]	[k] 0.382 [0.168-0.867]
Insomnia Absent ® Present	[l] 0.341 [0.122-0.953]	[k]0.211 [0.055-0.804]	0.051 [0.002-1.164]	0.578 [0.268-1.251]	0.641 [0.279-1.474]	0.660 [0.243-1.792]	0.684 [0.374-1.252]	0.700 [0.367-1.335]	0.879 [0.426-1.814]

Note : [a] Crude Odds ratio, [b]Adjusted Odds ratio, [c] Partially adjusted regression model, [d] Fully adjusted regression model, [e] CI: Confidence Interval, [f] Reference, [I] Adherence to Physical Activity , [j] Adherence to Healthy Diet, Significant Value (*P*)
[k] $P < 0.05$, [l] $P < 0.01$, [m] $P < 0.001$,

Fig. 3 projects the prevalence of severe depression, anxiety, and stress in patients suffering from different T2DM complications. Across all complication categories, severe depression is most prevalent among patients with neuropathic foot ulcers (54.76%) and nephropathy (61.54%); severe anxiety is particularly common in patients with neuropathic foot ulcers (50%), hypertension (61.90%), and retinopathy (65.22%); and severe stress is alarmingly prevalent in all categories, especially among patients with neuropathic foot ulcers (80.95%), hypertension (79.37%), and retinopathy (82.61%).

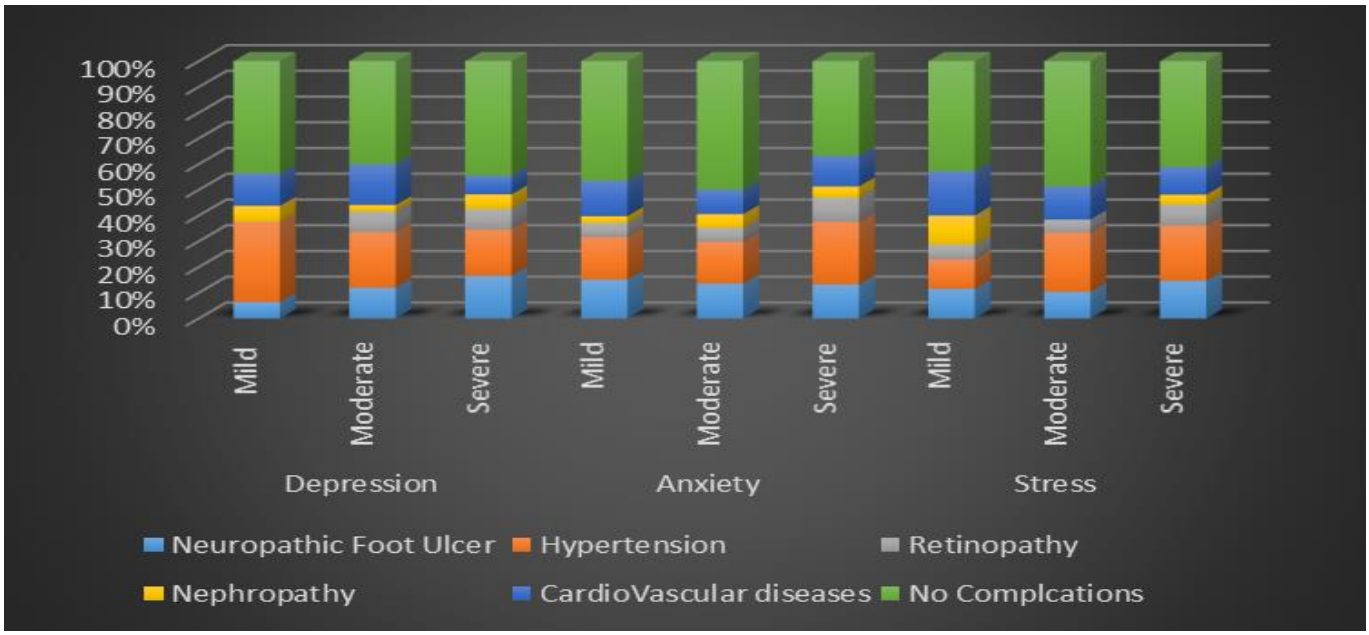

Fig 3: Impact of DAS on T2DM Complications among T2DM Patients

IV. DISCUSSION

A. Prediction of FBS Levels Status among T2DM Patients and the General Participants

The study examined the prevalence of fasting hyperglycemia in young adults (aged 24–40) with T2DM, finding an average FBS level of 162.56 mg/dL, which is higher than in other age groups. This finding contrasts with previous studies by Chandrupatla., *et* al (2021) and Rajput., *et* al. (2012), which reported higher FBS levels in older working-age groups. Female patients had a higher median FBS (157.2 mg/dL) than males, but healthy individuals maintained consistent FBS levels across all ages and genders. Lower education levels and lower income groups (such as housewives and students) were linked to higher FBS levels in T2DM patients, in line with studies in Taiwan and Korea. [18,19]

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Among clinical parameters, complications (165.57 mg/dL) and use of oral hypoglycemic medications (157 mg/dL) were linked to higher FBS levels in type 2 diabetes patients, while healthy individuals showed stable FBS levels. These findings are consistent with earlier studies conducted by Bin Rakhis., *et* al. (2022) and Lorenzati., *et* al. (2010). Lifestyle factors, such as smoking and insomnia, were significantly associated with the highest median FBS levels, similar to a 2015 study done by Bhaskar et al. linking insomnia to a 33% higher risk in adult T2DM patients. Interestingly, individuals without a family history of diabetes had higher FBS levels (160 mg/dL) compared to those with a family history (136.4 mg/dL), possibly due to better lifestyle adjustments among those aware of their genetic risk.[20]

B. Prevalence of DAS among T2DM Patients

The prevalence of severe DAS in our sample is notably higher than in previous studies among T2DM patients in Qatar (13.6%, 35.3%, and 23.4%) [21], Bahrain (11.9%, 41.3%, and 21%) [22] and Kathmandu, Nepal (10.8% and 4.7%)[2]. In North India, the rates were 26.3%, 27.6%, and 21%, respectively.[23] In South India, specifically Tamil Nadu, the prevalence of depression was 15.1% in Chennai [24], 6.3% for depression and 10.4% for anxiety in Madurai district[9] and high perceived stress in both genders in Perambalur district.[25] Limited data, especially with all three DAS disorders from Tamil Nadu contrasts with a study by Alzahrani., *et* al (2019) in Saudi Arabia, showing mild, moderate, severe, and extremely severe depression in 9.3%, 14.0%, 7.1%, and 3.3% of T2DM patients, respectively. The possible reason for the high prevalence of DAS among T2DM patients in this study could be due to a combination of cultural stigma and limited awareness about mental health, socioeconomic challenges, inadequate access to quality healthcare and the complexity of diabetes management. [26]

C. Mental Health Risk Factors Associated with T2DM Patients

This groundbreaking research is the first to investigate the risk factors associated of depression, anxiety, and stress among T2DM patients, using standard tools HAM-D, HAM-A and PSS available in the public domain. The study found that being married is linked to lower stress, highlighting the mental health benefits of social support. [27] Conversely, single status individuals are five times more likely to experience depression due to a lack of social support.[28] Patients with only a high school education are six times more likely to develop anxiety and three times more likely to suffer from depression, suggesting that limited health literacy makes diabetes management more challenging.[29,30] Patients with high FBS levels have very high to develop stress[2] and the presence of comorbidity with hypertension alongside T2DM is significantly associated with stress[31] whereas combined mode of treatment (Both OHD and Insulin therapy) is positively associated with anxiety.[7] Lower health literacy has been associated with worse health outcomes and higher rates of depression among chronic disease patients.[32] Moreover, the study found that the duration of treatment, HbA1c, blood pressure levels, menstrual irregularity, and BMI show no significant association with DAS, indicating that they might not directly impact these mental health outcomes in the studied population.[33] Patients with a family history have higher likelihood of experiencing stress. Managing diabetes in individuals with a family history requires constant monitoring and lifestyle adjustments, leading to ongoing stress.[34] Regular physical activity and adherence to a healthy diet, generally have protective effects against mental health issues.[35] Lifestyle risk factors like alcohol use and smoking have a complex relationship. They may initially reduce depression and anxiety due to self-medication effects, but long-term use is generally harmful. [36]

D. Impact of DAS on the T2DM Complications among the T2DM patients

The study shows a high incidence of stress, anxiety, and depression among patients with diabetic complications. This highlights the significant mental health burden associated with the condition. Previous research conducted by Tapp, R. J., *et* al. (2006) and Ali Ahmad., *et* al. (2014), also supports this outcome.

E. Limitation and Strength of the Study

The research was limited to one healthcare institute, so the results may not apply to larger groups of people. Furthermore, most participants had serious health issues, such as severe complications of T2DM, which could have affected the observed DAS. Despite its limitations, the study is notable for its thorough methodology and valuable insights into the T2DM-DAS connection. It effectively compares health outcomes between T2DM patients and the general population and includes diverse samples from a tertiary care hospital for accuracy. In the future, it is imperative for diabetes research to incorporate samples from different geographical locations and conduct a meta-analysis to definitively determine the prevalence of DAS in individuals with type 2 diabetes. Future research in nursing have to focus on implementing and assessing therapies aimed at reducing patients' stress, anxiety, and depression.

V. CONCLUSION

T2DM and mental health disorders often coexist due to biological, psychological, and social factors. This study examined how socio-demographic, mental health (DAS), and clinical factors relate to T2DM, comparing these aspects with the general population to evaluate the prevalence of DAS risk among T2DM patients in Madurai. The study highlights that two-thirds of young women with type 2 diabetes have higher FBS levels than men when compared to the general population. There is a notably high prevalence of severe depression, anxiety, and stress among patients with Type 2 diabetes mellitus when compared to the general population. 82.61% of the patients with uncontrolled diabetes developed severe stress, more than those with well-controlled and pre-diabetes status. Among the T2DM complications, severe depression is most prevalent among patients with neuropathic foot ulcers (54.76%) and nephropathy (61.54%). Factors such as marital status (single), high school education, poor glycemic control, comorbid conditions of type 2 diabetes with hypertension and family history are the predominant mental health risk factors in patients with type 2 diabetes. Interestingly, lifestyle factors such as alcohol use and

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smoking have a significant positive impact on mental health outcomes, possibly due to adaptive coping mechanisms and changes in perception. Effective diabetes management is crucial in reducing mental health risks. The study underscores the need for comprehensive care in T2DM, emphasizing a multidisciplinary approach that includes psychological support, lifestyle modifications and effective clinical management to enhance overall well-being and quality of life.

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