ORIGINAL RESEARCH ARTICLE

Poor Glycaemic Control and It's Risk Factors Among Diabetes Patients in An Urban Area of Western India

Yash Rajan[1], Hitesh Lakhabhai Bhabhor[2], Anup Kharde[3], Jay Kakadiya[4], Kush Varsadiya[5], Aman Damor[6*]

[1]Smt BK Shah Medical institute & Research centre, Waghodia, Vadodara, India
[2]GMERS Navsari, India
[3,6]Zydus Medical College and Hospital, Dahod, India
[4]Government Medical College, Surat, India
[5]MP Shah Medical College, Jamnagar, India

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ABSTRACT

Introduction: Diabetes is a major public health problem worldwide including India. Poor glycaemic control is a major risk factor for the development of diabetes-related complications. Hence, monitoring and achieving good glycaemic control is critical to reducing the risk of complications and improving outcomes in people with diabetes. This study conducted to determine the prevalence of poor glycaemic control and to identify the factors associated with poor glycaemic control.

Methodology: This cross-sectional descriptive study conducted in an urban area among those patients having diabetes since more than five years. All participants were interviewed and tested for HbA1c. Cases with good glycaemic control (HbA1c <7%) were compared with those with poor glycaemic control (HbA1c ≥7%). Multivariate analysis was conducted to find out independent determinants.

Results: Out of 632 cases, poor glycaemic control was found in 81.3% cases. Multivariate logistic regression indicated that living without a spouse (p 0.036), Female gender (p 0.032), MBI >23(kg/m2) (p <0.001), poor medication adherence (p 0.022), and high perceived stress level (p 0.011) were independent predictors of poor glycaemic control. More than 10 years duration of diabetes was found to be associated with good glycaemic control (p 0.016)

Conclusion: There are a high proportion of patients with poor glycaemic control. Higher BMI, poor drug adherence and higher stress level are independently associated with poor glycaemic control.

Keywords: HBA1c, Body mass Index, Perceived stress, GPAQ, MET, Physical activity

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***Correspondence:** Dr. Aman Damor (Email: amandamor1993@gmail.com)

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INTRODUCTION

Diabetes is a chronic metabolic disorder characterized by hyperglycaemia due to impaired insulin secretion, insulin action, or both. It is a major public health problem worldwide, affecting over 463 million people globally, and its prevalence is expected to increase to 700 million by 2045.[1] India is home to the second-largest number of people with diabetes in the world, with over 77 million people diagnosed with the condition in 2019.[1] The fifth round of NFHS (NFHS-5)[2] conducted from 2019 to 2020, revealed that the prevalence of high blood sugar levels (defined as fasting plasma glucose ≥126 mg/dL or random plasma glucose ≥200 mg/dL) among adults aged 18-69 years in India was 6.2% with higher rate among urban residents (7.9%) compared to rural residents (5.4%). In Gujarat state, the prevalence of high blood sugar levels was 6.9%, which is slightly higher than the national average.[2]

HbA1c (hemoglobin A1c) or glycated hemoglobin reflects the average blood glucose level over the preceding 2-3 months and is considered a reliable index of cumulative glycaemic control in people with diabetes. The American Diabetes Association (ADA) recommends that a target HbA1c level of less than 7% for most people with diabetes, although individualized targets may be appropriate based on factors such as age, duration of diabetes, and comorbidities.[3]

Poor glycaemic control is a major risk factor for the development of diabetes-related complications, such as retinopathy, nephropathy, neuropathy, and cardiovascular disease.[3,4] Several studies have demonstrated the importance of HbA1c as a predictor of diabetes-related complications. For example, the UK Prospective Diabetes Study (UKPDS) found that a 1% reduction in HbA1c was associated with a 21% reduction in diabetes-related deaths, a 14% reduction in myocardial infarction, and a 37% reduction in microvascular complications.[5] Similarly, the Diabetes Control and Complications Trial (DCCT) showed that intensive glycaemic control, as measured by HbA1c, reduced the risk of retinopathy, nephropathy, and neuropathy in people with diabetes.[6]

Hence, monitoring and achieving good glycaemic control is critical to reducing the risk of complications and improving outcomes in people with diabetes. It is important to note that the NFHS-5 data provides information on high blood sugar levels, which is not the same as poor glycaemic control, as measured by HbA1c. High blood sugar levels may or may not indicate poor glycaemic control, depending on factors such as the timing of the blood sugar measurement and the individual's diabetes management. Therefore, the findings from this study may provide a more accurate and comprehensive picture of the prevalence of poor glycaemic control in Indian adults with diabetes.

There is a lack of comprehensive data on the prevalence of diabetes and glycaemic control in India, particularly in the context of various factors that may contribute to poor glycaemic control in this population. The current literature suggests that factors such as age, sex, duration of diabetes, body mass index, physical activity, dietary habits, medication adherence, and access to healthcare may influence glycaemic control in people with diabetes. However, the extent to which these factors impact glycaemic control in Indian populations is not well understood.

The primary objective of this study is to determine the prevalence of poor glycaemic control in a sample of Indian adults with diabetes. The secondary objectives are to identify the factors associated with poor glycaemic control and assess the relationship between these factors and glycaemic control among the study population.

METHODOLOGY

The present study was a cross sectional descriptive study conducted in urban area of Surat city located in western part of India. It is an industrial city with textile and diamond cutting and polishing as main businesses. This study was a part of a large-scale screening and follow-up drive for non-communicable disease including diabetes and hypertension conducted by health department during the year 2021. In this drive field level health care workers were asked to motivate and refer above thirty-year people to visit nearby government health centre for screening for diabetes and hypertension. The cases already suffering from hypertension and diabetes were asked to refer health centre for follow-up investigation.

This study was conducted among those who were suffering from diabetes since more than five years, residents of the city since last 5 years and voluntarily visiting heath centres. Earlier research indicated that diabetic patients with less than 5 years of duration of disease had better glycaemic control than patients with 5 year or longer duration of disease.[7] Therefore, only patients with more than five year of disease were considered.

This study was approved by the Institutional ethical committee (letter no. 24305/PSM/2020). Written informed consent was obtained in the language convenient to each participant (Gujarati / Hindi / Marathi) before collecting the data.

Sample size and sampling method:

The sample size was calculated based on a study conducted by Manoharan D et al[8] which found that among the patients with diabetes since more than one year, 37.8% had HbA1c less than 7%. Using the formula sample size $n = \frac{(Z1-\alpha/2)^2\, pq}{d^2}$, the minimum calculated sample size was 627. Here, p = 0.38, q = 1-p = 0.62, with a 95% confidence interval (CI) and 10% allowable error.

There is total 55 urban health centres in Surat city. A training of staff nurse of all the health centres was conducted to explain the study proforma and consent procedure.

Any person above thirty-year visiting health centre as a part of the screening and follow up drive for diabetes and or hypertension was inquired about his/her diabetic status. If the person was not a known cases of diabetes or didn't know about his/her diabetes status, then he/she was excluded. If the person was a known patient of diabetes, duration of disease was ascertained by means of document or lab report or history of medication. If the duration of disease found to be 5 year or more, the person was explained about the study and asked for voluntary participation in the study. If the person agreed to participate, a detailed interview was conducted after taking written consent for interview as well as blood sample for HbA1c. After completion of interview 5 ml blood sample was obtain with all standard precautions. Cases diagnosed within last 5 years or having any ambiguity regarding 5 years duration of disease were excluded from the study.

All the centres were asked to enrol 12 cases per centre to ensure equal representation of all areas of the city. All heath centres were also asked to enrol maximum two cases per day so that the study conducted smoothly during the working hours of the centre without adding extra workload on the staff nurse and to ensure good quality of data.

Study variables

The study semi structured proforma was developed to include assessment of basic socio-demographic profile, medication adherence, physical activity, perceived stress, sociodemographic status, dietary habits, anthropometric measurements, duration of illness, smoking, etc among the study participants. The contents of the questionnaire were face validated by senior faculties from medicine and community medicine departments of the medical college.

Height of the patient was measured using stadiometer with precision of 1 mm and weight of the patient was measured using digital bathroom weight scale with precision of 0.1 kg.

Medication adherence was assessed by counting number of prescribed medications skipped during past one week. Patients taking 100% of prescribed medication (oral or injectable or both) during the prescribed time were labelled as having good medication adherence.

Stress level was assessed by the Perceived Stress Scale (PSS) scale.[9] PSS score has 10 questions and answers were recorded in the form of 'never', 'almost never', 'sometimes', 'fairly often' and 'very often' which were assigned score 0 to 4. Answer number 4, 5, 7 and 8 were assign reverse scoring. Score ranges from 0 to 40. PSS scores ranging from 0 to 13, 14–26, and 27–40 was considered as low, moderate, and high perceived stress, respectively.

Physical activity level was assessed by the Global Physical Activity Questionnaire (GPAQ) questionnaire.[10] The GPAQ comprises 16 questions (P1–P16) and Metabolic Equivalents which are commonly used to express the intensity of physical activities, were used for the analysis of GPAQ data. Physical activity level was divided in to two groups based on total Physical Activity MET minutes per week with cut-off value of 600 MET minutes per week.

Blood samples were collected and transported to the central laboratory with proper cold chain maintenance. All samples were tested with high-performance liquid chromatography (HPLC) for HbA1c. Samples not suitable for testing due to any reason were excluded from the study.

Analysis: The analysis the participants were divided in to two groups based on their HbA1c level. Patients with HbA1c value less than 7% were labelled as 'Good Glycaemic Control' group and cases with HbA1c value 7% or more labelled as 'Poor Glycaemic Control' group. All study variables compared between these two groups. Data were initially entered into Microsoft excel sheet and later imported to SPSS version 20 (IBM Corp., Armonk, N.Y., USA) for analysis. Quantitative data with normal distribution were presented in mean and standard deviation whereas qualitative data were presented by frequency and percentage. The chi-square and unpaired t test were respectively used for comparing qualitative and quantitative data between 'Good Glycaemic Control' group and 'Poor Glycaemic Control' group. P value <0.05 was considered for statistical significance of variables. All variables with a P value of 0.02 or less were considered in the multivariate regression model. Crude and adjusted odds ratios were calculated for all variables included in the multivariate analysis.

RESULTS

The study was conducted in all 55 health centres of the city. Against the target of 12 cases from each health centre, we could get 12 samples from 41 centres, 11 samples from 9 centres, 9 samples from 4 centres and 8 samples from 1 centre. Thus, total data and blood sample of 635 patients received. Three blood samples were discarded as they were unfit for testing. So, finally 632 cases were included in the final analysis.

Mean age of the participants was 61 ± 10.2 years. Participation of female was more (62.3%) compared to male (37.7%). Sociodemographic profile of the study was shown in table 1.

Mean HBA1c of the participants was 8.62 ± 2.1%. Cases with good glycaemic control i.e. HbA1c <7% were 118 (18.7%) and cases with poor glycaemic control i.e HbA1c ≥ 7% were 514 (81.3%).

Table 1: Association of Socio-demographic profile, smoking and alcohol use with glycaemic control

Variable	Poor Glycaemic control (%) (HbA1c ≥ 7%) (n=514)	Good Glycaemic control (%) (HbA1c < 7%) (n=118)	OR	95% CI	P value
Age (years)					
≥60	286 (55.6)	67 (56.4)	0.95	0.64 - 1.43	0.822
<60	228 (44.4)	51 (43.6)	ref		
Cohabitation status					
Living without spouse	90 (17.5)	11 (9)	2.06	1.07 - 4.00	0.029
Living with spouse	424 (82.5)	107 (91)	Ref		
Gender					
Female	329 (64)	65 (55.1)	1.45	0.97 - 2.17	0.071
Male	185 (36)	53 (44.9)	Ref		
Education					
Up to high secondary school	422 (82.2)	94 (79.5)	1.17	0.71 - 1.93	0.537
Graduate and above	92 (17.8)	24 (20.5)	Ref		
Financial dependency					
Dependent	306 (59.4)	61 (51.3)	1.37	0.92 - 2.05	0.12
Independent	208 (40.6)	57 (48.7)	Ref		
Socioeconomic status*					
BPL	185 (36)	38 (32.1)	1.18	0.77 - 1.81	0.437
APL	329 (64)	80 (67.9)	Ref		
History of smoking					
Current smoker	157 (30.5)	38 (32.2)	0.89	0.57 - 1.38	0.606
Past smoker	37 (7.2)	11 (9.3)	0.73	0.35 - 1.49	0.381
Never smoked	320 (62.3)	69 (58.5)	Ref		
History of alcohol use					
Current user	51 (9.9)	13 (11)	0.84	0.42 - 1.67	0.614
Past user	32 (6.2)	7 (5.9)	0.97	0.40 - 2.36	0.954
Never used	197 (38.3)	42 (35.6)	Ref		

*Socioeconomic status was assessed based on the availability of the BPL/APL card.

Table 2: Association of co-morbidities and family history of co-morbidities with glycaemic control

Variable	Poor Glycaemic control (%) (HbA1c ≥ 7) (n=514)	Good Glycaemic control (%) (HbA1c < 7) (n=118)	OR	95% CI	P value
Presence of any chronic comorbidities					
Present	394 (76.6)	92 (78.2)	0.93	0.57 - 1.50	0.76
Absent	120 (23.4)	26 (21.8)	Ref		
Hypertension					
Yes	268 (52.1)	73 (61.5)	0.67	0.45 - 1.01	0.056
No	246 (47.9)	45 (38.5)	Ref		
Dyslipidemia					
Yes	225 (43.7)	50 (42.3)	1.06	0.71 - 1.59	0.782
No	289 (56.3)	68 (57.7)	Ref		
Coronary Artery Disease					
Yes	126 (24.5)	27 (23.1)	1.09	0.68 - 1.76	0.709
No	388 (75.5)	91 (76.9)	Ref		
Thyroid disease					
Yes	97 (18.9)	14 (11.5)	1.73	0.95 - 3.15	0.071
No	417 (81.1)	104 (88.5)	Ref		
Family history of CAD					
Yes	149 (29)	39 (33.3)	0.82	0.54 - 1.26	0.368
No	365 (71)	79 (66.7)	Ref		
Family history of stroke					
Yes	66 (12.9)	18 (15.4)	0.82	0.47 - 1.44	0.486
No	448 (87.1)	100 (84.6)	Ref		
Family history of Hypertension					
Yes	205 (39.9)	53 (44.9)	0.81	0.54 - 1.22	0.318
No	309 (60.1)	65 (55.1)	Ref		
Family history of dyslipidemia					
Yes	119 (23.1)	26 (21.8)	1.07	0.66 - 1.72	0.794
No	395 (76.9)	92 (78.2)	Ref		
Family history of DM					
Yes	341 (66.4)	77 (65.4)	1.05	0.69 - 1.60	0.822
No	173 (33.6)	41 (34.6)	Ref		

Table 3: Association of clinical variables related to diabetes, stress and physical activity with glycaemic control

Variable	Poor Glycaemic control (%) (HbA1c ≥ 7) (n=514)	Good Glycaemic control (%) (HbA1c < 7) (n=118)	OR	95% CI	P value
Duration of DM (years)					
>10	255 (49.7)	72 (61)	0.63	0.42 - 0.95	0.025
5 to 10	259 (50.3)	46 (39)	Ref		
Current treatment					
Oral Hypoglycaemic Agents (OHA)	316 (61.5)	89 (75.4)	Ref		
Only Insulin	71 (13.8)	10 (8.5)	0.65	0.37 - 1.14	0.049
Insulin + OHA	127 (24.7)	19 (16.1)	2.97	1.54 - 5.75	0.019
BMI (kg/m2)					
>23	428 (83.2)	71 (60.3)	3.29	2.13 - 5.09	<0.001
≤23	86 (16.8)	47 (39.7)	Ref		
Any other non-allopathy treatment for diabetes					
No	491 (95.5)	113 (96.2)	0.94	0.35 - 2.54	0.91
Yes	23 (4.5)	5 (3.8)	Ref		
Facing difficulty in accessing treatment facility					
Yes	86 (16.8)	16 (13.6)	1.28	0.72 - 2.28	0.398
No	428 (83.2)	102 (86.4)	Ref		
Medication adherence*					
Poor	259 (50.3)	41 (34.6)	1.91	1.26 - 2.89	0.002
Good	255 (49.7)	77 (65.4)	Ref		
Perceived stress level#					
Low (PSS 0-13)	173 (33.6)	61 (51.3)	Ref		
Moderate (PSS 14-26)	277 (53.8)	51 (43.6)	1.91	1.26 - 2.91	0.002
High (PSS 27-40)	65 (12.6)	6 (5.1)	3.82	1.57 - 9.26	0.001
Total physical activity (MET min/week)$					
<600	286 (55.6)	47 (39.7)	1.89	1.26 - 2.85	0.002
≥600	228 (44.4)	71 (60.3)	ref		

* Patient skipping nay dose of prescribed medicine during last one week was considered as poor medication adherence.
# Assessed by Perceived stress scale[9];
$Assessed by Global Physical Activity Questionnaire (GPAQ) questionnaire[10]

The comparison of various socio-demographic variables with glycaemic control indicates that poor glycaemic control is associated with living without a spouse (p 0.029). Those diabetic patients living without a spouse had 2.06 times the chance of poor glycaemic control compared to those who were living with their spouse. It is interesting to note that education level (p 0.537), financial dependency (p 0.120), socio-economic status (0.437), current smoking (p 0.606), and current alcohol use (p 0.614) were not associated with poor glycaemic control. (Table 1)

The presence of any chronic co-morbid condition in the patient was not associated with poor glycaemic control (p 0.760). Chronic diseases like hypertension (0056), dyslipidemia (p 0.782), coronary artery disease (p 0.709), and thyroid disorder (p 0.071) were not a risk factor for poor glycaemic control. A family history of any such disease was also not a risk factor for poor glycaemic control. Poor glycaemic control was not found to be significantly higher in cases with a family history of diabetes (p 0.822). (Table 2)

The duration of diabetes was a significant risk factor for poor glycaemic control (p 0.025). Patients with more than 10 years of diabetes had a 1.59 (95% CI 1.06 – 2.39) time higher risk of poor glycaemic control compared to those with 5 –10 years of diabetes. Only insulin therapy, combined insulin, and oral hypoglycaemic agents (OHA) therapy, a BMI greater than 23 kg/m2, and poor medication adherence were also significantly associated with poor glycaemic control (p <0.05). (Table 3).

In univariate analysis, higher perceived stress levels and lower physical activity were also associated with poor glycaemic control (p <0.05). (Table 3)

Multivariate logistic regression of all important associated variables, found in univariate analysis, indicated that living without a spouse (p 0.036), Female gender (p 0.032), MBI >23(kg/m2) (p <0.001), poor medication adherence (p 0.022), and high perceived stress level (p 0.011) were independent predictors of poor glycaemic control. More than 10 years duration of diabetes was found to be associated with good glycaemic control (p 0.016) (Table 4) (Fig. 1)

DISCUSSION

Finding of the current study that 81.3% of participants had poor glycaemic control (HbA1c≥7) was remarkably, however it is consistent with the findings from other regions of India. In 2017, a multicentric study that covered 26 Indian states found that 23.4% of people had adequate glycaemic control.[11] In North Kerala, a hospital-based study found that 28.3% of people had adequate glycaemic control.[12]

Table 4: Multivariate logistic regression of variables associated with poor glycaemic control

Variable	Adjusted OR	95% CI	P value
Living without spouse	1.57	1.12 - 2.04	0.036*
Female	1.33	1.07 - 1.87	0.032*
Unemployed	1.41	0.62 - 2.36	0.124
Having Hypertension	0.88	0.52 - 1.42	0.092
Having thyroid disease	1.19	0.59 - 2.05	0.101
> 10 years duration of Diabetes	0.67	0.39 - 0.86	0.016*
Taking only Insulin	0.79	0.47 - 1.38	0.083
Taking Insulin + Oral Hypoglycaemic Agents	2.21	1.48 - 3.96	0.017*
BMI > 23(kg/m2)	2.02	1.33 - 4.03	<0.001*
Poor Medication adherence	1.52	1.16 - 2.72	0.022*
Moderate Perceived stress level	1.37	0.96 - 1.91	0.069
High Perceived stress level	2.82	1.62 - 7.14	0.011*
Total physical activity <600 (MET min/week)	1.47	0.86 - 2.77	0.083

All study variables with p value <0.2 in univariate analysis were included in the multivariate analysis. Back method was used in regression analysis.
*Statistically significant (p <0.05)

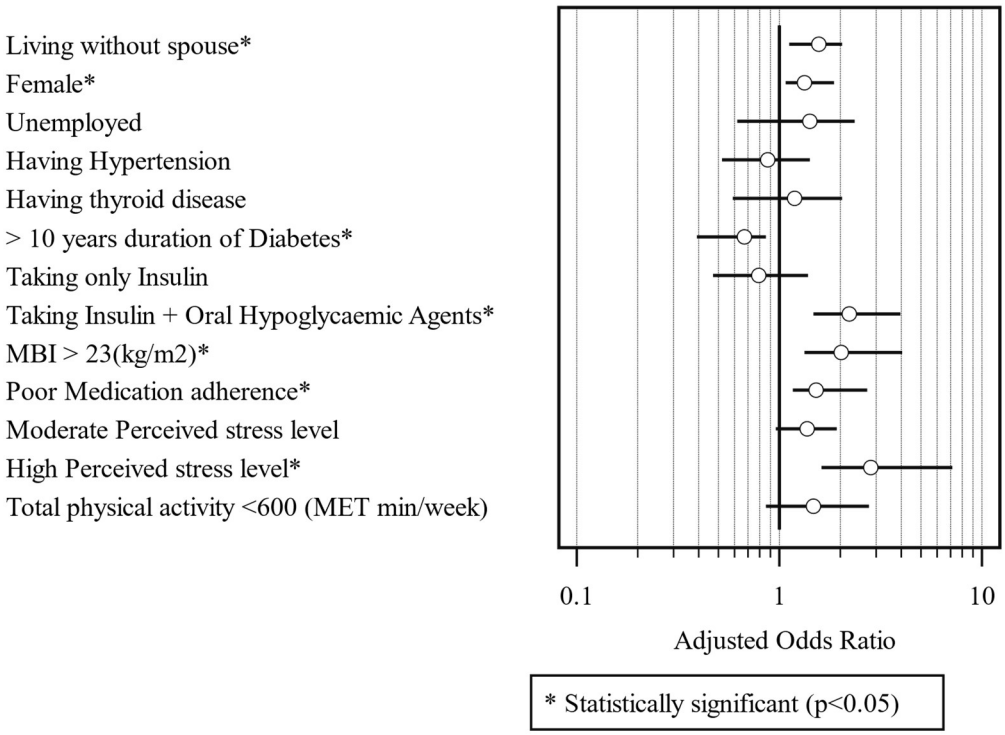

Fig 1: Adjusted Odds Ratio for variables associated with poor glycaemic control

A community-based study from the same region also found only 21.4% had good glycaemic control.[13] All these studies indicate a high prevalence of poor glycaemic control among Indian population. According to a study by Oluma et al., compared to diabetes with a shorter duration of disease, diabetes with a duration of more than 4 years is more likely to be associated with poor glycaemic control.[14] This further explains the likelihood of a higher percentage of patients with poor glycaemic control in the current study, which only includes patients with diabetes who have had it for longer than five years. The prevalence of good glycaemic control was 45.6% in Korea[15] and 62.6% in a cross-sectional study conducted across Europe's nine countries, showing a stark contrast between the proportions of glycaemic control in various other nations compared to India.[16] These variations in glycaemic control status are a reflection of the socioeconomic divides that exist today and the varying standards of medical care that patients around the world receive.

The present study found that patient living with their spouse had better control of their glycaemic level (adjusted OR = 1.57, 95% CI = 1.12, 2.04, P 0.036). A longitudinal study by Ford KJ et al found that marital relationships, regardless of the quality of the relationship, were associated with lower HbA1c values for male and female adults aged over 50 years.[17]. This suggests that cohabitation and marriage have a beneficial effect on diabetes management. This is probably because the spouse helps with daily activities like sticking to a diet and taking medications, as

well as periodic ones like follow-up diabetes check-ups. To assert a temporal relationship between co-habitation with a spouse and glycaemic control, however, is not permitted by the study's design. The possibility of the opposite explanation cannot be completely ruled out. Poor glycaemic control may cause some degree of diabetes symptoms, such as fatigue, thirst, blurred vision, and slowly healing wounds[18]; these symptoms may then have an impact on marital status or cause spousal strain if the health condition continues to deteriorate and makes the patient more irritable. In fact, there is some evidence that indicates that those in poorer health are more likely to get divorced or separate from their spouses.[19,20] However, given that type 2 diabetes symptoms can be mild or non-existent for years, this mechanism appears to be an unlikely explanation for our results.[3,18]

According to the current study, there is a significant correlation between having less than ideal glycaemic control and having a higher BMI (BMI >23 kg/m2) (adjusted OR = 2.02, 95% CI = 1.33, 4.03, P < 0.001). This result is in line with a number of other studies from India[13,21,22] as well as other part of the world[23–25] that found that diabetic patients who are obese and overweight are more likely to experience uncontrolled hyperglycaemia than normal weight people. Evidence indicates that insulin resistance seems to rise gradually with BMI levels[26], which opens the possibility for unchecked hyperglycaemia.

The results of the current study show that patients of the female gender have a higher risk of having poor glycaemic control than patients of the male gender (adjusted OR = 1.33; 95% CI = 1.07, 1.87, P = 0.032). A study from Kerala also found that female more than double risk of poor glycaemic control than male.[13] This phenomenon of women having less optimal glycaemic control was observed across the world.[27–30] A Swedish study, however, discovered that women had better glycaemic control than men.[31] According to a study by Kautzky-Willer et al.,[32] diabetic women are more likely than diabetic men to be overweight or obese. The risk of sex-dimorphic diabetes is influenced by these gender-specific differences in body mass and composition.[32]

Poor medication adherence (skipping any dose of prescribed antidiabetic medications in the previous one week) was found to be a risk factor against achieving better glycaemic control when the relationship between drug compliance and glycaemic control was examined (adjusted OR = 1.52, 95% CI = 1.16, 2.72, P = 0.022). Other studies have also found similar inverse relationship between glycaemic control and medication adherence.[33,34] According to a study by Kirkman et al., adherence increased with age.[34] This may be one of the reasons for better glycaemic control in cases with longer duration of disease. This is likely due to survival bias. Due to diabetic complications, people with poor adherence and poor glycaemic control may face more complication of diabetes and may not have lived to an older age.

Compared to diabetics receiving OHA or Insulin treatment alone, those receiving combined insulin and OHA treatment had a higher risk of developing uncontrolled hyperglycemia (adjusted OR = 2.21, 95% CI = 1.48, 3.96, P = 0.017). This result is consistent with those of the multicentric ICMR-INDIAB study, which showed that using insulin increased the risk of having insufficient glycaemic control. This result was also supported by a randomised controlled trial that was conducted among the Dutch population.[35,36] This could be as a result of the general practise of delaying the start of insulin therapy until after patients have tried every oral anti-hyperglycaemic medication on the market. Consequently, patients who use combined insulin and OHA have more severe and difficult-to-control hyperglycemia, and these people have worse glycaemic control than those who receive other forms of treatment.

High Perceived stress level was found to be associated with poor glycaemic control in the present study. (adjusted OR = 2.82, 95% CI = 1.62, 7.14). Studies regarding the influence of stress from work on glycaemic control show that stress influences glycaemic control.[37,38] However, one could argue that the association may be because poor glycaemic control become reason for stress in diabetic patient. A prospective study[39] and a meta-analysis[40] claim that stress not only negatively affect glycaemic control but also increases risk of development of Type 2 Diabetes:

This is community based large and comprehensive study that has been carried out in the representative sample of the entire city in western India. It is one of the very few population-based studies conducted in this part of the country to estimate glycaemic control among T2DM. However, the study also has certain limitation. Certain information related to personal history and family history were based on the patients' ability to recall information. So, certain level of recall bias cannot be entirely ruled out. In the study field workers have referred diabetic cases to the health centre. So, location of centre, distance from patients' home, availability of transportation, working hour of the centre and other environmental factors may affect the reporting of the referred cases to the centres.

CONCLUSION

The study concludes that there are a high proportion of patients with poor glycaemic control among diabetic patients. This emphasises the need to build awareness regarding glycaemic control so that they remain protected from the effects of the potentially avoidable glycaemic burden. Certain modifiable risk factors like higher BMI, poor drug adherence and higher stress level leads to poor glycaemic control. Diabetic persons should be encouraged and helped to keep their weight within normal limit. Qualitative research required to find out important reasons for poor drug adherence and higher perceived stress

among diabetic which will help to develop interventions to tackle poor drug adherence and stress.

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