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ABOUT COVER

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AIM AND SCOPE

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INDEXING/ABSTRACTING

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ORIGINAL ARTICLE

Observational Study

Adherence to self-care practices, glycemic status and influencing factors in diabetes patients in a tertiary care hospital in Delhi

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Abstract

AIM
To assess the adherence to self-care practices, glycemic status and influencing factors in diabetes patients.

METHODS
This was a cross-sectional observational analysis of baseline data from a quasi-experimental study conducted among 375 diabetic patients aged between 18 to 65 years at a major public tertiary care centre in New Delhi, India during February-September' 2016. The Summary of Diabetes Self-care activities measure was used to assess medical adherence in diabetic patients. Open ended questions were used to identify facilitators and inhibitors of medical adherence.

RESULTS
Mean age of the study subjects was 49.7 ± 10.2 years. A total of 201 men and 174 women were enrolled in the study. Three hundred nine (82.4%) subjects were adherent to their intake of anti-diabetic medication. On binary logistic regression, education level below primary school completion and absence of hypertension

comorbidity were found to be independent predictors of medication non-adherence. Sociocultural resistance was an important factor impeding outdoor exercise among younger women. Knowledge of diabetes in the study subjects was low with mean score of 3.1 ± 2 (maximum score = 10). Suboptimal glycemic control was found in 259 (69%) subjects which was significantly more likely in patients on Insulin therapy compared to those on Oral Hypoglycemic agents alone ($P < 0.006$).

DISCUSSION

Our study found a large gap existed between self-reported medication adherence and glycemic control. This suggests the need for enhanced physician focus for diabetic patient management.

Key words: Diabetes; Adherence; Glycemic control; Insulin; India

Core tip: A cross sectional analysis was conducted in 375 adult diabetic patients in the outpatient settings of a major tertiary care government hospital in Delhi (2016). A total of 309 (82.4%) subjects reported are adherent to their prescribed anti-diabetic medication. However, optimal glycemic control was achieved by only 116 (31%) subjects. These findings suggest the presence of a high burden of clinical inertia. Furthermore, patients on insulin therapy despite reporting higher medication adherence comprised a significantly higher proportion with suboptimal glycemic control compared to those are not on insulin therapy indicating the need to effectively validate patient administration of insulin.

INTRODUCTION

Diabetes is a chronic noncommunicable disease characterized by the phenotype of hyperglycemia which afflicts an estimated 69 million people in India, the second highest burden in the world after China[1]. It is well established that the lowering of blood glucose levels prevents or delays diabetic microvascular and macrovascular complications of diabetes[2,3]. Achieving and maintaining optimal blood glucose levels in diabetic patients requires good medical adherence in terms of medication, diet, physical activity while ensuring regular foot-care protects against foot-ulcer and complications like amputation[4-7].

Nevertheless, poor adherence to self-care pra-

ctices in diabetes persists as a major public health challenge globally[8]. Non-adherence in taking anti-diabetic medication in diabetic patients can occur from to unintentional factors like irregular access to oral hypoglycemic agents and Insulin[8-10]. Intentional factors which lower medication adherence include increasing complexity of regimen, fear of side effects of drugs and lack of patient perceived benefit from taking medication[11-13]. Non-adherence to treatment recommendations worsen clinical parameters, risk poor patient outcomes and only permit suboptimal benefit of treatment[6,14]. This necessitates ascertaining the burden of non-adherence to self-care practices and influencing factors in diabetes patients attending public health facilities in India. The study was thereby conducted with the objective of assessing the extent of adherence to self-care practices including medication intake and the influencing factors among diabetic patients undergoing treatment in a tertiary care hospital in Delhi.

MATERIALS AND METHODS

This was a cross-sectional observational analysis of baseline data from a quasi-experimental study conducted at the Diabetes and the Endocrinology OPDs of a major tertiary care government hospital in Central Delhi during the period from February 2016 to September 2016. Over a 1000 diabetes patient attend the OPD clinics of the hospital every week. All the prescribed diabetes related medication is provided free of cost at the hospital with refill required every 2 wk. At the time of initiation of treatment, the patients are provided dietary counselling from a dietician at the hospital while the other self-care practices are explained by the treating physician only. Furthermore, dietary counselling may be repeated in patients showing suboptimal glycemic control at the discretion of the treating physician.

Diabetic patients aged between 18 to 65 years and on diabetes treatment for at-least 1 year were included while those with serious comorbid ailments (advanced cardiovascular disease, history of cardiovascular accident, renal failure requiring dialysis, cancer, patients on psychotropic drugs, dementia and blindness) were excluded from the study. The primary outcome of this study was medication adherence which was assessed by the medication subscale of the Summary of Diabetes Self-care activities measure (SDSCA)[15]. The license to use the SDSCA was obtained. Based on 2 previous studies, daily medication adherence equating no missed doses in any of the previous 7 d (SDSCA medication score = 7) in an urban Indian hospital-clinic setting was expected to be 60%[16,17]. The sample size at 95% confidence levels and 5% absolute margin of error calculated by the Cochran formula, $(1.96^2 \times 0.6 \times 0.4)/0.05^2 = 369$. The patients were selected consecutively with a maximum of 12 patients being enrolled in a clinic day. Data was collected using a pretested patient interview schedule. Pretesting was conducted among 25 subjects at the medical OPD of a secondary care hospital in Delhi.

Table 1 Distribution of medical adherence in diabetes patients, Delhi, 2016 (*n* = 375)

Medical Adherence in study subjects (in previous 7 d)	mean ± SD (d)
Medication adherence	6.25 ± 1.5
Adhering to a healthy eating plan	5.22 ± 1.2
Consuming ≥ 1 portion of green vegetables	3.25 ± 3
Consuming ≥ 1 portion of fruits	1.8 ± 1.8
Practicing carbohydrate spacing	4.87 ± 1.2
Exercising for at-least 30 min in a day	2.25 ± 2.5
Engaged in moderate physical activity as part of work, travel or household chores for at least 10 min continuously	4.42 ± 2.1
Foot inspection	0.14 ± 0.58

The diagnosis of diabetes, clinical characteristics and treatment details were validated from the patient medical records. Adherence to self-care practices in the patients was assessed using the SDSCA during the period preceding 7 d from the day of enrolment. The items of the questionnaire were translated into the local language, Hindi through a validated back and forth translation process. The subjects who reported missing their anti-diabetic medications on at-most 1-d in the previous 7 d equivalent to ≥ 80% medication rate were classified as adherent to their prescribed anti-diabetic medication. The subjects who reported adherence to a healthy diet on at-least 5 d were classified as adherent to diet. The subjects who reported engaging in moderate physical activity as part of work, travel or household chores for at-least 150 min interspersed over 3 to 5 d were classified as adherent to physical activity. Open ended questions were used to identify facilitators and inhibitors of medical adherence.

The cut-off for optimal glycemic control in the present study was accepted at fasting blood glucose levels ≤ 130 mg/dL as per the recommendations of the American Diabetes Association[18]. The knowledge of diabetes in the patients was assessed using the 10 item Spoken Knowledge in Low Literacy in Diabetes Scale by Rothman *et al*[19]. The socioeconomic status of the subjects was assessed using the modified Kuppuswamy classification updated for 2016 income criteria[20].

Statistical analysis
Data was analysed using IBM SPSS Version 17. Analytical tables were used for depicting bivariate associations. The association between categorical variables was assessed using the χ^2 test and continuous variables using the Student *t* test. *P* value < 0.05 was considered as statistically significant. The variables which were significantly associated with medication non-adherence ($P \leq 0.05$) were included in a step-wise binary logistic regression model. The final model was tested for goodness-of-fit by the Hosmer-Lemeshow test.

RESULTS
A total of 375 diabetic patients were enrolled in the study.

Patient characteristics
On univariate analysis, the mean age of the study subjects was 49.7 ± 10.2 years (mean ± SD). The study sample comprised of 201 (53.6%) men and 174 (46.4%) women. The educational status of the majority of the subjects was low with 132 (35.2%) educated below primary, 105 (28%) with 5-9 years of schooling and 138 (36.8%) with ≥ 10 years of schooling. The Socioeconomic Status of the study participants classified as per the updated modified Kuppuswamy scale was upper (2.1%), upper middle (22.4%), lower middle (53.3%), upper lower (21.3%) and lower (0.8%). The median duration of diabetes in the study participants was 5 years.

Adherence to self-care practices
The medication adherence and self-care practices of the study subjects as per the SDSCA measure is reported in Table 1.

Medication: A total of 309 (82.4%) subjects were adherent to the intake of their prescribed anti-diabetic medication (SDSCA medication score ≥ 6) while 66 (17.6%) were non-adherent. Among the adherent subjects, 254 (67.8%) reported missing none of their prescribed anti-diabetic medication on any occasion in the previous 7 d while 55 (14.2%) reporting missing their dose on only a single day. Among the reasons for medication non-adherence, 96 (25.6%) reported missing doses due to forgetfulness while 75 (20%) subjects reported self-modification of drug dosage depending upon their symptoms and sense of well-being.

Facilitators for good medication adherence observed in the study subjects were perceived benefits; "Taking medications on time keeps me well", higher self-efficacy "First medicine, then roti (bread)", "I may forget taking food but not my medicine" and the presence of family support "My daughter/daughter in law bring forth my medicines before me exactly on time". In this regard, family assistance in terms of help in remembering medication was reported by 52 (13.9%) subjects. Moreover, 42 (35.6%) subjects on insulin therapy were receiving assistance from a family member in administration of insulin.

On bivariate analysis, low education level (below primary school completion), living in joint family, patient not on insulin therapy, absence of hypertension comorbidity and lack of family assistance for taking medication were found to be significantly associated

with medication non-adherence (Table 2).

A binary logistic regression analysis was performed to assess the effects of education level, family type, insulin therapy, hypertension comorbidity and family assistance for taking anti-diabetic medication on the likelihood that the patients reported non-adherence to their anti-diabetic medication. The logistic regression model was statistically significant ($P < 0.001$) and the model correctly classified 82.4% of cases. Of the five predictor variables, only two (education level and hypertension comorbidity) were statistically significant (Table 3). Diabetic patients without hypertension comorbidity had 2.6 higher odds of reporting non-adherence to their anti-diabetic medication compared to hypertensives.

Diet: Most (84.6%) subjects reported adhering to a healthy diet prescribed for managing diabetes. However, consumption of green vegetables and fruits was low in the subjects (Table 1).

Physical activity and exercise: A total of 254 (67.7%) subjects reported low levels of physical activity. Female gender, living in joint family and low educational level (below primary school completion) were significantly associated with lower physical activity (Table 2). Furthermore, among female subjects below 40 years of age ($n = 28$), only 3 (10.7%) were exercising for the recommended duration while 9 (36%) attributed their inability to exercise to the prevailing sociocultural resistance in their communities which deterred them from exercising outdoors.

Monitoring of blood glucose: Only 66 (17.6%) subjects reported possession of a personal and functional glucometer which precluded regular self-monitoring of blood glucose in most subjects.

Foot-care practices: Most subjects did not inspect their feet for lesions even once a week (Table 1). Most (92.7%) subjects trimmed their toe nail straight. Although, 325 (86.6%) subjects reported washing their feet daily only 54 (14.4%) were cleaning and drying between the toes afterward.

Glycemic control
The mean HbA1c in the subjects was 8.39 ± 2.0 ($n = 354$). Only 116 (31%) subjects showed optimal glycemic control (FBS $\leq$ 130 mg/dL). On bivariate analysis, insulin therapy was found to be significantly associated with suboptimal glycemic control ($P = 0.006$). The subjects who reported receiving family support for adhering to a recommended healthy diet were significantly more likely to exhibit good glycemic control ($P = 0.035$). The proportion of women with suboptimal glycemic status was more compared to men but the different was not statistically significant (Table 4).

Knowledge of diabetes in the study subjects was low with mean score of 3.1 ± 2 (maximum score = 10). The knowledge score was significantly lower in patients with low education level (below primary school) compared to those educated beyond primary school ($P < 0.001$). However, the knowledge scores did not differ significantly among subjects with medication non-adherence or in those showing suboptimal glycemic control.

DISCUSSION

Diabetes has been described as a "whole life disease" since its successful management requires patients to effectively modulate several aspects of their daily living which forms the basis of diabetic self-management[21]. Our study found nearly four-fifth of the subjects reporting being adherent to their medications (SDSCA medication score $\geq$ 6). This is lower than a study in a government health facility in Puducherry that reported 95.6% diabetic patients being adherent to their medications which also used the SDSCA assessment method[22]. A previous study in government hospitals of Delhi by Basu *et al*[10] found nearly three-fourth of the diabetic subjects showing good medication adherence assessed by the MMAS-8 scale. In our study, no missed anti-diabetic medication doses in the previous 7 d signifying daily medication adherence was reported by nearly two-third of the subjects (67.4%). The rates of daily medication adherence among diabetes subjects found in our study (67.8%) are higher compared to two South Indian clinic-based studies which reported 60% daily medication adherence rate[16,17].

In contradiction to previous studies, low socioeconomic status was not found to be associated with medication non-adherence in the present study[9,10]. However, our study found low educational level limited to primary school was an independent predictor of medication non-adherence while also associated with lower patient knowledge of diabetes.

Our study found hypertensive patients to be significantly more adherent to their anti-diabetic medications which could be on account of perception of increased susceptibility to disease and perceived benefit of medications in the comorbid patients.

A majority of the subjects are in our reported low physical activity and exercise levels. Apart from medical conditions like joint arthritis, environmental and sociocultural factors can also impede the levels of physical activity in diabetic populations[23]. Environmental barriers like paucity of open public recreational spaces is known to undermine exercising behavior especially among low income groups[24]. Similarly, the catchment areas of the health facility in the present study had a high population density with few public parks providing limited avenues for exercising. Furthermore, our study also found a high proportion of younger women reporting sociocultural resistance in their communities against engaging in outdoor exercise. This finding is in agreement with a previous study which reported the possibility of women being made uncomfortable and being judged by those

Table 2 Patient characteristics and association with medical non-adherence n (%)

Variable	Total (n = 375)	Medication non-adherence (n = 66)	Dietary non-adherence (n = 58)	Physical activity non-adherence (n = 253)
Age (yr)				
< 50	168 (44.8)	29 (17.2)	28 (16.6)	109
≥ 50	207 (55.2)	37 (17.8)	30 (14.5)	144
Gender				
Men	201 (53.6)	31 (15.4)	36 (18)	114 (56.7)[b]
Women	174 (46.4)	35 (20.1)	22 (12.6)	139 (80)
Education (yr)				
< 5	132 (35.2)	33 (25)[a]	21 (16)	101 (76.5)[b]
≥ 5	243 (64.8)	33 (13.5)	37 (15.2)	152 (62.5)
SES				
Upper-upper middle	92 (24.5)	14 (15.2)	14 (15.2)	56 (61)
Lower middle	200 (53.4)	34 (17)	27 (13.5)	137 (68.5)
Upper lower-lower	83 (22.1)	18 (21.7)	17 (20.5)	60 (72.3)
Family type				
Joint	289 (77)	58 (20)[a]	46 (16)	204 (70.5)[a]
Nuclear/alone	86 (23)	8 (9.3)	12 (14)	49 (57)
DM duration (yr)				
≤ 5	205 (54.7)	37 (18)	34 (16.6)	130 (63.4)
> 5	170 (45.3)	29 (17)	24 (14.1)	123 (72.3)
Hypertension				
Present	191 (51)	22 (11.5)[b]	29 (15.2)	126 (66)
Absent	184 (49)	44 (24)	29 (15.7)	127 (69)
Insulin therapy				
Present	118 (31.5)	12 (10.2)[a]	20 (17)	78 (66.1)
Absent	257 (68.5)	54 (21)	38 (14.8)	175 (68)
Family assistance with medication				
Present	71 (19)	7 (9.8)[a]		
Absent	304 (81)	59 (19.4)	-	-
Family help with diet				
Present	89 (23.7)	-	8 (9)	-
Absent	286 (76.3)		50 (17.5)	

[a]$P < 0.05$; [b]$P < 0.01$.

Table 3 Logistic regression analysis determining factors associated with non-adherence to anti-diabetic medication (n = 66)

Predictor variable	Odds ratio[1]	95%CI	P value
Education < 5 yr	2.06	1.1-3.6	0.01
Living in nuclear family	2.1	0.95-4.8	0.06
Insulin therapy	1.7	0.83-3.5	0.14
Absence of hypertension comorbidity	2.6	1.4-4.6	0.001
Family assistance for taking medication	0.56	0.23-1.3	0.2

[1]Adjusted odds with other predictor variables controlled.

around them when they tried exercising outdoors[25]. In this regard, community directed sociocultural resistance which restricts movement of women in public spaces should also be recognized as a public health challenge. While long term efforts should be concentrated upon reducing such bias and discrimination against women in society, the short-term recommendations for exercise should take cognition of the prevailing social reality.

Foot care in our diabetic subjects was very poor compared to the findings of other Indian studies which predispose them to risk of foot ulcerations. This necessitates imparting regular health education regarding appropriate foot-care to diabetic patients at the clinics.

Similar to our study, Kassahun *et al*[26] also observed higher fasting blood glucose levels in patients on Insulin therapy. However, in the present study, participants on Insulin reported higher medication adherence compared to those on oral hypoglycemic agents alone ($P \leq 0.05$). Such a finding was also reported in a previous Delhi study[10]. These finding could result from several factors like delayed initiation of Insulin therapy, a high burden of insulin resistance, improper insulin application practices or inadequate insulin intake along with the overestimation of insulin adherence.

In conclusion, our study explored aspects of medication adherence and self-care practices in a diabetic population predominantly belonging to the lower socioeconomic classes undergoing treatment in a major tertiary care public health facility in Delhi. Our study findings have the following important implications: (1)

Table 4 Patient characteristics associated with suboptimal glycemic control *n* (%)

Variable	Total (*n* = 375)	Suboptimal glycemic control (*n* = 259)	*P* value
Age (yr)			
≤ 50	168 (44.8)	118 (70.2)	0.74
> 50	207 (55.2)	141 (68.1)	
Gender			
Men	201 (53.6)	131 (65.1)	0.09
Women	174 (46.4)	128 (73.5)	
Education (yr)			
< 5	132 (35.2)	96 (72.7)	0.29
≥ 5	243 (64.8)	163 (67)	
SES			
Upper/upper middle	92 (24.5)	57 (62)	
Lower middle	200 (53.4)	143 (71.5)	0.24
Lower middle/lower	83 (22.1)	59 (71)	
Family type			
Joint	289 (77)	205 (71)	0.18
Nuclear/alone	86 (23)	54 (62.8)	
DM duration (yr)			
≤ 5	205 (54.7)	136 (66.3)	0.22
> 5	170 (45.3)	123 (72.3)	
Hypertension			
Present	191 (51)	130 (68)	0.74
Absent	184 (49)	129 (70)	
Insulin therapy			
Present	118 (31.5)	93 (79)	0.006
Absent	257 (68.5)	166 (64.6)	
Family help with diet			
Present	89 (23.7)	53 (59.5)	0.035
Absent	286 (76.3)	206 (72)	
Medication adherence			
Non-adherent	66 (17.6)	55 (83.3)	0.005
Adherent	309 (82.4)	204 (54.4)	

Our study found more than four-fifth of the diabetic subjects undergoing treatment from outpatient settings of a government health facility which provides free of cost medication were adherent to their anti-diabetic medication which corroborates the observations in previous studies from similar health facilities[10,22]. It is also well established that the inability to acquire medications due to economic constrains significantly reduces medication adherence[6,8,9]. Expanding coverage of medications to all diabetic patients for achieving universal health coverage should be the primary concern for India's national program for prevention and control of non-communicable diseases including diabetes; (2) The inability to realize optimal glycemic control status despite high levels of self-reported medication adherence was found to be a major challenge for a large number of the study subjects. In our study, 82% subjects were adherent to their anti-diabetic medications but only 31% showed optimal glycemic control. There are few studies in India which have reported both medication adherence and glycemic control in diabetic populations. This high medication adherence-suboptimal glycemic control gap was also previous seen in a Delhi study[10] although not found in a Chennai study[16]. This phenomenon is suggestive of the presence of a high burden of clinical inertia defined as "resistance to initiate or intensify treatment in a patient not at the evidence-based glycated hemoglobin goal"[27]. In developing nations, clinical inertia leading to accumulation of glycemic burden is often due to delayed initiation of insulin therapy arising from both patient and health system related factors[28]. A dual burden of clinical inertia and medication non-adherence may further accelerate the worsening of health outcomes in diabetics. Enhanced physician focus is recommended for diabetic patients showing persistently suboptimal glycemic control despite good self-reported medication adherence. Future studies should also identify the factors driving clinical inertia during diabetes management in such resource-constrained settings. Furthermore, developing interventions for overcoming the barriers and challenges which drive clinical inertia and hinder the achievement of optimal glycemic control and positive health outcomes are urgently warranted; (3) Family support can facilitate medical adherence relating to medication intake, diet and physical activity in patients. Enlisting familial support when available should be prioritized by physicians especially in patients with poor health literacy; (4) Our study findings are indicative of the presence of high burden of poor diabetes knowledge associated with low educational status. Developing effective health education and patient communication strategies by mobilizing paramedical health workers including nurses and pharmacists esp-

ecially in health settings with high patient load need prioritization; and (5) Existing medication adherence scales like the SDSCA may overestimate insulin adherence. This phenomenon could be explained as an outcome of self-desirability bias or the tendency of patients to over-report adherence in order to satisfy the interviewer and shield themselves from the anticipated criticism or guilt of failing to comply with the physician or healthcare provider's recommendations. Moreover, standard (generic) medication adherence scales do not assess the validity of the patient execution of the steps of insulin administration which constitutes a significant determinant of insulin adherence[29]. A need is perceived for development of specific scales for assessment of insulin adherence with higher reliability and validity especially in low-literacy populations.

Our study has certain limitations. First, the cross-sectional analysis did not permit observation of the trend of patient adherence towards self-care practices and glycemic control status over time. Second, geriatric patients over 65 years of age were excluded and the results cannot be generalized to them despite the high risk of non-adherence in older populations[30]. Third, the interrelationship among the categorical variables could influence results of the logistic regression analysis due to multicollinearity.

ARTICLE HIGHLIGHTS

Research background
Nearly 80% of the global burden of diabetes is concentrated in the developing world. India has 69 million diabetic patients which is the second highest in the world after China. Management of diabetes requires lowering of blood glucose to optimal levels to prevent or delay the onset of diabetic complications which risk end organ damage. Patient adherence to anti-diabetic medication, healthy diet, and regular physical activity constitutes the mainstay of diabetes treatment. However, poor treatment adherence is a major public health challenge globally but especially in the resource-constrained settings concentrated in the developing world which undermines efforts in controlling diabetes. A complex array of factors influences medical adherence and glycemic control in diabetes patients.

Research motivation
There is paucity of evidence ascertaining the determinants of treatment adherence and glycemic control in diabetes patients attending public health facilities in the developing world.

Research objectives
The study was conducted with the objective of assessing the extent of adherence to self-care practices including medication intake and the influencing factors among diabetic patients undergoing treatment in the outpatient setting of a tertiary care hospital in Delhi. Understanding the determinants of medical adherence through this study would facilitate engineering tailored interventions promoting medical adherence and improved health outcomes among diabetic patients in resource-constrained settings.

Research methods
Diabetic patients aged between 18 to 65 years and on diabetes treatment for at-least 1 year were included while those with serious comorbid ailments (advanced cardiovascular disease, history of cardiovascular accident, renal failure requiring dialysis, cancer, patients on psychotropic drugs, dementia and blindness) were excluded from the study. The patients were selected consecutively with a maximum of 12 patients being enrolled in a clinic day. Data

was collected using a pretested patient interview schedule. The Summary of Diabetes Self-care activities measure (SDSCA) by Toobert *et al* was used to assess medical adherence in the diabetic patients. Open ended questions were used to identify facilitators and inhibitors of medication, exercise and dietary adherence. The subjects who reported missing their anti-diabetic medications on at-most 1-d in the previous 7 d equivalent to ≥ 80% medication rate were classified as adherent to their prescribed anti-diabetic medication. The subjects who reported adherence to a healthy diet on at-least 5 d were classified as adherent to diet. The subjects who reported engaging in moderate physical activity as part of work, travel or household chores for at-least 150 min interspersed over 3 to 5 d were classified as adherent to physical activity. The cut-off for optimal glycemic control in the present study was accepted at fasting blood glucose levels ≤ 130 mg/dL. The knowledge of diabetes in the patients was assessed using the 10 item Spoken Knowledge in Low Literacy in Diabetes Scale by Rothman *et al*.

Research results
A total of 309 (82.4%) subjects were adherent to the intake of their prescribed anti-diabetic medication (SDSCA medication score ≥ 6) while 66 (17.6%) were non-adherent. Among the adherent subjects, 254 (67.8%) reported missing none of their prescribed anti-diabetic medication on any occasion in the previous 7 d while 55 (14.2%) reporting missing their dose on only a single day. On bivariate analysis, low education level (below primary school completion), living in joint family, patient not on insulin therapy, absence of hypertension comorbidity and lack of family assistance for taking medication were found to be significantly associated with medication non-adherence. On adjusted analysis, low education level (below primary school completion) and absence of hypertension comorbidity were found to be significant predictors of medication non-adherence. A total of 254 (67.7%) subjects reported low levels of physical activity. Female gender, living in joint family and low educational level (below primary school completion) were significantly associated with lower physical activity. The mean HbA1c in the sample population was 8.39 ± 2.0 (*n* = 354). Only 116 (31%) subjects showed optimal glycemic control (FBS ≤ 130 mg/dL). On bivariate analysis, insulin therapy was found to be significantly associated with suboptimal glycemic control (*P* = 0.006). Knowledge of diabetes in the study subjects was low with mean score of 3.1 ± 2 (maximum score = 10). The knowledge score was significantly lower in patients with low education level (below primary school) compared to those educated beyond primary school (*P* < 0.001).

Research conclusions
Our study found a large gap exists between the self-reported medication adherence (82.7%) and attainment of optimal glycemic control (31%) patients. These findings suggest the possibility of significant clinical inertia prevalent in the study setting. A dual burden of medication non-adherence and clinical inertia could undermine efforts in effective diabetes management in the resource-constrained settings of the developing world. Understanding the factors driving clinical inertia in these settings requires assessment through future studies. The present study also found patients on Insulin tend to report higher medication adherence but show suboptimal glycemic control compared to patients only on oral hypoglycemic agents. This indicates overestimation of insulin adherence when based on single item self-report measures. Future studies should assess insulin adherence through self-report based on correctness of the steps executed in the process of insulin administration. In this study, family support was found to improve medication adherence and adoption of healthy lifestyle. This indicates the need of the treating physician to enlist valuable family support whenever available for the diabetic patient.

Research perspectives
The study shows improving medication adherence in diabetic populations does not necessarily correlate with improvement in glycemic status due to the possibility of clinical inertia which requires reduction through enhanced physician focus on patient outcomes.

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