

## A Survey on Factors Affecting Knowledge and Satisfaction with Care Among Persons with Diabetes Mellitus in an Urban Health Centre and its Outreach Clinics in South India

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### Abstract

**Objective.** To determine the level of knowledge and factors affecting knowledge and satisfaction with diabetes care among persons with diabetes at urban health centre (UHC) and community health worker (CHW)-led outreach clinics (ORC) in South India.

**Methodology.** A cross-sectional study was carried out using a structured questionnaire. One hundred patients at the UHC and 200 patients at the ORC were included.

**Results.** Patients with DM of more than eight years, with co-morbidities and maintained on insulin had good knowledge at the UHC. At the ORC, participants who received education beyond the primary level and belonging to non - Hindu religion had higher knowledge. Patients at the ORC experienced better satisfaction in terms of waiting time for appointments, consultation, registration system and counselling. At the UHC, those who received primary education or those with lower educational attainment had better satisfaction. Overall, knowledge ( $p = 0.03$ ) and satisfaction ( $p = 0.00001$ ) of diabetes care was better at the ORC than at the UHC.

**Conclusions.** Our study found better knowledge and satisfaction with diabetes care at the ORC than at the UHC. Whether or not the difference can be attributed to CHW-based clinics in the community needs to be further elucidated.

**Key words:** community health workers, primary health care, knowledge, satisfaction, diabetes

### INTRODUCTION

Diabetes mellitus is a rising epidemic in South-East Asia and in India in particular. In 2021, the worldwide number of people with diabetes has been estimated to be 536.6 million. India has 74.2 million people with diabetes and the number is estimated to rise to 124.9 million by 2045.<sup>1</sup> The International Diabetes Federation reports that one in seven adults with diabetes come from India.<sup>1</sup> The median annual direct and indirect costs for diabetes care in India is estimated at 25,391 INR (\$525.5) and 4970 INR (\$102.8), respectively.<sup>2</sup>

Comprehensive management of diabetes involves active participation of patients in making significant lifestyle modifications.<sup>3</sup> Medication adherence, treatment compliance, self-monitoring of blood sugar and follow-up with their physicians entail long-term commitment from patients and their families.<sup>4</sup> Adherence is the degree to which the person's behavior is consistent with the

recommendations and compliance is the extent to which a patient's behavior matches the prescriber's advice.<sup>5</sup> These self-care behaviors are found to be associated with improved glycemic control and reduction in the incidence of complications.

The cognitive evaluation of whether or not a treatment regimen meets the patient's subjective expectations is termed as treatment satisfaction, which may influence treatment adherence in patients with diabetes.<sup>6</sup> A Palestinian study documented that patients with moderate satisfaction had greater adherence to medication and had better quality of life.<sup>7</sup> Treatment adherence has also been found to be related to patient-provider communication. Poor communication was found to be associated with inadequate medication adherence, particularly for oral hypoglycemics.<sup>8</sup>

Knowledge related to diabetes is important to improve self-care and self-monitoring of blood sugar among patients with diabetes. However, poor knowledge of the

risk factors for developing diabetes is well documented in Indian literature.<sup>9</sup> An Ethiopian study observed that those who were illiterate and had diabetes for less than five years had low knowledge regarding diabetes, thus affecting their compliance and adherence.<sup>10</sup> Other factors found to be associated with poor knowledge of diabetes include age, marital status, occupation and family history of diabetes.<sup>11</sup> A Bangladesh study identified female gender and lower income as factors contributing to the low level of knowledge regarding diabetes.<sup>12</sup> Of the many interventions, health education is one of the proven cost-effective, scalable interventions to improve the knowledge on diabetes in developing countries.<sup>13</sup>

Diabetes care is a significant part of the ambulatory and inpatient services of the urban health centre (UHC) where this study was conducted. About 40% of the out-patient visits to the UHC comprise of care related to diabetes.<sup>14</sup> Nearly 500 patients were admitted during the years 2020-2021 due to diabetes and diabetes-related problems.<sup>15</sup>

The UHC provides primary and secondary level healthcare services to the low-resource urban communities. Outreach clinics (ORCs) were initiated in 2016 to improve accessibility in the low-income areas of the community. The entire population of the community was enlisted by the community health worker (CHW) assigned to the community. Community-based health education sessions are routinely conducted by the CHW and community health nurse (CHN). One assigned team consisting of a physician, CHN, CHW and social worker (SW) provide healthcare services to a particular community. Besides running the weekly clinics, the CHWs screen asymptomatic patients, assess post-hospitalised patients and those who are not compliant to medications.

This study was undertaken to measure the factors associated with the knowledge and satisfaction related to diabetes care at the UHC and ORCs.

## OBJECTIVES

1. To determine the level of knowledge on diabetes among patients with diabetes mellitus attending the UHC and the ORCs.
2. To assess the satisfaction with care among patients with diabetes mellitus attending the UHC and the ORCs.
3. To determine factors associated with adequate knowledge and satisfaction with care among patients with diabetes attending the UHC and the ORCs.

## METHODOLOGY

### Study setting and design

This was a cross-sectional study done at the UHC and ORCs. The UHC is one of the secondary care service units of a private academic tertiary care center, which serves as the former's referral center. The UHC serves a population

of 200,000 hailing from the low-resource urban communities of the town. However, not all patients from these communities seek care at the UHC. The clinical services at the UHC and the ORCs are subsidized by the tertiary care center. The UHC is managed by a team comprising of physicians trained in Family Medicine, Community Medicine, post graduate trainees and junior medical officers.

The UHC has a capacity of 46 inpatient beds, two beds in the labor room and an operating room, and the center also includes laboratory and pharmacy services. It provides daily ambulatory care, weekly antenatal services in addition to the ORCs serving the local urban communities. Approximately 180-200 patients seek healthcare daily in the out-patient department (OPD) at the UHC.

The outreach services involve community engagement through community volunteers. Population demographics and prevalence of non-communicable diseases in the community served by the ORCs are reported by the CHW. A population of nearly 12,000 is served in these communities, of which approximately 1000 of them have one or more non-communicable diseases.

### Sample size and sampling technique

Based on the assumption that at least 50% of the participants have adequate knowledge and are satisfied with the care, a relative precision of 20% was utilized, and the required sample size was calculated using the formula  $4 pq/d^2$ . The sample size was determined to be 100 for each setting. Hence, 100 patients with diabetes from UHC and 200 patients (50 each from different communities) from the ORC were enrolled in the study. They were selected randomly from the list of patients with diabetes seeking care at the UHC or at the ORC. There was no duplication of participants.

### Participants

All adults >18 years of age with diabetes of more than one year duration who were provided care either at the UHC or at the ORC for more than a year were included in the study. Those who were acutely ill were not included in the study.

### Data Sources, measurement and statistical analysis

A structured questionnaire was developed by the investigators. Face-face interviews with eligible participants were conducted by the investigators to capture the data of demographics, knowledge and satisfaction with diabetes care.

The knowledge section had a maximum score of 14 and minimum score of 0. Those whose correct answers were more than 11 ( $\geq 80\%$ ) were considered as having good knowledge, 7-11 (50-79%) as having average knowledge and less than 7 (<50%) as having poor knowledge of diabetes care.

The satisfaction with care section had 8 questions and each question contained 5 responses. Each question had a score of 0 to 4. The maximum possible score was 32 and the minimum was 0. Those scoring 24 and more (>75%) were considered to be satisfied with the care provided to them. Data was collected during the months of March-May 2022.

Data was entered using Epi-Data 3.1 software and analyzed using SPSS version 23. Descriptive statistics were calculated using proportions for categorical variables and means (SD) for continuous variables. Measures of central tendency and SD were calculated for the aggregate scores on knowledge and satisfaction with care. The association of adequate knowledge and satisfaction with care with demographic factors, duration of diabetes, number of visits, presence of complications and type of treatment was calculated using Chi-square test. *P*-value <0.05 was considered to be significant.

### Institutional Review Board Clearance (IRB) and Ethics Committee (EC) Approval

This proposal was approved by the institutional review board and ethics committee-wide IRB Min.No 14502 (OBSERVE) dated 23.02.2022.

## RESULTS

A total of 300 participants with diabetes duration of more than a year were contacted. All participants gave their consent. One hundred patients seeking care at the urban health center (UHC) and 200 patients from the outreach clinics (ORC) participated in the study.

The socio-demographic distribution of respondents (Table 1) was almost similar in both settings. There were a greater proportion of Hindus (*p* = 0.005) and those with middle school education (*p* = 0.04) in the ORC and more patients had diabetes of more than 10 years of duration (*p* = 0.02) in the UHC. The mean (SD) age of the participants at the urban health center was 55.08 (10.63) years and the median age was 55 years with a range of 28-80 years. Similarly, the mean (SD) age of the participants from the outreach clinics was 55.24 (11.49) years and the median age was 55 years with a range of 31-93 years.

The mean (SD) years of education of the participants at the UHC was 4.7 (3.88), median of 5.0 with a range of 0-17 years of education. Similarly for the ORC, the mean (SD) years of education was 5.04 (3.81), median of 5.0 with a range of 0-15 years of education. The mean (SD) duration of diabetes among the participants at the UHC was 8.8 (5.89) years, median of 8 years and range of 1-29 years. Whereas, the mean (SD) duration of diabetes among the participants at

**Table 1.** Distribution of respondents according to socio-demographics (N = 300)

Variable	UHC (n = 100), No (%)	ORC (n = 200), No (%)	<i>p</i>
Age in years			
<45	18 (18)	37 (18.5)	0.91
45-60	51 (51)	98 (49.0)	0.74
>60	31 (31)	65 (32.5)	0.79
Sex			
Male	18 (18)	48 (24)	0.24
Female	82 (82)	152 (76)	
Religion			
Hindu	70 (70)	168 (84)	<b>0.005</b>
Others	30 (30)	32 (16)	
Education			
No education	29 (29)	51 (25.5)	0.52
Primary	34 (34)	62 (31.0)	0.60
Middle school	15 (15)	51 (25.5)	<b>0.04</b>
High school	21 (21)	35 (17.5)	0.47
College	1 (1)	1 (0.5)	0.62
Occupation			
Unemployed	65 (65)	129 (64.5)	0.93
Employed	35 (35)	71 (35.5)	
Duration of diabetes in years			
<5	28 (28)	58 (29.0)	0.86
5-10	38 (38)	99 (49.5)	0.06
>10	34 (34)	43 (21.5)	<b>0.02</b>
Diabetes treatment			
OAD	89 (89)	173 (86.5)	0.54
Insulin	11 (11)	27 (13.5)	
Co-morbidities			
Yes	68 (68)	137 (68.5)	0.93
Frequency of clinic visits			
≤5	63 (63)	114 (57.0)	0.32
>5	37 (37)	86 (43.0)	

UHC – Urban Health Center; ORC – Outreach Clinic

the ORC was 7.57 (4.97) years, median of 6 years and range of 1-30 years.

Most of the participants had only one co-morbidity and hypertension was the most common condition in both settings. Other co-morbidities reported were dyslipidemia, mental illness, seizure disorder, rheumatoid arthritis and tuberculosis. The mean (SD) number of visits at the UHC was 5.10 (2.03) with a median of 5 and a range of 0-12 visits. For the ORC, the mean (SD) number of visits was 5.5 (1.85), median of 5 and a range of 2-11 visits.

Knowledge regarding diabetic diet and exercises was good at the UHC. Participants at the UHC had average knowledge regarding the target fasting glucose level, annual screening tests for proteinuria, eye exam, follow-up visit date and medication details. However, they had poor knowledge about the target postprandial glucose value, other annual blood tests (creatinine, HbA1c, fasting lipid profile), foot exam and foot care.

At the ORC, knowledge of diabetic diet was good. Participants had average knowledge regarding exercises, target fasting and postprandial glucose values, annual screening tests for proteinuria, foot exam, eye exam, follow-up visit and medication details. However, poor knowledge on other annual blood tests and foot care was noted.

The participants at the ORC had significantly better knowledge on target fasting and postprandial glucose values ( $p = 0.01$ ,  $0.03$  respectively). They also had better knowledge about annual tests including creatinine, HbA1c (glycated hemoglobin) and cholesterol ( $p = 0.01$ ) than the participants at the UHC as seen in Table 2.

Participants from the UHC with diabetes of more than 8 years duration [ $p = 0.002$ , OR 95% CI = 0.15 (0.04-0.58)], with co-morbidities [ $p = 0.02$ , OR 95% CI = 0.15 (0.02-0.99)] and on insulin [ $p = 0.003$ , OR 95% CI = 0.15 (0.04-0.59)] were found to have good knowledge regarding diabetes care. This was found to be statistically significant (Table 3).

On the contrary, patients from the ORC who received more than primary school education [ $p = 0.0001$ , OR 95% CI = 0.21 (0.10-0.41)] and belonging to non-Hindu religion [ $p = 0.001$ , OR 95% CI = 0.27 (0.12-0.59)] were found to have significantly higher knowledge regarding diabetes care (Table 4).

### Satisfaction with care (Tables 5 and 6)

At the UHC, the patients were satisfied with the explanation given by doctors and pharmacists, the counselling performed by the nurses, and the short waiting time at the pharmacy. About half of them said they would strongly recommend this center to others. However, patients at the UHC had longer waiting times to get an appointment and to be seen by doctors. Only two-thirds of them were satisfied with the registration system.

At the ORC, waiting time to get an appointment or to see the doctor was much shorter, similar to the waiting time at the pharmacy. Patients were satisfied with the registration system, the explanation by the doctors and pharmacists and the counselling by the nurses. The majority of them said they would strongly recommend the clinic to others.

Satisfaction with care at the ORC was significantly better in terms of waiting time for appointments ( $p = 0.00001$ ), doctor consultation ( $p = 0.00001$ ), the registration system (0.00001), and counselling by the nurse ( $p = 0.01$ ). A higher number of patients were willing to recommend diabetes care services to others (0.00001).

There was no significant difference in satisfaction with regards to the explanation by the doctors and the pharmacists and the waiting time at the pharmacy between the UHC and the ORC (Table 5).

At the UHC, patients with primary school education or with lower educational attainment were found to have higher satisfaction with care. This was statistically significant [ $p = 0.003$ , OR 95% CI = 4.15(1.59-10.84)]. There was no

**Table 2.** Knowledge regarding diabetes care at the UHC/ORC\* (N = 300)

Knowledge questions – Do you know about	UHC (n = 100)	ORC (n = 200)	Z-score	p
	No (%)	No (%)		
Diabetic diet	94 (94)	194 (97)	1.25	0.21
Exercises	85 (85)	155 (77.5)	1.53	0.13
Fasting glucose target value	59 (59)	147 (73.5)	2.55	<b>0.01</b>
Postprandial glucose target value	42 (42)	111 (55.5)	2.21	<b>0.03</b>
Annual blood tests – does not know any tests	14 (14)	31 (15.5)		
Knows only one test	51 (51)	87 (43.5)		
Knows only two tests	22 (22)	31 (15.5)		
Knows all three tests (Creatinine/HbA1c/Fasting lipid profile)	13 (13)	51 (25.5)	2.49	<b>0.01</b>
Urine test for proteinuria	56 (56)	102 (51)	0.82	0.41
Annual foot exam	42 (42)	108 (54)	1.96	0.05
Foot care	44 (44)	81 (40.5)	0.58	0.56
Annual eye exam	66 (66)	131 (65.5)	0.09	0.93
Follow-up visit date	78 (78)	147 (73.5)	0.85	0.39
Medications taken – knows fully	63 (63)	113 (56.5)	1.08	0.28
Knows Partially	29 (29)	81 (40.5)		
Does not know at all	8 (8)	6 (3)		

UHC – Urban Health Center; ORC – Outreach Clinic

association between other factors and satisfaction with care at the UHC (Table 6).

There was no association between age, gender, religion, education, occupation, duration of diabetes, presence of co-

morbidities, number of clinic visits and type of treatment with satisfaction with care at the ORC.

In both settings, only half of the participants had average knowledge on diabetes care. Majority of the participants

**Table 3.** Factors influencing knowledge of diabetes care at the UHC (N = 100)

Variable	Good knowledge (n = 15), No (%)	Average/Poor knowledge (n = 85), No (%)	X <sup>2</sup> value (p)	Odds ratio (95% CI)
Age in years				
≤55	7 (13.5)	45 (86.5)	0.20 (0.65)	0.78 (0.26-2.34)
>55	8 (16.7)	40 (83.3)		
Sex			<b>0.73 (FE)</b> (0.83)	1.17 (0.29-4.65)
Male	3 (16.7)	15 (83.3)		
Female	12 (14.6)	70 (85.4)		
Religion			<b>0.37 (FE)</b> (0.36)	0.59 (0.19-1.84)
Hindu	9 (12.9)	61 (87.1)		
Others	6 (20.0)	24 (80.0)		
Education			2.19 (0.14)	2.67 (0.70-10.16)
≤Primary school	12 (19.0)	51 (81.0)		
>Primary school	3 (8.1)	34 (91.9)		
Occupation			0.54 (0.46)	1.58 (0.46-5.38)
Unemployed	11 (16.9)	54 (83.1)		
Employed	4 (11.4)	31 (88.6)		
Duration of diabetes			<b>9.28 (0.002)</b>	<b>0.15 (0.04-0.58)</b>
≤8 years	3 (5.4)	53 (94.6)		
>8 years	12 (27.3)	32 (72.7)		
Co-morbidities			<b>0.03 (FE)</b> (0.02)	<b>0.12 (0.02-0.99)</b>
No	1 (3.1)	31 (96.9)		
Yes	14 (20.6)	54 (79.4)		
No. of clinic visits			0.71 (0.40)	0.62 (0.21-1.89)
≤5 times	8 (12.7)	55 (87.3)		
>5 times	7 (18.9)	30 (81.1)		
Diabetes treatment			<b>0.01 (FE)</b> (0.003)	<b>0.15 (0.04-0.59)</b>
OAD	10 (11.2)	79 (88.8)		
Insulin	5 (45.3)	6 (54.5)		

**Table 4.** Factors influencing knowledge of diabetes care at the ORC (N = 200)

Variable	Good knowledge (n = 52), No (%)	Average/Poor knowledge (n = 148), No (%)	X <sup>2</sup> value (p)	Odds ratio (95% CI)
Age in years				
≤55	26 (24.8)	79 (75.2)	0.18 (0.68)	0.87 (0.46-1.64)
>55	26 (27.4)	69 (72.6)		
Sex			2.91 (0.09)	1.83 (0.91-3.69)
Male	17 (35.4)	31 (64.6)		
Female	35 (23.0)	117 (77)		
Religion			<b>11.41 (0.001)</b>	<b>0.27 (0.12-0.59)</b>
Hindu	36 (21.4)	132 (78.6)		
Others	16 (50)	16 (50)		
Education			<b>21.87 (0.0001)</b>	<b>0.21 (0.10-0.41)</b>
≤Primary school	15 (13.3)	98 (86.7)		
>Primary school	37 (42.5)	50 (57.5)		
Occupation			3.48 (0.06)	0.54 (0.29-1.04)
Unemployed	28 (21.7)	101 (78.3)		
Employed	24 (33.8)	47 (66.2)		
Duration of diabetes			0.62 (0.43)	1.29 (0.68-2.44)
≤6 years	30 (28.3)	76 (71.7)		
>6 years	22 (23.4)	72 (76.6)		
Co-morbidities			0.68 (0.41)	0.74 (0.37-1.50)
No	14 (22.2)	49 (77.8)		
Yes	38 (27.7)	99 (72.3)		
No. of clinic visits			0.19 (0.66)	1.16 (0.61-2.19)
≤5 times	31 (27.2)	83 (72.8)		
>5 times	21 (24.4)	65 (75.6)		
Diabetes Treatment			0.87 (0.35)	0.66 (0.28-1.58)
OAD	43 (24.9)	130 (75.1)		
Insulin	9 (33.3)	18 (66.7)		



**Table 5.** Satisfaction with diabetes care at the UHC/ORC (N = 300)

Satisfaction of care	UHC (n = 100) No (%)	ORC (n = 200) No (%)	Z-score	p
No. of days waited for appointment				
4 to >7 days	17 (17)	2 (1)		
2-3 days	39 (39)	17 (8.5)		
1 to <1 day	44 (44)	181 (90.5)	8.77	<b>0.00001</b>
Satisfied with the registration system				
Poor	1 (1)	2 (1)		
Average	31 (31)	20 (10)		
Good/Excellent	68 (68)	178 (89)	4.46	<b>0.00001</b>
Waiting time to see the doctor				
>4 hours	31 (31)	1 (0.5)		
2-4 hours	41 (41)	21 (10.5)		
<2 hours	28 (28)	178 (89)	10.74	<b>0.00001</b>
Explanation of the treatment by doctor				
Poor	1 (1)	0		
Average	8 (8)	11 (5.5)		
Good/Excellent	91 (91)	189 (94.5)	1.15	0.25
Counselling by the nurses				
Poor	3 (3)	1 (0.5)		
Average	15 (15)	15 (7.5)		
Good/Excellent	82 (82)	184 (92)	2.58	<b>0.01</b>
Waiting time at the pharmacy				
>2 hours	0	5 (2.5)		
1-2 hours	12 (12)	22 (11)		
<1 hour	88 (88)	173 (86.5)	0.36	0.72
Explanation of medicines by pharmacist				
Poor	1 (1)	1 (0.5)		
Average	17 (17)	40 (20)		
Good/Excellent	82 (82)	159 (79.5)	0.51	0.61
Recommend to others				
May be	12 (12)	0		
If needed	35 (35)	17 (8.5)		
Strongly recommend	53 (53)	183 (91.5)	7.67	<b>0.00001</b>

**Table 6.** Factors influencing satisfaction with diabetes care at the UHC (N = 100)

Variable	Satisfied (n = 38) No (%)	Not Satisfied (n = 62) No (%)	X <sup>2</sup> value (p)	Odds ratio (95% CI)
Age in Years				
≤55	18 (34.6)	34 (65.4)	0.53 (0.47)	0.74(0.33-1.67)
>55	20 (41.7)	28 (58.3)		
Sex				
Male	5 (27.8)	13 (72.2)	0.97 (0.32)	0.57 (0.19-1.75)
Female	33 (40.2)	49 (59.8)		
Religion				
Hindu	23 (32.9)	47 (67.1)	2.62 (0.11)	0.49 (0.21-1.17)
Others	15 (50.0)	15 (50.0)		
Education				
≤Primary school	31 (49.2)	32 (50.8)	<b>9.08 (0.003)</b>	<b>4.15 (1.59-10.84)</b>
>Primary school	7 (18.9)	30 (81.1)		
Occupation				
Unemployed	29 (44.6)	36 (55.4)	3.45 (0.06)	2.33 (0.94-5.74)
Employed	9 (25.7)	26 (74.3)		
Duration of diabetes				
≤8 years	21(37.5)	35 (62.5)	0.01 (0.91)	0.95 (0.42-2.15)
>8 years	17 (38.6)	27 (61.4)		
Co-morbidities				
No	12 (37.5)	20 (62.5)	0.01 (0.94)	0.97 (0.41-2.31)
Yes	26 (38.2)	42 (61.8)		
No. of clinic visits				
≤5 times	23 (36.5)	40 (63.5)	<b>0.16 (0.69)</b>	<b>0.84 (0.37-1.94)</b>
>5 times	15 (40.5)	22 (59.5)		
Diabetes treatment				
OAD	31 (34.8)	58 (65.2)	<b>0.10 (FE) (0.06)</b>	<b>0.31 (0.08-1.13)</b>
Insulin	7 (63.6)	4 (36.4)		

FE: Fisher's Exact calculated where the expected cell values are less than 5

were satisfied with the care provided at the ORC than at the UHC. The knowledge on diabetes care ( $p = 0.03$ ) and satisfaction with care ( $p = 0.00001$ ) were statistically better at the ORC as compared to the UHC as seen in Figure 1. There is a significant difference in the mean scores of satisfaction with care ( $p = 0.00001$ ) between the UHC and the ORC. There is no significant difference in the mean knowledge scores in both the settings (Figure 2).

**DISCUSSION**

Amidst the rising incidence of diabetes in low-and-middle-income countries, there are challenges in implementing quality diabetes care to large communities due to complex factors. Accordingly, CHW are roped in globally to improve accessibility to diabetes care.<sup>16</sup>

Research on the role of CHWs in the delivery of diabetes care is rapidly accumulating. A systematic review on CHW-led diabetes care concluded that more research is needed to understand the role of CHWs in disease awareness, behavioral change and health outcomes.<sup>17</sup> Our study evaluated the knowledge and satisfaction of diabetes care delivered through CHWs in comparison to those who accessed care for diabetes directly at the UHC in low-resource urban communities.

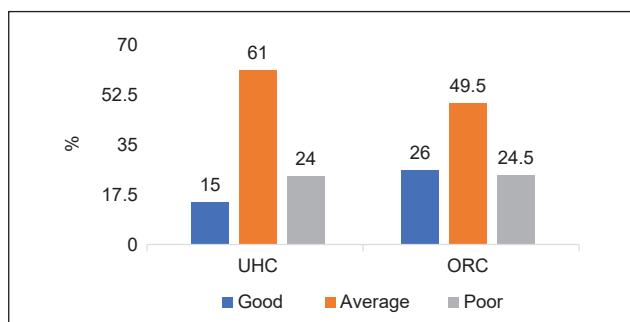
In our study, knowledge and satisfaction of diabetes care was significantly better in the ORCs. Both systems (UHC and ORCs) had similar results in relation to interaction with doctors, nurses and pharmacists. Physician communication was found to improve patient satisfaction in various studies, particularly in primary care practices in Saudi Arabia, Japan and Qatar.<sup>18-20</sup> In addition to physician communication, treatment satisfaction is reported to be associated with receiving guidance on exercise therapy and tailored pharmacological therapy.<sup>20</sup> The system factors of waiting time for registration and consultation with doctors and nurses are found to be better in the ORCs. This is likely to be due to the system of having an assigned team consisting of physicians, CHN, CHWs for each community and the established system of follow-up for patients.

In our system of CHN-supervised, CHW-based diabetes care that is linked to the UHC, the CHWs are the vital link to the community. CHWs engage patients through

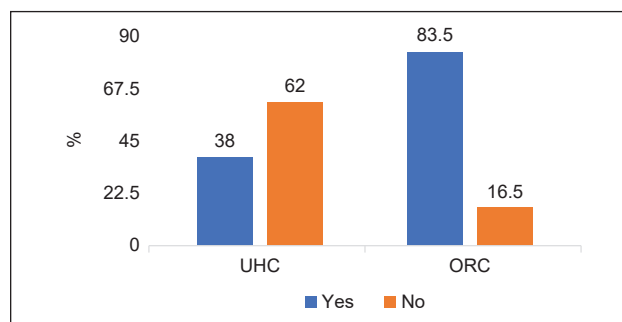
in-person, telephonic and group conversations, and home visits in the community. Besides health education and monitoring of annual screening tests, they assist patients in communicating with physicians about specific needs like footwear or change in treatment regimen and facilitate appointments with physicians and referral to the UHC. The scoping review on CHW-based diabetes care included 54 articles primarily from developed countries.<sup>16</sup> The roles of a CHW are captured in the triad of education, support and advocacy. Our study provides evidence on the role of CHW in improving the knowledge of diabetes care in low-resource communities in developing countries.

Our study found the duration and type of treatment for diabetes and prevalence of co-morbidities of participants at the UHC and the ORCs to be similar. The higher proportion of participants who received more than primary education and who belonged to the Hindu religion in the ORCs is representative of the communities served by the ORCs. It is interesting that the number of visits of participants to the UHC and the ORCs were equal, though ORCs run weekly in the community to improve accessibility. It may not be possible to determine the health-seeking behavior of participants as they may also seek healthcare from government or other private health care systems. A community-based study in Indonesia found that no demographic factors were significantly associated with the health-seeking behavior of patients.<sup>21</sup> Still, health-seeking behavior plays a vital role in the management of non-communicable diseases.

Approximately 50% of our study participants are in the age group of 45-60 years with half of them diagnosed with diabetes for more than five years. A tertiary care-based study in Gujarat found the mean age of the patient population to be more than 60 years.<sup>22</sup> Majority of the participants are women who are dependent on family members and neighbors to accompany them to the health center. This may partially explain their health-seeking behavior. Our literature review found evidence for the influence of gender and lower income on the knowledge of diabetes.<sup>12</sup> The greater proportion of women in our study probably accounts for the sub-optimal knowledge on diabetes that is likely to influence their health-seeking behavior. Similar evidence is documented on the influence of socio-demographic and socioeconomic conditions on glycemic control and health outcomes.<sup>23</sup>



**Figure 1.** Knowledge of diabetes care (N = 100)/ORC (N = 200).



**Figure 2.** Satisfaction with diabetes care (N = 100)/ORC (N = 200).

The most commonly used pharmacological treatment in our study population are the oral anti-diabetes drugs (OADs). A very small proportion of our participants are on insulin. This is similar to what was reported during our audit in 2013 and similar to what is found in literature.<sup>24,25</sup> Most international guidelines based on studies from the West are not applicable to LMIC due to epidemiological, cultural and socio-economic variations. Diabetes is an expensive disease.<sup>26</sup> Often, government healthcare services provide only two to three OADs, and variable supply of insulin. Most of our patients pay out-of-pocket for treatment. There are also challenges in terms of storage facilities for insulin.

Our study identified sub-optimal knowledge of many factors related to diabetes care in the UHC and in the ORC. Better knowledge on medication and annual screening tests among participants completing middle school is identified in the ORC. This is similar to the Ethiopian study in which 43% of the study participants were identified as illiterate. Yet, more than 50% of them demonstrated good knowledge, attitude and practice towards glycemic control.<sup>27</sup> Better knowledge of diabetes care is found among patients with longer duration of diabetes and those on insulin in the UHC. Similar results were reported in Pakistan where university-level education and the type of therapy was associated with better knowledge of the disease.<sup>28</sup> The results of our study reiterate the need for health education relevant to the context of our communities.

Our results of better knowledge and satisfaction with diabetes care at the ORCs is related to the multiple factors at the ORCs that favor patient-centered care. The same team of CHW, CHN and physician assigned to each ORC facilitated better communication and continuity of care by the healthcare team. Patients within the same community foster emotional and social support in accessing the healthcare team for emergencies and screening. A systematic review on the effects of continuity of care on health outcomes of patients with diabetes found decreased mortality, complications and health service utilisation.<sup>29</sup> A Taiwanese study reported similar results on continuity of care for patients with diabetes.<sup>30</sup>

Our study in lower socio-economic communities illustrated the unique challenges faced in such settings. CHW-led diabetes care is a viable alternative to improve accessibility of services for low- resource communities. The role of CHWs and CHN should focus on patient-centered education, support to improve accessibility and advocacy for patients in the community. Patient-centred education should emphasise healthy lifestyle, self-care, health-seeking behaviour, medication adherence and treatment compliance. Health education is one of the proven scalable interventions to address the health-seeking behaviour and the social milieu of patients and to lessen the costs of diabetes care. Health education emphasising prevention and patient-centred care is likely to be one of the most cost-effective strategies in the Indian context.

## CONCLUSIONS

Our study identified sub-optimal knowledge of diabetes care among study participants. In comparison, better knowledge and satisfaction with care was found at the ORC than at the UHC though no major difference was identified in terms of their socio-demographics or in the number of visits. At the UHC, better knowledge was found to be associated with longer duration of diabetes, presence of co-morbidities and use of insulin. At the ORC, better knowledge was found to be associated with receiving more than primary school education and belonging to non-Hindu religion. At the UHC, patients with lower educational attainment were found to have higher satisfaction with care. There was no association between age, gender, religion, education, occupation, duration of diabetes, presence of co-morbidities, number of clinic visits, and type of treatment with satisfaction with care at the ORC. Overall, the system factors of waiting time for registration, consultation with doctors and nurses were more favorable in the ORCs.

## Strengths and Limitations

Comprehensive data collection on the factors influencing knowledge and satisfaction of diabetes care at the UHC and at the ORCs was performed.

It is a cross-sectional study. Patients who were former clients at the UHC or at the ORCs were not included in the study. Only those who were eligible based on the inclusion criteria were included. There was no duplication of participants from the UHC or ORC.

Sample size was reached by recruiting participants randomly. Participants who were included are representative of the communities in the ORCs and those who seek care at the UHC. Participants may not be representative of the general population in the society as the UHC and ORCs focus on the low-resource communities.

The UHC and the ORCs are financially supported by a private academic tertiary care hospital to provide subsidized care for the low-resource communities. The generalisability of the results to other health care systems in India may be questionable.

As the data was collected by the co-investigators, patients may not have been forthcoming with their thoughts especially with regard to satisfaction with care. The structured questionnaire was developed locally.

The pandemic affected the accessibility of care at both centers.

## Statement of Authorship

The authors certified fulfillment of ICMJE authorship criteria.

## CRediT Author Statement

LL: Writing-review and editing; PM: Investigation, Data Curation, Writing-review and editing; VK: Investigation, Data Curation,



Writing-review and editing; **SGA:** Methodology, Writing-review and editing, Supervision; **SR:** Methodology, Resources, Writing- original draft preparation; **RAP:** Conceptualization, Methodology, Software, Formal Analysis, Resources, Writing – original draft preparation, Writing-review and editing, Supervision, Project administration.

#### Author Disclosure

The authors declared no conflict of interest.

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None.

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