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Original Research Article

IMPACT OF COVID-19 ON TREATMENT COMPLIANCE IN DIABETES IN LUCKNOW: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: The COVID-19 pandemic disrupted healthcare access and daily routines, potentially impacting diabetes management. This study explored the impact of the pandemic on treatment compliance in diabetic patients in Lucknow, India.

Materials and Methods: A cross-sectional study was conducted over the two years with 410 individuals diagnosed with Type 2 Diabetes Mellitus in urban and rural areas of Lucknow. Employing a multistage random sampling technique, data collection occurred through structured interviews. The assessment encompassed demographic characteristics, medication compliance, blood glucose monitoring, and adherence to physical activity.

Results: The urban group had a higher proportion of males (46.3%) compared to the rural group (35.8%). Before the pandemic, urban participants adhered more to prescribed diet (85.4% vs. 68.3%), and exercise (47.0% vs. 25.2%) compared to rural participants. Medication compliance (70.4% vs 67.2% Urban; 48.8% vs 24.4% Rural) and Blood Glucose monitoring (71.1% vs 6.6% Urban; 78.0% vs 29.3% Rural) both decreased during the pandemic.

Conclusion: The study highlights diverse influences on diabetes prevalence and the vulnerability of diabetic patients during the pandemic, particularly in rural areas. Targeted interventions are needed to address challenges like financial constraints, lack of support, and disruptions to healthcare access.

Keywords: COVID-19, Diabetes Mellitus type 2, Lockdown, Treatment Compliance, Glucose Monitoring.

INTRODUCTION

In December 2019, the city of Wuhan, China, reported the first case of the novel coronavirus disease (COVID-19).[1]. Despite concerted efforts to contain the outbreak within China, the rapid transmission of the virus led the World Health Organization to declare COVID-19 a global pandemic.[2] The spectrum of COVID-19 symptoms varies from mild, resembling a common cold, to severe respiratory infections and, in extreme cases, multiple organ failure. Notably, chronic conditions such as obesity, hypertension, and diabetes mellitus have been identified as high-risk factors for the severity and fatality of the infection.[3]
Diabetes Mellitus type 2, a non-communicable disease, arises when the pancreas fails to produce sufficient insulin or when the body becomes resistant to insulin. Typically diagnosed in middle-aged and older individuals, the early symptoms of type 2 diabetes encompass frequent urination, increased appetite and thirst, blurred vision, lethargy, and delayed wound healing. The global epidemic of diabetes has the potential to escalate into a healthcare emergency, with predictions estimating its impact on approximately 300 million people by 2025.[4]
India, with an estimated 80 million diagnosed cases, stands as the epicentre of diabetes worldwide. Of the reported 73 million individuals with diabetes in India, every fifth person in the country is affected by the disease. Multiple factors, including poor dietary habits, sedentary lifestyles, rapid urbanization, substance use, increased life expectancy, excess body

weight, and genetic susceptibility, contribute to the escalating burden of type 2 diabetes. The surge in diabetes cases places considerable strain on India's economy and healthcare system.[4] Of particular concern are the 18 million diabetic patients over the age of 65, who are especially vulnerable to the adverse effects of COVID-19.[5]

Given these circumstances, we hypothesized that the many evolving circumstances such as lockdowns etc. resulting from ongoing COVID-19 may have impacted treatment compliance among diabetic patients including glucose monitoring. To explore this hypothesis, we conducted a cross-sectional study to assess the potential ramifications of lockdown measures on the management of diabetes, particularly in developing countries.

MATERIAL AND METHODS

This cross-sectional study involved 410 individuals diagnosed with Type 2 Diabetes Mellitus in urban and rural areas of Lucknow district. The study was conducted over two years, from February 2021 to February 2023, near the Urban and Rural Health Training Centres affiliated with Era's Lucknow Medical College and Hospital. Participants included both genders residing in Lucknow district with a confirmed diagnosis of Type 2 Diabetes Mellitus. A multistage random sampling technique was employed to ensure representation.

Inclusion criteria encompassed diagnosed cases of Type 2 Diabetes Mellitus, while exclusion criteria included diabetic pregnant and lactating females and individuals residing in Lucknow for less than six months.

This study was performed after ethical approval from the Institutional Ethical Committee and informed consent was taken from all patients. Data were collected through structured interviews. The sample size calculated based on variation in compliance score and compliance score change during lockdown was 410. Statistical analysis involved descriptive statistics to summarize participant characteristics. The limitations of this study include potential recall bias and the specificity of findings to the Lucknow district.

RESULTS

In the urban group (N=287), 46.3% were male, while in the rural group (N=123), the male proportion was lower at 35.8%. The age distribution showed a higher representation in the 40-50 years category for both urban (34.5%) and rural (31.7%) areas. Social class distribution varied, with Class 2 being the most prevalent in the urban group (37.6%) and Class 4 in the rural group (34.1%). Most participants were married in both urban (81.9%) and rural (83.7%) are ask. [Table 1]

In the urban group (N=287), 85.4% followed a prescribed diet, whereas in the rural group (N=123), this percentage was lower at 68.3%. A significant difference was observed in exercise adherence, with 47.0% in urban areas compared to 25.2% in rural areas. Regarding glucose monitoring, 74.9% in urban areas and 36.6% in rural areas reported regular monitoring. [Table 2]

Before the pandemic, 70.4% of urban participants and 48.8% of rural participants always took medication on time. However, during the pandemic, the urban group exhibited a decrease of 67.2%, while the rural group significantly decreased to 24.4%. [Table 3]

Before the pandemic, the majority in both urban (71.1%) and rural (78.0%) areas monitored their blood glucose most of the time. During the pandemic, a notable decrease was observed in the urban group, with only 6.6% monitoring always, compared to 29.3% in the rural group.

The chi-square tests revealed significant differences in medication compliance and blood glucose monitoring patterns before and during the pandemic period across urban and rural areas ($p<0.001$). [Table 4]

Before the pandemic, a substantial majority of urban participants (84.0%) reported 'Always' adhering to physical activity, while rural participants showed a lower rate (49.6%). Conversely, 'Most of the time' adherence was more prevalent in rural (47.2%) than in urban areas (15.7%). The Chi-Square test revealed a significant association between urban and rural subjects' physical activity before the pandemic (Chi Sq. = 53.72, $p < 0.001$).

During the pandemic, a noticeable shift occurred in both urban and rural settings. 'Always' adherence to physical activity dropped to 48.8% in urban and 30.1% in rural areas. Conversely, 'Most of the time' adherence increased in both settings (Figure 1). The Chi-Square test for this period demonstrated a substantial association between adherence and location, with Chi Sq. values of 77.14 (urban), 67.86 (rural), and an overall Chi Sq. of 129.60, all indicating $p < 0.001$.

Comparing adherence before and during the pandemic revealed a significant change. In urban areas, the Chi Sq. was 83.60 ($p < 0.001$), in rural areas, it was 67.86 ($p < 0.001$), and overall, it was 129.60 ($p < 0.001$). These results underscore the profound impact of the pandemic on physical activity patterns, with a noteworthy decrease in 'Always' adherence and a corresponding increase in 'Most of the time' adherence, particularly pronounced in rural areas. [Table 4]

With regards to overall treatment compliance (Figure 1) of all patients Before the pandemic, the majority of participants reported 'Always' adhering to Medication Compliance at 63.90%, Blood Glucose Monitoring at 24.60%, and Adherence to Exercise at 73.70%. 'Most of the time' adherence was observed in 34.90% for Medication Compliance, 73.20% for Blood Glucose Monitoring, and 25.10% for Adherence to Exercise. A minimal percentage (1.20%) reported 'Never' adhering to Medication

Compliance, 2.20% to Blood Glucose Monitoring, and 1.20% to Exercise.

Following the pandemic, there was a notable shift in adherence patterns. 'Always' adherence decreased to 54.40% for Medication Compliance, 13.40% for Blood Glucose Monitoring, and 43.10% for Adherence to Exercise. Conversely, 'Most of the time' adherence increased to 40.70% for Medication Compliance, 58.50% for Blood Glucose Monitoring, and 49.30% for Adherence to Exercise. The percentage reporting 'Never' adherence rose to 4.90% for Medication Compliance, 28.00% for Blood Glucose Monitoring, and 7.50% for Adherence to Exercise. [Table 5]

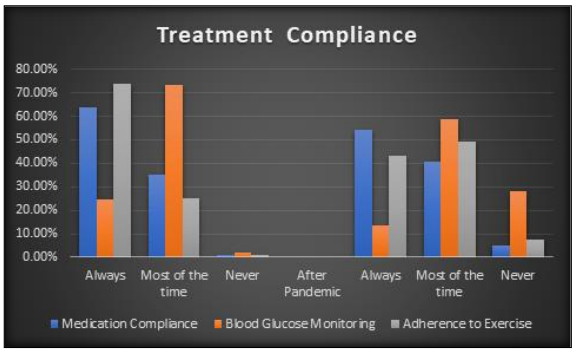

Figure 1:

Figure 1 Overall Treatment Compliance of All Patients with Diabetes (Medication compliance, Blood Glucose Monitoring and Adherence to Exercise) Before and After the Pandemic

Table 1: Distribution of Subjects according to Bio-Demographic Profile

Variable		Urban (N=287)	Rural (N=123)	Total (N=410)
		No. (%)	No. (%)	No. (%)
Gender	Male	133 (46.3%)	44 (35.8%)	177 (43.2%)
	Female	154 (53.7%)	79 (64.2%)	233 (56.8%)
Age	20 - 30 year	5 (1.7%)	0 (0.0%)	5 (1.2%)
	30 - 40 year	43 (15.0%)	12 (9.8%)	55 (13.4%)
	40 - 50 year	99 (34.5%)	39 (31.7%)	138 (33.7%)
	50 - 60 year	87 (30.3%)	30 (24.4%)	117 (28.5%)
	60 - 70 year	40 (13.9%)	35 (28.5%)	75 (18.3%)
	>= 70 year	13 (4.5%)	7 (5.7%)	20 (4.9%)
Social class	Class 1	63 (22.0%)	7 (5.7%)	70 (17.1%)
	Class 2	108 (37.6%)	25 (20.3%)	133 (32.4%)
	Class 3	71 (24.7%)	41 (33.3%)	112 (27.3%)
	Class 4	35 (12.2%)	42 (34.1%)	77 (18.8%)
	Class 5	10 (3.5%)	8 (6.5%)	18 (4.4%)
Marital status	Married	235 (81.9%)	103 (83.7%)	338 (82.4%)
	Unmarried	11 (3.8%)	3 (2.4%)	14 (3.4%)
	Widow	39 (13.6%)	16 (13.0%)	55 (13.4%)
	Divorcee	2 (0.7%)	1 (0.8%)	3 (0.7%)

Table 2: Distribution of Subjects according to Treatment plan for Diabetes Mellitus

Variable		Urban (N=287)	Rural (N=123)	Total (N=410)
		No. (%)	No. (%)	No. (%)
Diet	Yes	245 (85.4%)	84 (68.3%)	329 (80.2%)
	No	42 (14.6%)	39 (31.7%)	81 (19.8%)
Exercise	Yes	135 (47.0%)	31 (25.2%)	166 (40.5%)
	No	152 (53.0%)	92 (74.8%)	244 (59.5%)
Duration of exercise	<30 minutes	74 (54.8%)	20 (64.5%)	94 (56.6%)
	>30 minutes	61 (45.5%)	11 (35.5%)	72 (43.6%)
Glucose monitoring	Yes	215 (74.9%)	45 (36.6%)	260 (63.4%)
	No	72 (25.1%)	78 (63.4%)	150 (36.6%)
Walking barefoot	Yes	71 (24.7%)	81 (65.9%)	152 (37.1%)
	No	216 (75.3%)	42 (34.1%)	258 (62.9%)

Table 3: Distribution of subjects according to Medication compliance (Before and During the Pandemic period)

Taking medication on time		Urban (N=287)	Rural (N=123)	Total (N=410)	Chi Sq.	p-value
		No. (%)	No. (%)	No. (%)		
Before pandemic	Always	202 (70.4%)	60 (48.8%)	262 (63.9%)	18.67	**<0.001**
	Most of the time	81 (28.2%)	62 (50.4%)	143 (34.9%)		
	Never	4 (1.4%)	1 (0.8%)	5 (1.2%)		
During pandemic	Always	193 (67.2%)	30 (24.4%)	223 (54.4%)	64.76	**<0.001**
	Most of the time	82 (28.6%)	85 (69.1%)	167 (40.7%)		
	Never	12 (4.2%)	8 (6.5%)	20 (4.9%)		
Before vs During		**Chi Sq. = 350.0 p<0.001**	**Chi Sq. = 70.50 p<0.001**	**Chi Sq. = 417.97 p<0.001**		

Table 4: Distribution of subjects according to Blood Glucose Monitoring (Before and During the Pandemic period)

Blood Glucose Monitoring		Urban (N=287)	Rural (N=123)	Total (N=410)	Chi Sq.	p-value
		No. (%)	No. (%)	No. (%)		
Before pandemic	Always	74 (25.8%)	27 (22.0%)	101 (24.6%)	4.94	0.084
	Most of the time	204 (71.1%)	96 (78.0%)	300 (73.2%)		
	Never	9 (3.1%)	0 (0.0%)	9 (2.2%)		
During pandemic	Always	19 (6.6%)	36 (29.3%)	55 (13.4%)	56.11	**<0.001**
	Most of the time	164 (57.1%)	76 (61.8%)	240 (58.5%)		
	Never	104 (36.2%)	11 (8.9%)	115 (28.0%)		
Before vs During		**Chi Sq. = 116.74 p<0.001**	**Chi Sq. = 14.61 p<0.001**	**Chi Sq. = 110.84 p<0.001**		

Table 5: Distribution of subjects according to Physical Activity adherence (Before and During the Pandemic period)

Adherence to Physical activity		Urban (N=287)	Rural (N=123)	Total (N=410)	Chi Sq.	p-value
		No. (%)	No. (%)	No. (%)		
Before pandemic	Always	241 (84.0%)	61 (49.6%)	302 (73.7%)	53.72	**<0.001**
	Most of the time	45 (15.7%)	58 (47.2%)	103 (25.1%)		
	Never	1 (0.3%)	4 (3.3%)	5 (1.2%)		
During pandemic	Always	140 (48.8%)	37 (30.1%)	177 (43.1%)	77.14	**<0.001**
	Most of the time	125 (43.6%)	77 (62.6%)	202 (49.3%)		
	Never	22 (7.7%)	9 (7.3%)	31 (7.5%)		
Before vs During		**Chi Sq. =83.60 p<0.001**	**Chi Sq. = 67.86 p<0.001**	**Chi Sq. = 129.60 p<0.001**		

DISCUSSION

The bio-demographic profile of the study population revealed a higher representation of females in both rural (64.2%) and urban (53.7%) areas. This gender distribution aligns with the findings of Paulsamy et al. (2021),[6] who also reported a predominance of females (65.76%) in their study. The age distribution showed a notable concentration in the 40-50 years age group, consistent with studies by Verma et al. (2021),[7] and Bandyopadhyay et al. (2022).[8]

Marital status indicated that the majority of participants were married (82.4%), a trend also reported by D'Onofrio et al. (2021) [9]. Social class distribution highlighted disparities, with Class 2 being more prevalent in urban areas (37.6%), and Class 4 dominating in rural areas (34.1%). This corresponds with the findings of Kumari et al. (2022),[10] showcasing the socio-economic diversity within the study population. Educational and occupational differences were evident, with a higher proportion of illiterate subjects in rural areas and a prevalence of housewives in both urban (39.0%) and rural (41.5%) settings.

A significant decrease in medication compliance was observed both in urban and rural settings during the COVID-19 pandemic. The disruptions were attributed to the constraints imposed by the pandemic, including lockdowns and restrictions. These findings resonate with the study by Pawan et al. (2021),[12] where financial constraints and a lack of family support were identified as contributing factors to irregular medication intake during the pandemic. This highlights the multifaceted challenges faced by diabetic patients, extending beyond the health realm to encompass socio-economic factors.

In contrast, Verma et al. (2021),[7] reported no significant changes in medication adherence during the lockdown and, in some cases, even noted an improvement. This divergence in findings emphasizes the variability in responses to the pandemic's impact on healthcare behaviours. Sankar et al. (2020),[13] also noted that the majority of their study participants reported no change and had continued access to their medications during the lockdown, reflecting the adaptability of healthcare systems in certain contexts. The observed decrease in medication compliance underscores the vulnerability of diabetic patients during public health emergencies.

In comparison to blood glucose monitoring before and during a pandemic, there was a decrease in the monitoring due to imposed restrictions and the closure of diagnostic labs. ($p<0.001$) Similarly, Ghosh A et al. (2020),[5] reported a major decrease in the frequency of blood glucose monitoring. As in rural areas and small cities, most people rely on laboratories, which were closed during the lockdown, for their blood glucose estimation.

It was observed that there was a marked reduction in physical activity due to the COVID-19 lockdown and closure of public parks and gyms. ($p<0.001$).

A decrease in physical activity was also reported by Ghosh A et al. (2020),[5] in their study. Similarly, Leite NJC et al. (2022),[11] also reported in their study that the pandemic has made it difficult for people to maintain their usual physical activity routines. The participants expressed fear of exercising outside due to the increase in the number of cases of the disease. Almost all participants reported psychological health issues such as fear, frustration, anxiety and stress. Kumari N et al (2022),[10] in their study also found similar findings as the majority of patients stated that their physical activity was affected due to the

lockdown imposed (p< 0.00001). However, three-fourths of the participants reported an increased sitting time and screen time during this pandemic period.

While this study provides valuable insights into medication compliance trends during the pandemic, it is not without limitations. The cross-sectional design limits the ability to establish causal relationships, and the study's focus on a specific geographic location may impact the generalizability of findings to other regions. Future research could explore the long-term effects of the pandemic on diabetes management and investigate the effectiveness of interventions aimed at improving medication adherence in diverse populations. Additionally, qualitative approaches may offer deeper insights into the psychosocial and economic factors influencing medication compliance in the context of public health emergencies.

CONCLUSION

The study highlights the diverse bio-demographic factors influencing Type 2 Diabetes Mellitus in urban and rural populations. Gender, age, religion, social class, marital status, education, and occupation contribute to the varied prevalence of diabetes.

During the COVID-19 pandemic, a significant decrease in medication compliance was observed, revealing the vulnerability of diabetic patients to disruptions in healthcare access and daily routines. The challenges faced, including financial constraints and lack of family support, underscore the need for targeted interventions.

Long-term follow-up studies are essential to monitor the sustained effects of the pandemic on diabetes management and refine public health responses.

In essence, the study provides valuable insights into the complex dynamics of diabetes management during public health emergencies, advocating for a holistic approach to safeguard the well-being of individuals with Type 2 Diabetes Mellitus.

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