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## Effect of COVID19 pandemic and national lockdown on persons with diabetes from rural areas availing care in a tertiary care center, southern India



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### ABSTRACT

**Background and aims:** COVID-19 pandemic and lockdown measures to contain it have affected health care services globally. This study aims to assess the effect and urban-rural differences of COVID19 pandemic on diabetes care.

**Methods:** This cross-sectional study was conducted among persons with diabetes (PWDs) registered for care at a diabetes clinic of a tertiary care center in Southern India. We collected following information by telephonic interviews: physician consultations, access to diabetes medications and blood sugar tests, use of telemedicine services, out of pocket expenditure and psychological morbidity.

**Results:** A total of 350 PWDs were interviewed. Majority were male (78%) and from rural areas (79%). One fourth (24%) met any physician for diabetes care at least once during lockdown. PWDs from rural areas mainly consulted a physician in a private clinic (55%) compared to urban areas (26%). Two third (65%) availed medications from private medical shops. Almost half (46%) got their blood sugar tested during and majority of them (81%) reported unsatisfactory glycemic control. Only few (5%) was aware and three utilized telemedicine services. Almost all (99%) spent money (US \$ 8.3) for diabetes care. One third (33%) had moderate or high psychological distress.

**Conclusions:** Majority of PWDs did not consult a physician during lockdown. Cost of care was high. Measures to improve utilisation of telemedicine services and peripheral health facilities are needed.

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## 1. Introduction

COVID-19 (Coronavirus Disease-2019), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first appeared in December 2019 in the Wuhan district of China [1] and affected almost all countries across the world including India [2]. The elderly and those with certain underlying diseases like diabetes are more vulnerable to SARS-CoV-2 complications [3,4]. Presence of diabetes mellitus at admission is a risk factor for both intensive care unit (ICU) hospitalization and death [5–7]. According to the Centers for Disease Control and Prevention (CDC), persons with diabetes (PWDs) who develop COVID-19 are at higher risk of developing a

serious illness, such as pneumonia. If infected, PWDs have about 7% risk of death from COVID-19 [8]. However, with good blood sugar control, PWDs can reduce the risk of severe COVID-19 illness [9,10].

Considering the high-risk, persons with diabetes should take extra precautions amid COVID-19 pandemic. Strict facial masking, social distancing and proper hand hygiene should be the norm. Consulting the physicians regularly and modifying the medications for good glycemic control should be of utmost importance as it has shown to boost the innate immune system [11]. Although it would be wise to stick to the ongoing therapy or intensify the same.

Government of India imposed national level lockdown from March 23rd to May 31st 2020. The lockdown was extended till 30th June with some relaxations. Due to nationwide lockdown, it is expected that there will be disruption of diabetes care including availability of manpower, medications and laboratory investigations. Similarly, those who were availing care from a tertiary care center, which is far from their home, might face difficulty to

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seek the care due to travel restrictions and also due to limited outpatient services provided during the pandemic. PWDs seeking care from public health facilities, might be forced to buy medicines from private medical shops adding to out of pocket expenditure. PWDs may not consult physician or check their glucose levels due to the ban on travel. All these reasons along with fear of COVID-19 may lead to psychological distress; which may affect glycemic control.

A nation-wide lockdown and travel restrictions are extremely rare and there are limited studies on effect of such situation on medicine availability, increased out of pocket expenditure (OOPE) on health, change in lifestyle and psychological stress among PWDs. Understanding medication availability, and OOPE of diabetes care will help policymakers to identify new strategies for providing better drug availability at Government sector in case of another pandemic or similar situations of lock down. Understanding psychological distress among a high-risk group of COVID-19 can help to plan interventions and knowing patient's willingness to avail telemedicine services will help to expand the telemedicine services to a large population. So, we aimed to study the impact of COVID-19 pandemic and national lockdown in PWDs availing care at a tertiary care center in southern part of India. We also aimed to understand the urban-rural differences in diabetes care during this period.

## 2. Subjects, material and methods

### 2.1. Study design and setting

This cross-sectional analytical study was conducted between July and August 2020 among PWDs on diabetes care at a diabetes clinic of a tertiary care center in Puducherry, Southern India. Approximately 2500 PWDs were registered and seeking care from this clinic. Drugs including insulin are provided free of cost to all PWDs. PWDs visit the clinic every month for routine check-ups and drugs. Due to COVID 19 pandemic, diabetes clinic was closed for physical consultation (personal visit) from first week of March 2020 and a tele-consultation (only voice call) was started on 24 × 7 basis for the PWDs. From the last week of April, this service was upgraded to a video consultation facility, where a doctor could see the patient's case records and examine any visible signs of disease over a video call. According to Government of India guidelines, all investigations and medicines prescribed through telemedicine services should be provided free of cost at government health facilities [12].

### 2.2. Study population and sample size calculation

All PWDs who were registered and on treatment for at least one year at the diabetes clinic as on March 22nd 2020 were eligible for the study. Assuming 50% of PWD have access to diabetes medications during lockdown period, with 95% confidence interval and 5% absolute precision, the required sample size was 384. This sample size was calculated using OpenEpi version 3.0. From the Hospital Management and Information System (HMIS), we extracted mobile numbers of PWDs and a line list was prepared. The required number of samples were chosen using a simple random technique from the line list.

### 2.3. Data variables and data collection

Data was collected through telephonic interviews with PWDs. Information on age, gender, occupation, education, duration of diabetes mellitus, duration on treatment, and presence of comorbidity were collected. Personal protection measures, i.e., wearing

masks, and handwashing were also asked. Availability of medications were assessed. Lifestyle behaviours such as tobacco use, alcohol consumption, fruits and vegetable consumption were assessed using World Health Organizations (WHO) steps survey questions [13]. OOPE in availing diabetes care during lockdown was assessed using the direct (consultation fees, laboratory cost, medication charges, and hospitalization charges) and indirect (transportation charges, and food cost) expenditure for the month of May 2020. To assess the psychological morbidity, Kessler psychological distress scale (K10) was applied [14]. The K10 scale involves 10 questions about emotional states; each with a five-level response scale. Items are scored from one 'none of the time' to five 'all of the time'. Scores of the 10 items are then summed, yielding a minimum score of 10 and a maximum score of 50.

### 2.4. Operational definitions

**Diabetes control status:** Ideal [Fasting Blood Sugar (FBS) 80–110 mg/dl and Post Prandial Blood Sugar (PPBS) 120–140 mg/dl], satisfactory (FBS 111–125 mg/dl and PPBS 141–180 mg/dl) and unsatisfactory (FBS >125 mg/dl and/or PPBS >180 mg/dl) [15].

**Psychological stress:** A score of 16–21 was considered as "moderate psychological stress" and a score >21 was considered as "high psychological stress" [14].

**Tobacco use:** Self-reported tobacco use in any form during the preceding month of lockdown and during lockdown.

**Alcohol use:** Self-reported alcohol use at least once (minimum one standard drink) during the preceding month of lockdown and during lockdown.

### 2.5. Data analysis

The data was entered into Epicollect5: mobile and web application and analysed using Stata version 11.0 (StataCorp LP, College Station, TX, USA). We did a stratified analysis based on area of residence to understand the urban-rural differences in diabetes care during this period. Age, family income and costs were summarized as mean (SD) or median (inter quartile range) depending on the distribution. All categorical variables were summarized as percentages. Costs were collected in Indian rupees (INR) and converted to United States dollars (USD) based on May 2020 conversion rate (1 USD = 75.51 INR). Behavioural and life style factors among PWDs before and during the lockdown was analysed using Mc-Nemars Chi-squared test. A p value of less than 0.05 was considered as statistically significant.

### 2.6. Ethics

The study protocol was reviewed by the Institute Ethics Committee of Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry and assigned the approval number JIP/IEC/2020/184. A telephonic consent was obtained from the participant before enrolling the study.

## 3. Results

We contacted 454 PWDs through telephonic calls and 350 responded (response rate of 77%). The mean (SD) age of the PWDs was 57 (12) years. Median monthly family income was 4000 INR (US \$52.8). The sociodemographic characteristics of the participants are summarized in Table 1. Majority of the participants were male (n = 274, 78%) and from rural areas (n = 275, 79%). One fifth (n = 73, 21%) of the PWD had no formal education and were currently not employed (n = 72, 21%). Most of them were married (n = 314, 90%) and around three fourths (n = 245, n = 70%) were on

**Table 1**  
Socio-demographic characteristics of persons with type 2 diabetes in Puducherry and Tamil Nadu, India, March to June 2020 (N = 350).

Variable	Rural (n = 275)	Urban (n = 75)	Total (N = 350)
<b>Age in years</b>			
Up to 45	52 (18.9)	9 (12.0)	61 (17.4)
46–60	109 (39.6)	34 (45.3)	143 (40.9)
Above 60	114 (41.5)	32 (42.7)	146 (41.7)
<b>Gender</b>			
Male	219 (79.6)	55 (73.3)	274 (78.3)
Female	56 (20.4)	20 (26.7)	76 (21.7)
<b>Education</b>			
No formal education	56 (20.4)	17 (22.7)	73 (21)
Class 1-5	63 (22.9)	19 (25.3)	82 (23.4)
Class 6-10	130 (47.3)	25 (33.3)	155 (44.3)
Class 11-12	14 (5.1)	8 (10.7)	22 (6.4)
Graduate and above	12 (4.4)	6 (8)	18 (5.2)
<b>Occupation</b>			
Monthly salaried	29 (11.0)	16 (21.2)	45 (12.9)
Daily waged	61 (22.1)	23 (30.9)	84 (24)
Agriculture	107 (38.9)	17 (22.7)	124 (35.4)
Homemaker	18 (6.6)	2 (9.3)	25 (7.1)
Unemployed	60 (21.8)	12 (16.0)	72 (20.6)
<b>Marital Status</b>			
Married	250 (90.9)	64 (85.5)	314 (89.7)
Unmarried	7 (2.6)	4 (5.3)	11 (3.1)
Widowed/separated	18 (6.7)	7 (9.3)	25 (7.2)
<b>Duration of diabetes since diagnosis (in years)</b>			
1–5	87 (31.6)	18 (24.0)	105 (30)
6–10	94 (34.2)	26 (34.7)	120 (34.3)
>10	94 (34.2)	31 (41.3)	125 (35.7)
<b>Type of medication</b>			
Oral	151 (54.9)	32 (42.7)	183 (52.3)
Insulin	25 (9.1)	13 (17.3)	38 (10.9)
Both	99 (36.0)	30 (40.0)	129 (36.9)
<b>Family history of diabetes</b>	95 (34.6)	28 (37.3)	123 (35.1)
<b>Presence of comorbidities</b>	133 (48.4)	40 (53.3)	173 (49.4)

treatment for diabetes for more than five years. Nearly half (n = 167, 48%) were on insulin. Around one third (n = 123, 35%) had a family history of diabetes and half of them (n = 173, 49%) had comorbidities. All of them reported using face mask while going outside home and washing hands frequently.

Diabetes care during national lockdown period during March 23 - June 23, 2020 is depicted in Table 2. One fourth (n = 84, 24%) of the PWDs consulted a physician for diabetes care during this period. PWDs from rural areas mainly consulted a physician in a private clinic (55%) compared to urban areas (26%). Of total, only 11% (n = 9) consulted a primary care physician. Majority (n = 186, 68%) of the PWDs in rural areas availed diabetes medications from private medical shops or clinics. Almost half (n = 163, 46%) of the PWDs tested their blood sugar during the study period and majority of them (n = 131, 81%) reported unsatisfactory glycemic control.

Almost all (n = 315, 90%) PWDs were willing to avail telemedicine services. PWDs from rural areas were more willing (91%) compared to urban (85%). Only eighteen PWDs (5%) knew about the existing telemedicine services at the diabetes clinic; of which only three (all from rural areas) PWDs utilized the services. Psychological distress in the last four weeks from the day of interview shows that 30% (n = 105) had moderate psychological stress and 3% (n = 9) had high psychological stress.

Almost all (n = 346, 99%) the PWDs spent money for diabetes care during the month of May 2020; of them, 78% (n = 217) spent for direct medical cost and 95% (n = 331) spent for direct non-medical cost. Proportion of PWDs spent for direct medical cost from rural areas (79%) was more compared to urban areas (71%). The median (IQR) total direct medical cost was US \$10 (5.3–14.5) and direct non-medical cost was US \$1 (0.7–1.3). For medications, about US\$ 9.9 was spent by PWDs during lockdown (n = 227). The

total median (IQR) expenditure for the diabetes care was US \$ 8.3 (1.7–14.3) (Table 3).

Change in behavioural and life style factors among PWDs before and during the lockdown is shown in Table 4. There was a significant reduction in alcohol (8.7% vs 3.3%, p = 0.007) and tobacco use (10.2% vs 3.6%, p = 0.002) in rural areas. Also, there was a decrease in fruits consumption among PWDs in both rural and urban areas.

#### 4. Discussion

Our study found that majority of the PWDs did not consult a physician during three months of lockdown; where the guidelines recommend monthly visits [16]. Our study participants were on regular care at a government tertiary care center before lockdown, but during lockdown among those who approached a physician, majority chose private clinic for the routine health care. We also found that the PWDs availed their medications from private medical shops or clinic using their previous prescriptions. Diabetes mellitus is a chronic disease, which requires a continuous availability of health care services. Public health facilities were engaged in combating the COVID pandemic during initial phase of lockdown and may be not accessible for people with other disease conditions. This findings were similar to a study from northern India where 91% of the PWDs availed medicines from a chemist [17]. But a study conducted during the early phase of lockdown period at Bhopal, India found that the therapeutic adjustments were required in 20% of individuals [18]. Disparities in health care delivery and drug access could be the reason for poor utilisation of primary care sector [19].

Our study found that only 5% of the PWDs were aware about the telemedicine services and very few availed the service. In our setting, majority of the PWDs were from rural areas; awareness and

**Table 2**  
Indicators of diabetes care during national lockdown period (during March 23 - June 23, 2020) in Puducherry and Tamil Nadu, India (N = 350).

Diabetes care during March 23 - June 23, 2020	Rural n (%)	Urban n (%)	Total n (%)	95% CI
<b>Met any physician for diabetes care</b>	65 (23.6)	19 (25.3)	84 (24)	19.6–28.8
<b>Facility where met the physician (N = 84)</b>				
Private Clinic	36 (55.4)	5 (26.3)	41 (48.8)	37.7–60.0
Government general hospital/diabetes specialist	21 (32.3)	13 (68.4)	34 (40.5)	29.9–51.7
Primary health center	8 (12.3)	1 (5.3)	9 (10.7)	5.0–19.4
<b>Medicines availed from</b>				
Medical shop/clinic	186 (67.6)	40 (53.3)	226 (64.6)	59.3–69.6
Primary health center	52 (18.9)	14 (18.7)	80 (22.9)	18.6–27.6
Government general hospital	45 (16.4)	22 (29.30)	67 (19.1)	15.2–23.7
Not availed	4 (1.5)	3 (4.0))	7 (2)	0.8–4.1
<b>Tested blood sugar</b>	124 (45.1)	39 (52.0)	163 (46.6)	41.3–52.0
<b>FBS control status (N = 163)</b>				
Ideal (80–110 mg/dl)	27 (21.8)	10 (25.6)	37 (22.7)	16.5–29.9
Satisfactory (111–125 mg/dl)	18 (14.5)	6 (15.4)	24 (14.7)	9.7–21.1
Unsatisfactory (>125 mg/dl)	79 (63.7)	23 (59.0)	102 (62.4)	54.7–70.0
<b>PPBS control status (N = 162)</b>				
Ideal (120–140 mg/dl)	10 (8.1)	4 (10.5)	14 (8.6)	4.8–14.1
Satisfactory (141–180 mg/dl)	21 (16.9)	7 (18.4)	28 (17.3)	11.8–24.0
Unsatisfactory (>180 mg/dl)	93 (75.0)	27 (71.1)	120 (74.1)	66.7–80.6
<b>Diabetes control status (N = 162)</b>				
Ideal (FBS 80–110 and PPBS 120–140 mg/dl)	10 (8.1)	2 (5.3)	12 (7.4)	3.9–12.6
Satisfactory (FBS 111–125 and/or PPBS 141–180 mg/dl)	16 (12.9)	3 (7.9)	19 (11.7)	7.2–17.7
Unsatisfactory (FBS >125 or PPBS >180 mg/dl)	98 (79.0)	33 (86.8)	131 (80.9)	73.9–86.6
<b>Knowledge about diabetes clinic Telemedicine services</b>	15 (5.5)	3 (4.0)	18 (5.1)	3.1–8.0
<b>Availed telemedicine services</b>	3 (1.1)	0 (0)	3 (0.9)	3.6–41.4
<b>Willing to avail telemedicine services</b>	251 (91.3)	64 (85.3)	315 (90)	86.4–92.9
<b>Psychological distress in the last four weeks (K10 score)</b>				
High (22–29)	5 (1.8)	4 (5.3)	9 (2.6)	1.2–4.8
Moderate (16–21)	86 (31.3)	19 (25.3)	105 (30.0)	25.2–35.1
Low (10–15)	184 (66.9)	52 (69.3)	236 (67.4)	62.2–72.3

FBS-Fasting Blood Sugar, PPBS- Post Prandial Blood Sugar.

**Table 3**  
Cost of diabetes care during COVID lockdown period for the month of May 2020 in Puducherry and Tamil Nadu, India (N = 350).

Cost category	Rural n (%)	Urban n (%)	Total n (%)	Median (IQR) INR	Median (IQR) USD
<b>Direct medical</b>					
Consultation	35 (12.7)	7 (9.3)	42 (12.0)	200 (200–200)	2.6 (2.6–2.6)
Investigations	116 (42.2)	29 (38.7)	145 (41.4)	80 (60–100)	1.1 (0.8–1.3)
Medications	185 (67.3)	42 (56.0)	227 (64.9)	750 (500–1050)	9.9 (6.6–13.9)
Hospitalization	2 (0.7)	0 (0)	2 (0.5)	6500 (3000–10000)	85.8 (39.6–132.0)
<b>Direct non-medical</b>					
Food	1 (0.4)	1 (1.3)	2 (0.5)	365 (30–700)	4.8 (0.4–9.2)
Travel	261 (94.9)	70 (93.3)	331 (94.6)	75 (50–100)	9.0 (0.7–1.3)
<b>Total direct medical</b>	218 (79.3)	53 (70.7)	271 (77.4)	750 (400–1100)	9.9 (5.3–14.5)
<b>Total direct non-medical</b>	261 (94.9)	70 (93.3)	331 (94.6)	75 (50–100)	1.0 (0.7–1.3)
<b>Total expenditure</b>	272 (98.9)	74 (98.7)	346 (98.9)	625 (130–1080)	8.3 (1.7–14.3)

1 US Dollar (USD) = 75.8 Indian Rupees (INR)

availability of smart phones could be low which led to less utilisation of telemedicine services. In contrary to this findings Ghosh et al. from New Delhi reported a higher (69%) awareness about telemedicine services among PWDs. There are many challenges in tele-consultation such as low patients' acceptance, poor internet facilities, patients' inability to operate smartphones, error in communication and security issues [20]. But in the current scenario, telemedicine can fine-tune PWDs' medications, ensure drug compliance, and support continuous diabetes education. It can also help in counselling patients about their high-risk status and need of strict facial masking, social distancing and hand hygiene [21]. In our study, even after availing medications, majority of the PWDs had an

unsatisfactory glycemetic control. Uncontrolled glycemia reported by other studies in India before lockdown ranges from 70 to 77% [22,23]. Hence lockdown may not be a major reason for unsatisfactory glycemetic control. Only half of the PWDs were able to measure their blood sugar during lockdown and this highlights the need for self-monitoring of blood glucose (SMBG) at their home [24,25].

One third of the PWDs had moderate or high psychological distress. This finding is much lower than the other studies conducted in India (87%) [17] and China (53.8%) [26], but both the studies assessed mental stress at the initial phase of COVID pandemic. During pandemic, it is expected that general population

**Table 4**  
Behavioural and life style factors among persons with type 2 diabetes before and during the lockdown period in Puduchery and Tamil Nadu, India (N = 350).

Behavioural and life style factors	Before n (%)	During n (%)	p value
<b>Rural (n = 275)</b>			
<b>Alcohol use</b>			
Yes	24 (8.7)	9 (3.3)	0.007
No	251 (91.3)	266 (96.7)	
<b>Tobacco use</b>			
Yes	28 (10.2)	10 (3.6)	0.002
No	247 (89.8)	265 (96.4)	
<b>No. of days of fruit consumption in a week</b>			
0	21 (7.6)	54 (19.6)	<0.001
1	82 (29.8)	121 (44.0)	
2	126 (45.8)	71 (25.8)	
>2	46 (16.3)	29 (10.6)	
<b>No of days of vegetable consumption in a week</b>			
Up to 5	30 (10.9)	13 (4.7)	0.019
6	69 (25.1)	66 (24.0)	
7	176 (64.0)	196 (71.3)	
<b>Urban (n = 75)</b>			
<b>Alcohol use</b>			
Yes	7 (9.3)	0 (0)	0.013
No	68 (90.7)	75 (100)	
<b>Tobacco use</b>			
Yes	5 (6.7)	3 (4.0)	0.719
No	70 (93.3)	72 (96.0)	
<b>No. of days of fruit consumption in a week</b>			
0	4 (5.3)	8 (10.7)	0.001
1	22 (29.3)	42 (56.0)	
2	41 (54.7)	20 (26.7)	
>2	8 (10.7)	5 (6.7)	
<b>No of days of vegetable consumption in a week</b>			
Up to 5	3 (4.0)	3 (4.0)	0.94
6	20 (26.7)	15 (20.0)	
7	52 (69.3)	57 (76.0)	

will have some level of psychological distress due to various reasons like restricted mobility, loss or reduction in income and fear of COVID infection. Special groups like PWDs can be targeted for telephonic interventions for psychological morbidity and the PWDs can be encouraged to use helplines initiated by Government of India [27].

OOPE on diabetes care was much high in our study population during lockdown period. Even after Government of India included diabetes care as an essential service and re-organized the services at peripheral public health facilities during the period of lockdown/restriction, there was a shortfall in reaching government health facilities to PWDs. Implementing fixed day services for each village/ward area, ensuring adherence to physical distancing can be a better model for reducing the OOPE. Robust primary healthcare can be a better alternative for obtaining follow-up care and medications for PWDs [7]. The current study shows a decrease in consumption of alcohol & tobacco and an increase in vegetable consumption among PWDs. Decrease in alcohol and tobacco consumption may be due to closure of alcohol shops and general shops during the lockdown.

This is one of the first study from southern part of India assessing the effect of COVID 19 and lockdown on diabetes care in terms of medication availability, glycemic control, life style changes, and psychological morbidity. Data on OOPE on diabetes

care was also collected during lockdown period, which is important to formulate community level policies. The finding of this study adds information on impact of COVID and lockdown period on diabetes care and will help in formulation public health measures to support vulnerable groups of COVID 19 or any future pandemics.

There are limitations in our study. Practices of wearing mask and hand hygiene were self-reported and hence subject to social desirability bias. Glycaemic control was assessed using fasting and post prandial blood sugar values; HbA1C could have provided better estimates.

## 5. Conclusion

Majority of the PWDs did not consult any physician during lockdown period and most of them had a poor glycemic control. The awareness about telemedicine services was very low and OOPE on diabetes care was very high. These results suggest an urgent action plan to improve awareness among PWDs regarding availability of telemedicine services and strengthening the provision of diabetes care at primary care centers.

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## Conflicts of interest

None.

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