Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Diabetes & Metabolic Syndrome: Clinical Research & Reviews 14 (2020) 1579–1584

Contents lists available at ScienceDirect

Diabetes & Metabolic Syndrome: Clinical Research & Reviews

journal homepage: www.elsevier.com/locate/dsx

A cross sectional study reveals severe disruption in glycemic control in people with diabetes during and after lockdown in India

Mohammed Abdul Khader [a], Talha Jabeen [a, *], Ramanachary Namoju [a, b, **]

[a] Department of Pharmacology & Pharmacy Practice, Bhaskar Pharmacy College, Jawaharlal Nehru Technical University, Hyderabad, Telangana, 500075, India

[b] Department of Pharmacology, GITAM University, Gandhi Nagar, Vishakhapatnam, Andhra Pradesh, 530045, India

ARTICLE INFO

Article history:
Received 31 July 2020
Received in revised form
10 August 2020
Accepted 13 August 2020

Keywords:
Diabetes
COVID-19
Online survey
Lockdown
SARS-CoV-2
India

ABSTRACT

Background and aims: Uncontrolled diabetes has been associated with poorer clinical outcomes in COVID-19. We aimed to evaluate and assess the impact of COVID-19 pandemic on management of diabetes and challenges faced by people with diabetes in India during and after the lockdown phase.

Methods: A cross-sectional study based on an online questionnaire survey was designed. The questions collected socio-demographic details, medical and social history, and impact of the pandemic on medical and social life from 1582 participants. Linear regression was employed to evaluate association of different parameters with the change in glycemic levels.

Results: The frequency of clinical visits during the COVID-19 pandemic were reduced in 87.28% of participants. 92.45% of participants were able to monitor their blood glucose levels (BGLs) in which 78.42% (49.35%, 20.91%, and 8.16%) participants experienced an increase in BGL (mild, moderate, and severe respectively). Only 47.41% of participants possessed the digital glucometer at home. 69.07% of participants reported a decrease in physical activity while 46.88% reported an increase in food intake. 80.06% of participants were able to buy all medicines and 29.80% were gone for virtual consultations while 87.81% reported that they didn't have access to healthcare services. Overall, 89.47% participants experienced disruption in therapy. A highly significant correlation ($r = 0.89$, $p = 0.0145$) was found between increasing age and reporting of higher BGLs.

Conclusion: This study provides a firsthand evidence of major disruption in diabetes care activities during and after the lockdown phase in India and increased risk of poorer clinical outcomes, if infected by SARS-CoV-2.

1. Introduction

The coronavirus disease (COVID-19), a pandemic originated from China as a cluster of unknown pneumonia cases is continuing to wreak havoc globally [1]. As of July 24, the World Health Organization (WHO) has documented 15,931,445 positive COVID-19 cases and the death toll stood at 641,885. India, with no exception, is ringing high alarm bells to the outbreak. Currently, India has a load of 13,35,210 COVID-19 cases, making it the worst-hit nation of Asia and third worst-hit nation in the world after the United States and Brazil [2]. The outbreak is frequently testing the preparedness of health services and their ability to cope with a pandemic response [3]. The first confirmed case of SARS-CoV-2 positive in India was reported on 30th January. Following the drastic growth in daily case counts, the government had drawn up plans to deal with a worsening of the pandemic in the country. A series of lockdowns starting from March 24, 2020 were imposed on people in the country to break the chain of virus transmission [4]. Further, United Nations and WHO have praised India's response to the pandemic as 'comprehensive' and 'robust'. However, since the start of "unlocking" and easing of restrictions from June 1st, India is witnessing an exponential rise in COVID-19 cases indicating the possibility of 'community transmission' [2].

* Corresponding author. Department of Pharmacology & Pharmacy Practice, Bhaskar Pharmacy College, Jawaharlal Nehru Technical University, Hyderabad, Telangana, 500075, India.

** Corresponding author. Department of Pharmacology & Pharmacy Practice, Bhaskar Pharmacy College, Jawaharlal Nehru Technical University, Hyderabad, Telangana, 500075, India.

E-mail addresses: khadershoieb46455@gmail.com (M.A. Khader), talhajabeen9191@gmail.com (T. Jabeen), nrchary.pharma@gmail.com (R. Namoju).

https://doi.org/10.1016/j.dsx.2020.08.011
1871-4021/

Accumulating evidence suggests a high risk of becoming severely ill with the Coronavirus in people with increasing age and pre-existing comorbidities [5,6]. The mortality rate due to COVID-19 in India is very low (i.e. 2.57%) and interestingly majority (nearly 73%) of deaths are being observed in those having comorbidities [7]. Among all, diabetes found to pose a particular adverse risk for COVID-19 infection [8]. Uncontrolled diabetes compromises innate immunity, the first line of defense against SARS-CoV-2 [9]. This results in disruption of cell-mediated immunity, diminished lymphocyte transformation, impaired leukocyte function, greater viral replication in pulmonary epithelial cells, and consequent pneumonitis [10]. Since people with diabetes are at increased risk of morbidity and mortality associated with SARS-CoV-2 infection, their routine care, and monitoring are highly important [11]. Apart from the risk of COVID-19 infection, a poorly controlled diabetes has the potential to root life-threatening complications like macrovascular diseases (angina pectoris, myocardial infarction, stroke, peripheral artery disease), microvascular diseases (retinopathy, nephropathy, and neuropathy), and immune dysfunction (more susceptible to bacterial and fungal infections) [12].

With medical focus largely centered on COVID-19, the clinical support needed by patients living with non-communicable diseases (NCDs) is getting severely affected [13,14]. Treatment delays, discontinuation of routine care, services, and uncertainty around medicine availability have left them more at risk than ever. A survey of 155 countries by the WHO reported dramatic curtailment of health services for patients living with NCDs during the COVID-19 pandemic. It was reported that diabetes treatment has been partially or completely disrupted in 49% of the countries surveyed. The lower-income countries and countries moving in to transition towards the community transmission are being majorly affected [15]. A recent study in the Brazilian population revealed the impact of COVID-19 on diabetics [16]. India harbors 77 million diabetes patients, which makes it the second most affected nation in the world, after China. The number is projected to grow 134 million by 2045 as per the International Diabetes Federation [17]. On the other hand, only a few papers have discussed the association between the COVID-19 outbreak and its impact on diabetes care in India. However, these studies had a relatively smaller sample size and were primarily conducted during the period of nation-wide lockdown [18–21].

By virtue of being with a higher prevalence of diabetes and a hasty upsurge in COVID-19 cases during the unlocking phase, and with their overlapping on morbidity and mortality of people, it is essential to study the impact of COVID-19 on diabetic care in India and helps improvise the preparedness for current and future thereat imposed by COVID-19. Keeping the above points in view, this study was designed to evaluate the impact of COVID-19 pandemic on medical treatment, routine care services, and challenges faced by people living with diabetes in India.

2. Methods

A cross-sectional study based on an online questionnaire survey was designed to assess the impact of COVID-19 on the medical treatment of diabetes people. The study was conducted in between 12:00 IST, June 10th, 2020, and 12:00 IST, July 15th, 2020. People with diabetes were invited for the study through social networking platforms including Facebook, WhatsApp, LinkedIn, text message, through their affiliated institutions, and diabetes social media groups. The questionnaire consisted of 25 multiple choice questions in English and Telugu. The survey initiation clearly stated the right of the individuals to participate or not to participate in the survey. All the participants enrolling must have to fill the informed consent form.

2.1. Inclusion criteria

- People who are diagnosed with diabetes
- Any gender
- Age more than 18 years

2.2. Exclusion criteria

- Not able to provide informed consent for the study

The questionnaire consisted of mainly 3 domains: A) socio-demographic details, e.g., subject's age, gender, state, city, town, educational qualification, financial income; B) medical and social history, e.g., type of diabetes, comorbidities, smoking, and drinking habits; C) impact of COVID-19 outbreak on their medical and social life, e.g., frequency of clinic visits, changes in glycemic levels, digital glucometer at home, access to health care services, changes in the eating habits and physical activity, changes in drinking and smoking habits, online consultations, the reason for cancellation or postponement. In the end, a blank space was given to leave a comment. The questions were designated to relate the current situation of participants "during" the pandemic, to "before" the pandemic.

2.3. Statistical analysis

Descriptive analysis was computed in terms of mean value ± (standard deviation) for continuous variables and frequency (percentage) for categorical variables. Student's t-test was used to examine the association between continuous variables. Multivariable logistic regression analysis was used to adjust for the effect of cofounders when appropriate to determine the association of binary outcomes. Linear regression was employed to evaluate the association of different parameters with the change in glycemic levels. A p-value of <0.05 was considered statistically significant. All statistical analyses were done using the SPSS statistic 22.0 (IBM SPSS Statistics, New York, United States) database. Bar diagrams, tables and charts were created using Microsoft Excel 2016 version to depict percentages, and averages.

3. Results

3.1. Characteristics of survey respondents

A total of 1582 responses obtained in the study duration and 72 responses excluded due to the incomplete information. A total of 1510 responses then assessed for the study. The majority of participants were male (63.77%) and belonged to the age group of 41–50 (36.29%). The mean age was 41.6 years. The participants were from 9 different states in India -Telangana, Andhra Pradesh, Tamil Nadu, Maharashtra, Karnataka, Kerala, Delhi, Punjab, and Rajasthan., of which, 27.15% comprised from Telangana state (Hyderabad = 14.76%). A significantly higher number of participants lived in urban localities (80.33%). The highest levels of education for most of the participants were graduation (42.31%) and secondary (22.11%). 29% of participants had a monthly income ₹ >20,000 and 25.82% had a monthly income in the range of ₹3,000–10,000. People with type-2 diabetes were predominant in the study (87.01%). Comorbidities were present in 80.13% of the participants. The most common comorbidities were hypertension and dyslipidemia. 12.5% and 10.19% of participants had smoking and drinking habits respectively. The complete socio-demographic profile of the participants is shown in Table 1.

Impact of epidemic on medical treatment and social life of

Table 1
Socio-demographic profile and health status of the participants (n = 1510).

Patient characteristics	n	%
Gender		
Male	963	63.77%
Female	543	35.96%
Non-Binary	4	0.26%
Age(years)		
18–30	315	20.86%
31–40	395	26.15%
41–50	548	36.29%
51–60	138	9.13%
61–70	65	4.30%
>70	49	3.24%
States(Top 5)		
Telangana	410	27.15%
Andhra Pradesh	228	15.09%
Tamil Nadu	203	13.44%
Maharashtra	176	11.65%
Karnataka	145	9.60%
Cities(Top 5)		
Hyderabad	223	14.76%
Vishakhapatnam	98	6.49%
Chennai	119	7.88%
Mumbai	65	4.30%
Mysuru	56	3.70%
Town		
Urban	1213	80.33%
Rural	297	19.66%
Level of education		
Post-graduation	260	13.90%
Graduation	639	42.31%
Higher secondary (12th)	217	14.37%
Secondary (10th)	334	22.11%
Primary	48	4.17%
None	12	3.11%
Monthly financial income in rupees		
<3000	14	0.92%
3000-10,000	390	25.82%
10,001–20,000	514	24.03%
>20,000	438	29.00%
Refused/don't know	154	10.19%
Diabetes type		
Type 2	1314	87.01%
Type 1	21	1.39%
Gestational	103	6.82%
Others (LADA, MODY, any others)	72	4.76%
Comorbidities		
Yes	1210	80.13%
NO	300	19.86%
	Smoking	
Yes	189	12.5%
No	1321	87.48%
Drinking		
Yes	154	10.19%
No	1356	89.80%

LADA- Latent autoimmune diabetes in adults; MODY- Maturity Onset Diabetes of the Young. Categorical variables are expressed as frequency (percentage).

people with diabetes:

The frequency of clinical visits of participants significantly decreased as compared to pre-pandemic period (Fig. 1. A): 135 (8.94%) participants didn't visit the clinic till now i.e., from March 22nd to June 30th; 755 (50.00%) participants visited once in three months; 428 (28.34%) visited once in two months; and 192 (12.71%) visited once monthly. 1396 (92.45%) participants monitored their blood glucose level (BGL), either with digital glucometer in-home or through blood samples in a lab or a clinic (Fig. 1. B) in which 78.42% (49.35%, 20.91%, and 8.16%) participants experienced an increase in BGL (mild, moderate, and severe respectively) (Fig. 2. A). 716 (47.41%) possessed blood glucose measuring device (digital glucometer) at home (Fig. 1. C). The COVID-19 pandemic disrupted physical activity and food intake. 1043 (69.07%), 378 (25.03%) and 89 (5.89%) participants showed a decrease, no change, and increase in physical activity respectively than before the pandemic (Fig. 1. D). 708 (46.88%), 597 (39.53%), and 205 (13.57%) participants showed an increase, no change, and a decrease in food intake respectively than before (Fig. 1. E). The epidemic increased virtual consultations. 450(29.80%) participants used the virtual platform to follow up with doctors during the study period, while 116 (7.68%) expressed that they used the virtual platform before the pandemic also (Fig. 2. B). Further, the COVID-19 pandemic disrupted the purchase of medicines. 1209 (80.06%) participants purchased all the medicine. 398 (26.35%) did not buy due to unavailability of medicines, 614 (40.66%) did not buy due to financial constraints and 944 (62.51%) felt purchase of medicines difficult due to fear of corona (Fig. 1. F). Participants allowed to choose more than one reason in case of multiple answers applied. Among 1510 participants, a total of 1326 (87.81%) didn't have access to healthcare services as before the pandemic (Fig. 1. G). The major reasons for cancellation and postponement of appointments with doctors were a) fear of getting infected with COVID-19 – 1365 (90.39%), b) absence of physician from the clinic – 1250 (82.78%), c) lack of communication with clinics – 1032 (68.34%), and d) financial constraints – 997(66.02%). Participants were asked to choose more than one reason in case of multiple answers applied (Fig. 1. H). A total of 1351 (89.47%) expressed that the COVID-19 pandemic disrupted their therapy [majorly –1011 (66.95%) and slightly – 340 (22.51%)] (Fig. 2. C). Further, Logistic regression analysis showed a significant correlation with regard to increasing age and reporting of an increase in BGLs ($r = 0.89$, $p = 0.0154$), (Fig. 3).

4. Discussion

This study provides the firsthand evidence of major disruption in diabetes care activities during and after the lockdown phase in India. With India witnessing exponential growth in COVID-19 cases since the start of unlocking [2], the challenged healthcare resources laid down falling short to meet the needs of the entire population, including individuals with diabetes.

In our survey, we found the majority of people irrespective of being in urban or rural localities, were not able to follow up with doctors. However, people living in rural areas were found to have an additional level of difficulties through traveling, making it more inconvenient for them to see a doctor. With global priorities set to contain the spread of the virus, the absence of physicians for people having NCDs and fear of getting infected with COVID-19 are playing key roles in the disruption of diabetes care. Other major factors identified were financial constraints and altered work-timings of clinics due to pandemic. The majority of participants monitoring their BGL either at home/laboratory/clinic said that they observed a spike in their BGL. Our data mainly consisted of people having type-2 diabetes (87.01%). Recent literature has mainly focused on disrupted glycemic control among type-1 diabetes people [19,21]. Therefore, irrespective of the type of diabetes, there is a need to monitor BGLs in this population. Diabetes people infected with SARS-CoV-2 had a more than triple mortality rate of 7% in comparison to 2% in those without diabetes [22]. Uncontrolled diabetes has the potential to results in long-term complications, if not addressed at the earliest [12]. 53% of participants had digital glucometer at home while 47% didn't have. This was not studied previously. In the times of COVID-19, the use of such devices are a must for diabetes people and they should be educated about its importance. Pharmacists working in clinical settings and dispensing areas can play a great role in patient education about such devices. Concerning authorities should make sure that no shortage of such devices happens. Regardless of the existence of pandemic, such devices help diabetics for self-monitoring and self-care [23].

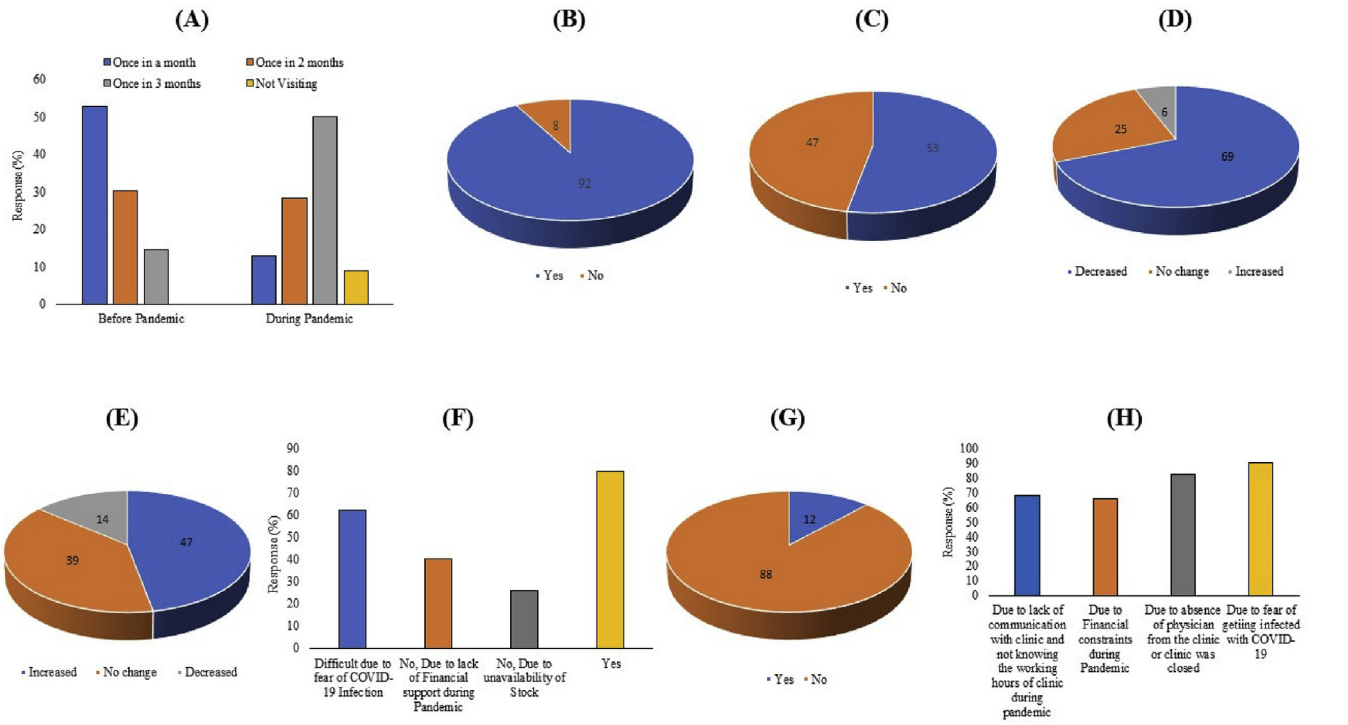

Fig. 1. Impact of COVID-19 pandemic on the factors relating to the glycemic control among participants: (A) Impact of COVID-19 on clinic visits of participants. (B) Participants monitoring their blood glucose levels. (C) Participants having apparatus to measure blood glucose levels at home. (D) Physical activity of participants (E) Eating habits of participants (F) Ability to buy medicines during the pandemic. (G) Access to healthcare services as compared to pre-pandemic period (H) Reasons for postponement or cancellation of appointment with physician. Categorical variables are expressed as frequency (percentage).

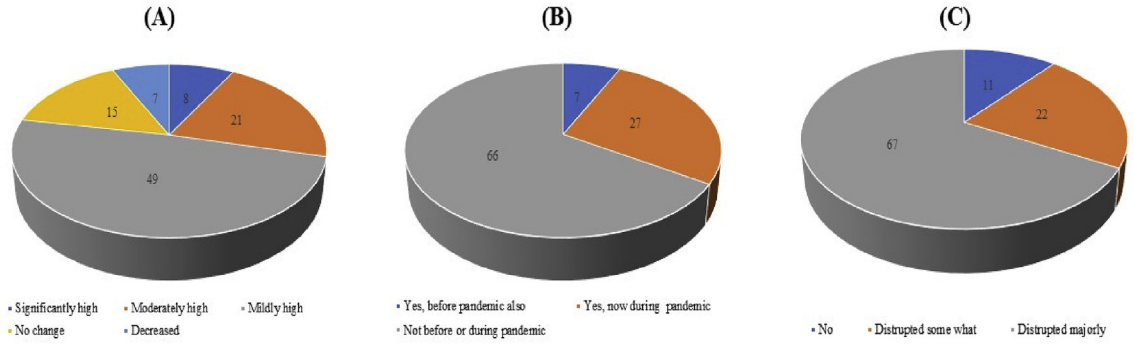

Fig. 2. Outcomes observed due to disruption in glycemic control factors among participants
(A) Increase in BGLs (B) Virtual consultation, and (C) BGL disruption.

With no doubts, lockdown measures and mobility restrictions were found effective to control the spread of COVID-19 [24], but, at the same time, showing their harmful consequences on prevention and control of diabetes and other NCDs [25]. Barone et al., reported that stricter measures against the pandemic may lead to present and future severe impact on diabetes care in South and Central America [26]. Though mobility restrictions are eased during the post-lockdown phase in India, fear of getting infected with COVID-19 and "work from home" scenario is keeping people confined to their homes only. 69.07% of participants experienced a decrease in their physical activity and 46.88% had an increase in their food intake than before. A decrease in physical activity of diabetes people (59.5%) was also reported by Barone et al. The study also reported an increase in food intake (29.71%) among diabetics. In line with recommendations suggested by Barone et al., internet and television broadcasting can be used as an effective medium to create awareness among people of habits and behaviors, such as regular physical activity [16]. However, the use of television by participants was not investigated in the current study. The proportion of people using virtual consultation platforms with doctors has significantly increased. Only 7.68% of participants said of using virtual consultation before while it got increased to 29.80% during the pandemic. A pilot study from Government medical university reported 4880 teleconsultations were given by 38 ophthalmologists during COVID-19 lockdown in India [27]. Overall, 87.81% of participants said not having access to overall healthcare services as before and 89.47% said pandemic has disrupted their therapy. Increased age people were found to have the worst glycemic control ($p = 0.0154$). The presence of comorbidities and behavioral habits predicted increase BGLs, but did not reach statistical significance. Many participants in the comment section provided at the end said that they are more stressed about uncertainty prevailing

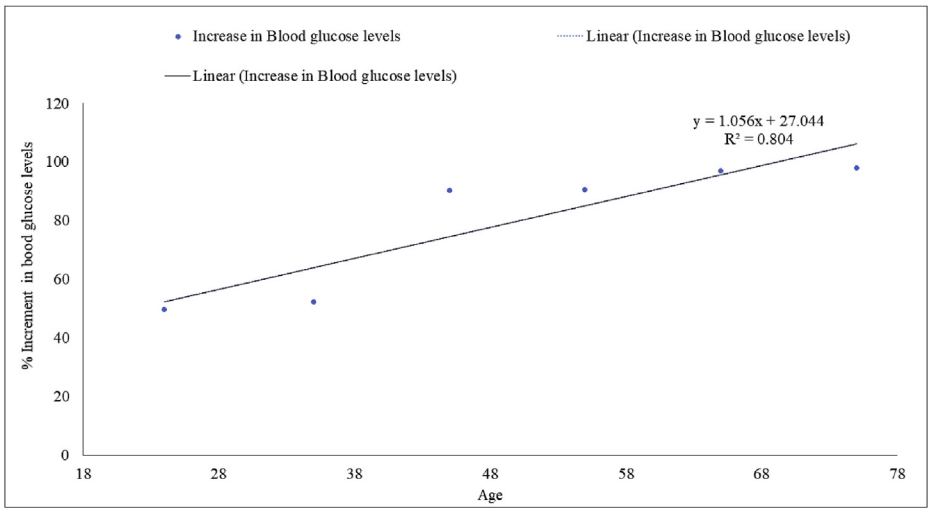

Fig. 3. Linear regression analysis between age and %increment in blood glucose levels ($P < 0.05$).

due to pandemic and waiting for normalcy to return. LE Joesnen et al., reported an increase in COVID-19 specific worry among diabetics in Denmark [28].

The results from our survey revealed flaws in government measures, healthcare policies to protect this vulnerable group of people from public health emergency due to the COVID-19 pandemic. Though a lot of plans are being made by the government and states [2], they did not cover most of this population. We found people with old age are those having a major disruption in the BGLs. Since the risk of becoming severely ill with SARS-CoV-2 appears to be high in people with increased age and poorly controlled diabetes, disturbed diabetes care is paying the way for the consequences that might be worse than the pandemic itself. This may also result in the diabetes population in India projected to grow 134 million by 2045 much sooner than predicted earlier. As India has entered into the "unlock" phase, an increase in COVID-19 caseload is resulting in an additional disruption in care for diabetes people. Since many other countries have also entered into the "unlocking phase", an immediate call to look for people having diabetes seems eminently appropriate. Self-monitoring of BGLs through devices like digital glucometer is essential. Availability of medicines, diagnostic tools shouldn't get under stocked. Diabetes people should be educated about the symptoms of hyperglycemia, essentially in times when their visit to doctor's in-person appears risky and difficult. Though the use of telemedicine platforms is growing with much attention in India since the beginning of the pandemic, many milestones are still needed for its acceptance among people [29]. Since many people in the survey said fear of getting infected with COVID-19 and the absence of physicians from clinics were the main reasons for therapy disturbance, clear knowledge and understanding of people about telemedicine will provide greater convenience while not having to expose themselves to infection in an in-person clinic. Broader strategies to protect people's jobs and economic crises arising from pandemic are essential.

5. Limitations

The main limitations of our study includes a) our sample is not reflective of the diabetic population of India. We had more than two-third participants from Southern India (72.51%) therefore the geographical distribution could lead to varying responses. b) All responses have been collected through online-mode without having access to objective data to validate the subjective responses and c) only people having internet facilities were able to participate in survey while India has 58.52% of people who don't have access to the internet.

6. Conclusions

Our study revealed a severe disruption in diabetes care activities during and after the lockdown phase in India. The COVID-19 pandemic has created additional challenges for the healthcare sector and people with diabetes are not spared from this. Though the lockdown measures are eased, the ongoing pandemic continues to devastate the healthcare services for NCDs. Considering more severe symptoms and complications of SARS-CoV-2 in diabetics; disrupted glycemic control, physical inactivity and altered food consumption are paying the way for consequences that may be worse than the epidemic itself. India is having the second largest diabetes population globally and need an additional set of measures to be implemented soon. Teleconsultation, use of digital devices, minimizing sedentary behavior, and home delivery of medicines should be encouraged among people with diabetes and NCDs.

Funding

The authors received no specific funding for this work.

Author contributions

All 3 authors (AKM, TJ and RN) contributed equally to the designing of study, acquisition and analysis of data, preparation, revision and final version of approval of the manuscript. All authors have read and consented to the manuscript.

Declaration of Competing interest

The authors declare no conflict of interest.

Acknowledgments

We are immensely grateful to all the participants who took part in the survey. We thank our colleagues who greatly assisted the research. We thank Dr. Laeeq Ur Rehman who helped to distribute

the anonymous survey to all diabetic groups and target physicians. We thank our friends across the states in helping us to distribute the survey platform to diabetics.

References

[1] Madabhavi I, Sarkar M, Kadakol N. COVID-19: a review. Monaldi Arch Chest Dis Arch Monaldi Mal Torace 2020;90. https://doi.org/10.4081/monaldi.2020.1298.

[2] Mohanty SK. Contextualising geographical vulnerability to COVID-19 in India. Lancet Glob Health 2020. https://doi.org/10.1016/S2214-109X(20)30329-6.

[3] Webster P. Virtual health care in the era of COVID-19. Lancet Lond Engl 2020;395:1180–1. https://doi.org/10.1016/S0140-6736(20)30818-7.

[4] The Lancet null. India under COVID-19 lockdown. Lancet Lond Engl 2020;395:1315. https://doi.org/10.1016/S0140-6736(20)30938-7.

[5] Guan W-J, Ni Z-Y, Hu Y, Liang W-H, Ou C-Q, He J-X, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708–20. https://doi.org/10.1056/NEJMoa2002032.

[6] Li X, Xu S, Yu M, Wang K, Tao Y, Zhou Y, et al. Risk factors for severity and mortality in adult COVID-19 inpatients in Wuhan. J Allergy Clin Immunol 2020;146:110–8. https://doi.org/10.1016/j.jaci.2020.04.006.

[7] 73% of COVID-19 deaths in India are people with comorbidities, no underreporting of deaths: Govt. 2019. https://www.livemint.com/news/india/73-of-covid19-deaths-in-india-are-people-with-co-morbidities-health-ministry-11591094600772.html.

[8] Bloomgarden ZT. Diabetes and COVID-19. J Diabetes 2020;12:347–8. https://doi.org/10.1111/1753-0407.13027.

[9] Geerlings SE, Hoepelman AI. Immune dysfunction in patients with diabetes mellitus (DM). FEMS Immunol Med Microbiol 1999;26:259–65. https://doi.org/10.1111/j.1574-695X.1999.tb01397.x.

[10] Hussain A, Bhowmik B, do Vale Moreira NC. COVID-19 and diabetes: knowledge in progress. Diabetes Res Clin Pract 2020;162:108142. https://doi.org/10.1016/j.diabres.2020.108142.

[11] Shearer D. COVID-19: the underestimated pandemic impacting people with diabetes. J Diabetes Sci Technol 2020;14:778–9. https://doi.org/10.1177/1932296820929389.

[12] Papatheodorou K, Banach M, Bekiari E, Rizzo M, Edmonds M. Complications of diabetes 2017. J Diabetes Res 2018;2018:3086167. https://doi.org/10.1155/2018/3086167.

[13] Jabeen T, Khader MA, Jabeen S. A Review on the antiparasitic drug Ivermectin for various viral infections and possibilities of using it for novel severe acute respiratory syndrome coronavirus 2: New hope to treat coronavirus disease-2019. Asian J Pharmaceut Clin Res 2020. https://doi.org/10.22159/ajpcr.2020.v13i8.38357.

[14] Zhang G, Yang H, Zhang A, Shen Q, Wang L, Li Z, et al. The impact of the COVID-19 outbreak on the medical treatment of Chinese children with chronic kidney disease (CKD): a multicenter cross-section study in the context of a public health emergency of international concern. Infectious Diseases (except HIV/AIDS); 2020. https://doi.org/10.1101/2020.02.28.20029199.

[15] Dyer O. Covid-19: pandemic is having “severe” impact on non-communicable disease care, WHO survey finds. BMJ 2020:m2210. https://doi.org/10.1136/bmj.m2210.

[16] Barone MTU, Harnik SB, de Luca PV, Lima BL de S, Wieselberg RJP, Ngongo B, et al. The impact of COVID-19 on people with diabetes in Brazil. Diabetes Res Clin Pract 2020;166:108304. https://doi.org/10.1016/j.diabres.2020.108304.

[17] Kaveeshwar SA, Cornwall J. The current state of diabetes mellitus in India. Australas Med J 2014;7:45–8. https://doi.org/10.4066/AMJ.2013.1979.

[18] Ghosh A, Arora B, Gupta R, Anoop S, Misra A. Effects of nationwide lockdown during COVID-19 epidemic on lifestyle and other medical issues of patients with type 2 diabetes in north India. Diabetes Metab Syndr 2020;14:917–20. https://doi.org/10.1016/j.dsx.2020.05.044.

[19] Verma A, Rajput R, Verma S, Balania VKB, Jangra B. Impact of lockdown in COVID 19 on glycemic control in patients with type 1 Diabetes Mellitus. Diabetes Metab Syndr 2020;14:1213–6. https://doi.org/10.1016/j.dsx.2020.07.016.

[20] Nachimuthu S, Vijayalakshmi R, Sudha M, Viswanathan V. Coping with diabetes during the COVID - 19 lockdown in India: results of an online pilot survey. Diabetes Metab Syndr 2020;14:579–82. https://doi.org/10.1016/j.dsx.2020.04.053.

[21] Pal R, Yadav U, Verma A, Bhadada SK. Awareness regarding COVID-19 and problems being faced by young adults with type 1 diabetes mellitus amid nationwide lockdown in India: a qualitative interview study. Prim Care Diabetes 2020. https://doi.org/10.1016/j.pcd.2020.07.001.

[22] Gupta R, Hussain A, Misra A. Diabetes and COVID-19: evidence, current status and unanswered research questions. Eur J Clin Nutr 2020;74:864–70. https://doi.org/10.1038/s41430-020-0652-1.

[23] Beran D, Aebischer Perone S, Castellsague Perolini M, Chappuis F, Chopard P, Haller DM, et al. Beyond the virus: ensuring continuity of care for people with diabetes during COVID-19. Prim Care Diabetes 2020. https://doi.org/10.1016/j.pcd.2020.05.014.

[24] Ghosal S, Bhattacharyya R, Majumder M. Impact of complete lockdown on total infection and death rates: a hierarchical cluster analysis. Diabetes Metab Syndr 2020;14:707–11. https://doi.org/10.1016/j.dsx.2020.05.026.

[25] Ghosal S, Sinha B, Majumder M, Misra A. Estimation of effects of nationwide lockdown for containing coronavirus infection on worsening of glycosylated haemoglobin and increase in diabetes-related complications: a simulation model using multivariate regression analysis. Diabetes Metab Syndr 2020;14:319–23. https://doi.org/10.1016/j.dsx.2020.03.014.

[26] Barone MTU, Villarroel D, de Luca PV, Harnik SB, Lima BL de S, Wieselberg RJP, et al. COVID-19 impact on people with diabetes in South and Central America (SACA region). Diabetes Res Clin Pract 2020;166:108301. https://doi.org/10.1016/j.diabres.2020.108301.

[27] Pandey N, Srivastava RM, Kumar G, Katiyar V, Agrawal S. Teleconsultation at a tertiary care government medical university during COVID-19 Lockdown in India - a pilot study. Indian J Ophthalmol 2020;68:1381–4. https://doi.org/10.4103/ijo.IJO_1658_20.

[28] Joensen LE, Madsen KP, Holm L, Nielsen KA, Rod MH, Petersen AA, et al. Diabetes and COVID-19: psychosocial consequences of the COVID-19 pandemic in people with diabetes in Denmark-what characterizes people with high levels of COVID-19-related worries? Diabet Med J Br Diabet Assoc 2020;37:1146–54. https://doi.org/10.1111/dme.14319.

[29] Ghosh A, Gupta R, Misra A. Telemedicine for diabetes care in India during COVID19 pandemic and national lockdown period: guidelines for physicians. Diabetes Metab Syndr 2020;14:273–6. https://doi.org/10.1016/j.dsx.2020.04.001.