Title Page

Title: Guardian reported impact of the COVID- 19 Pandemic on the lifestyle of children with diabetes mellitus

Short Title: COVID -19 Pandemic impact on children with diabetes mellitus

Authors

Author 1 :
Dr Varuna Vyas
Associate Professor
Department of Pediatrics,
All India Institute of Medical Sciences, Jodhpur
India
Email address: drvaruna.vyas@gmail.com

Author 2 :
Dr Kuldeep Singh
Professor and Head
Department of Pediatrics,
All India Institute of Medical Sciences, Jodhpur
India
Email address: kulpra@gmail.com

Author 3 :
Dr Puneet Pareek
Additional Professor
Department of Radio- Therapy,
All India Institute of Medical Sciences, Jodhpur
India
Email address: drpuneetpareek@gmail.com

Author 4 :
Dr. Mahendra Kumar Garg
Professor and Head
Department of Endocrinology
All India Institute of Medical Sciences, Jodhpur
India
Email address: mkgargs@gmail.com

Author 5 :
Dr Siyaram Didel
Assistant Professor
Department of Pediatrics,
All India Institute of Medical Sciences, Jodhpur
India
Email address: drdsram2001@gmail.com

Author 6 :
Dr Priyanka Priyanka
Senior Resident
Department of Pediatrics,
All India Institute of Medical Sciences, Patna
India
Email address: priyanka01.1991@gmail.com

Author 7 :
Dr. Akhil Dhanesh Goel
Associate Professor
Department of Community Medicine and Family Medicine
All India Institute of Medical Sciences, Jodhpur
India
Email address: doc.akhilgoel.aiims@gmail.com

Author 8:
Dr Sanjeev Misra
Director
Professor and Head
Department of Surgical Oncology
All India Institute of Medical Sciences, Jodhpur
India
Email address: misralko@gmail.com

Corresponding Author:
Name: Dr Varuna Vyas
Email Address: drvaruna.vyas@gmail.com
Address: Department of Pediatrics, Room number 3147, Academic Block, All India Institute of Medical Sciences, Jodhpur
Jodhpur, Rajasthan, India 342005
Telephone number: + 91 9810508477

Funding: None
Conflict of Interest: The authors have no conflict of interest to declare.

Guardian reported impact of the COVID- 19 Pandemic on the lifestyle of children with diabetes mellitus

Abstract

Introduction: The Coronavirus disease-2019 (COVID-19) Pandemic has had an unprecedented impact on the lives and lifestyles of people of all ages worldwide. Lifestyle has an essential role in the management of diabetes in children.

Methods: The study was carried out at a tertiary care centre in India. A telehealth survey was conducted among the parents/ guardians of children with diabetes to study the impact of the COVID - 19 Pandemic. The survey evaluated effects on lifestyle, diabetes management, and challenges in connecting to a new telemedicine program.

Results: The survey was completed by guardians of 91 patients. The mean age of the patients was 13.0±3.8 years in boys and 11.9±4.5 years in girls. Fifty-seven per cent of them were boys, and 63.7% stayed in rural areas. The pandemic has resulted in a significant increase in screen time and sleep duration. The median non-educational screen time has gone up from 1.00 (0.5-2.0) hours to 2.50 (1.0-4.0) hours. The mean sleep duration in children increased from 9.1 ± 1.4 hours to 9.7 ± 1.4 hours. Telemedicine services have been established with minimum resources, but they have limitations, and awareness about them is limited.

Conclusion: The COVID- 19 Pandemic has made the lifestyle of children with diabetes more sedentary. Some of them have also faced challenges with regard to diabetes-related supplies and management. It would be fair to anticipate more complications related to this sedentary lifestyle in the future and work towards identifying and treating them.

Keywords: COVID- 19, children, diabetes mellitus

Introduction

The Coronavirus disease - 2019 (COVID-19) Pandemic has been an unprecedented and challenging situation. There has been a multifaceted impact on children with the complete closure of physical offline schools, mobility restriction, and economic fallout [1]. The healthcare infrastructure availability and utilization have also changed [2]. Children with diabetes mellitus are a vulnerable group that need individualized treatment, regular checkups, monitoring and engagement in an active lifestyle [3] and are entirely dependent on insulin for their survival. While data from around the world has shown that children are less likely to be affected by the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)[4], patients with diabetes are at risk of poor prognosis [5]. There is a paucity of data on children with diabetes mellitus from developing countries on how they have been affected by the COVID 19. Experience with telemedicine in this group is also limited. We had a cohort of children with diabetes mellitus following up at the Department of Pediatrics at our hospital before the COVID-19 Pandemic began. Many of these patients are poor and travel long distances to reach the hospital. We hence decided to reach out to these patients proactively and evaluate how the pandemic was affecting them while also connecting them to our new telemedicine program.

Aim

To study the impact of the COVID 19 Pandemic on the sleep, screen time and physical activity of children with diabetes mellitus and the challenges faced by them in disease management.

At the start of the COVID 19 pandemic, we had a cohort of 140 pediatric patients with diabetes mellitus following up with us. Many of these patients travelled long distances, and some used more than one mode of public transport to reach our hospital. With the pandemic and associated travel restrictions, we were aware that many patients would not be able to come to the hospital for their regular visits. They could have refrained from travelling to the hospital due to fear of the infection, even in emergency situations. Though telemedicine services had been initiated

at our centre soon after the lockdown, we were not sure how many patients would be aware of the same as many patients were coming from outside of our city and were from rural backgrounds. Telemedicine is a new concept in India, with explicit guidelines issued after the onset of the COVID 19 Pandemic. We were apprehensive about whether our patients would be aware of these services or not and that they may not seek help proactively. We also wanted to know how the pandemic and associated lockdown were affecting the children.

We hence decided to contact the caregivers of all children with diabetes mellitus following up in the Department of Pediatrics through a telephonic survey to find out how the children were doing.

Methods

Study design: Prospective observational study

Our centre is a tertiary care, multispecialty medical college hospital located in the northwestern part of India. We have some outreach centres which are dedicated to providing primary care. Children with diabetes mellitus follow up at our centre directly without any intermediary centre in between. Some patients have to travel over 200 kms to reach our hospital. We provide them with outpatient, inpatient as well as intensive care services as required. There are some public as well as private health care providers and health care facilities available in different parts of the state, but they work independently.

Children with type 1 Diabetes Mellitus following up with us in the Department of Pediatrics visit us at least every 3 monthly. Clinical visits in children with diabetes provide an opportunity to review a patient's history, blood sugar records and also to evaluate them physically. At every clinical visit, we check their vitals, including blood pressure, anthropometry and see for lipodystrophy. We also check their HbA1c every 3 monthly. After 2 years of disease in children > 11 years and 5 years of disease in children < 11 years, we start annual screening the patients for microvascular complications related to diabetes mellitus. This includes a detailed

ophthalmologic examination to look for diabetic retinopathy and urine spot albumin to creatinine ratio. Every two years, we also screen them for diabetes-related comorbidities such as hypothyroidism and celiac disease.

The survey was to be answered by the parents or guardians of the children with diabetes mellitus after giving verbal informed consent to participate in the study. Ethical approval was obtained for the study from the Institutional Ethical Committee. Records of all patients were reviewed. They were contacted telephonically on the numbers last registered in the hospital records. A total of 91 patients could be contacted out of 140. The survey was administered to each of the patients by one of the doctors of the treating team. In some cases, children who were 15 years or older also participated along with their guardians. At the end of the survey, patients were provided information on the availability of telemedicine services at our centre and how they can utilise them.

The survey was prepared in Hindi and English and administered in the language selected by the participant. The survey included before and after questions on how the Covid- 19 pandemic affected their lifestyle and questions on problems faced in diabetes management due to the pandemic. They were asked how their sleep pattern, including time to fall asleep and wake up in the morning and mid-day naps, changed with the pandemic. The duration of screen time and physical activity were also assessed similarly. The screen time was considered educational if it was utilised for online classes, watching educational videos related to the school syllabus or doing school syllabus related assignments. If the screen time was spent for in playing video games and watching videos for recreation/ television, it was classified as non-educational. Any activity such as walking, playing outdoors, running, and doing any laborious work at home or outside was considered physical activity. They were also asked whether there was any change in the pattern of junk food consumption, blood sugar checking and hypoglycemic episodes before and after the onset of the pandemic.

Telemedicine is a relatively new concept to many patients in India. Discrete guidelines for telemedicine were issued in India in March 2020. There were however, no dedicated guidelines regarding the management of diabetes mellitus in children. Our hospital communicated the information on the initiation of telemedicine services to the general public via newspapers, and it was also displayed on the website of our hospital. Despite our attempts to provide proactive care, we could include only 65% of our patients. We also inquired about the compliance of patients to insulin therapy, self-monitoring of blood glucose to identify poorly compliant patients at significant risk of acute and chronic complications and asked them to revert to the hospital at the earliest.

All the data was recorded in a proforma. The study was carried out between June 2020 and August 2020. Data was analysed using SPSS version 23. Descriptive analysis of patient demographics and clinical variables was performed using counts and proportions for categorical variables and mean and SD for continuous parametric data. Median and interquartile ranges were used for non-parametric data.

Results

Patient demographics

The mean age of the patients was 13.0±3.8 years in boys and 11.9±4.5 years in girls (p value=0.19). There were 52 (57.1%) males, and 58 (63.7%) children belonged to rural areas. A total of 64 (70.3%) patients were on a split-mix regime with NPH (Neutral protamine Hagedorn) and regular insulin, whereas 23 (25.3%) were on the basal-bolus regime, and the rest 4(4.4%) were on regimes consisting of premixed insulins. The median distance from the place of residence of our patients to the hospital was 120 kilometres (km) (IQR 25-200 km). In urban areas, the median distance was 60 km (IQR 7-200 km), and in rural areas, it was 125 km (IQR 70-200).

Patients in both rural and urban areas faced problems in procuring diabetes-related medical supplies (Table 1). Parents also used help from drivers of trucks supplying essentials such as petrol or travelled themselves in these trucks to get diabetes-related medical supplies. In one case, the family decided to decrease the dose of insulin due to its precarious availability.

The patients reported that the health facility located closest to their homes was at a median distance of 7 km (IQR 2-20 km) in rural areas and 3km (IQR 1-9 km) in urban areas. These health facilities ranged from Primary Health Centers to District hospitals, private clinics and hospitals.

Due to the closing down of schools and restriction of outdoor activities, there has been a mixed impact on the lives of children (Table 2).

Before the pandemic, the mean sleep duration in rural areas was 9.6 ± 1.3 hours, against 8.2 ± 1.2 hours in urban areas. After the pandemic, the mean sleep duration increased in rural areas to 10 ± 1.3 hours against 9.2 ± 1.3 hours in urban areas. Overall, the mean sleep duration in children increased from 9.1 ± 1.4 hours to 9.7 ± 1.4 hours (p-value <0.001). There was no significant effect on the eating habits or frequency of hypoglycemic episodes.

Connecting to a new telemedicine program:

When contacted by our team, only families of 13.8% of patients living in rural areas and 3% of those living in urban areas were aware of the telemedicine program. Most patients became aware of the telemedicine services only through the telehealth call made by our team.

Five patients were found to be ineligible to continue without visiting the hospital; due to poor compliance and not checking their blood sugars, and they were asked to revert to the hospital at the earliest. Tele consultations consisted of receiving blood glucose records, HbA1c reports etc., using mobile applications such as WhatsApp. The patients sent these records whenever it was convenient to them. The doctors reviewed these records and called them in designated telemedicine consultation timings. The doctor reverts to the patients via voice call, discusses

their blood glucose logs, changes made to the treatment and addresses any other concerns. Each call was also utilised to provide continuing education about the disease, especially the need for compliance and symptoms and management of hypoglycemia. They were given a chance to clarify any doubts/ other concerns that they may have. As we do not have any diabetes educator or outreach paramedical staff, we try to educate and empower the patient and his family for optimum diabetes management. After this, the advice is communicated to them in writing as well.

Discussion

The COVID-19 pandemic has been a harbinger of optimum utilisation of telecommunication services in fields like health and education. In our study, we have found that with the COVID-19 Pandemic, there has been a statistically significant increase in non-educational screen time as well as sleep duration. A study by Khan et al. in UAE showed that each hour increase in screen time is associated with a 21% greater likelihood of having metabolic syndrome [6]. This study was carried out before the COVID- 19 Pandemic. The screen time in this study was self-reported time spent in computer game use, videos, and television on a typical day in the past 30 days. They considered screen time as a dichotomous variable being less than 2 hours or being 2 hours or more. Post the pandemic, schools and after school tuitions etc., have gone online. Thus, adding a component of educational or compulsory screen time to the screen time spent for recreation. The educational screen time depends on the school and the age of the child. The educational screen time may increase access to the screen for many children and lead to an increase in the non-educational screen time as well.

On the other hand, no increase in screen time may suggest a lack of access to education during the pandemic. In our study, the rise in median non-educational screen time is 1.5 hours. The long-term implications of this remain to be seen. The future possibilities of increased cardiometabolic risk need to be kept in mind.

Sleep disturbance is seen as a risk factor for developing diabetes mellitus in adults [7] but literature on effect of sleep disturbance on children who already have diabetes is limited. Most of our patients had Type 1 Diabetes Mellitus, and all our patients were entirely dependent on insulin. None of our patients had type 2 diabetes mellitus. The mean sleep duration in both rural and urban areas was more than 8 hours before the start of the pandemic, and after the pandemic, there has been a significant increase in the sleep duration as well. The increase in screen time and sleep duration may have arisen due to temporary compulsions, leading to more permanent habits. In a descriptive study completed by parents of 515 children it was found that poor sleep quality in children with type 1 diabetes was associated with higher HbA1C and worse parental well being and worse parental sleep quality. The study also reported that shorter sleep duration (<9 hours) was associated with higher HbA1C.[8] Despite an extensive search, we could not find how an increased sleep duration affects children, especially those with diabetes mellitus. The pandemic has created new risk factors, the effect of which will only be known in the future. However, increasing sedentariness of children is the hallmark of the COVID-19 pandemic. Increased sedentariness leads to increased fat, increased insulin resistance and increased inflammatory cytokines [9]. These, in turn, will be risk factors for cardiovascular diseases.

A systematic review on the impact of the COVID 19 pandemic on children with diabetes was published in December 2020 [10]. It highlighted the lack of availability of diabetes-related supplies and delayed diagnosis of new-onset type 1 diabetes mellitus. The review also included a few studies on lifestyle. A web-based survey from Italy that included 204 children with diabetes found that despite the lockdown, two-thirds of the patients regularly engaged in physical activity[11]. The study did not evaluate the impact on sleep. Another Italian study retrospectively assessed the glycemic control in 13 types 1 diabetes mellitus patients using a hybrid closed loop system (insulin pump with continuous glucose monitoring)[12]. They

concluded that the glycemic control did not worsen during the periods of restrictions and lockdown and improved in those who were practising physical activity for more than 3 hours a week. None of our patients was on continuous glucose monitoring, and self-monitoring of blood glucose patterns were highly variable. Hence it is difficult to comment on the blood glucose control during the pandemic in our cohort.

The pandemic has suddenly brought telemedicine services to the forefront. Studies utilising telemedicine in diabetes mellitus have been published for nearly two decades now [13], but the experience from India is limited. One of the initial studies published from Italy involved four children and had computer-based software installed at the patients' house. This study involved four patients with a team of 6 healthcare professionals and bimonthly clinical visits [14]. More recent studies have utilised mobile applications [15]. Other studies have used videoconferencing technology for virtual outreach patients; however, each outreach telemedicine clinic had an onsite measurement of HbA1C, height, weight, blood pressure and certified education support [16] or the services of a telemedicine unit in the school nurses office and involved the school nurse [17]. These are elective studies with the availability of manpower and other resources and cannot be extrapolated to our setting. Studies on pediatric telemedicine in India were very limited. Hence it was difficult to identify an appropriate model. During our telemedicine survey, we found some patients ineligible for telemedicine-based care and asked them to return to the hospital at the earliest. Telemedicine is evolving to become a standard model of care; even in developing countries, it is equally important to identify danger signs and define telemedicine eligibility and ineligibility criteria. These criteria can be developed based on subjective clinical experience and should be further objectively validated to avoid under and over call back to the health facility.

A study from India evaluated social franchising and telemedicine programme for childhood diarrhoea and pneumonia. They found that even after three years, there was a large persistent

gap in knowledge of care and the care actually delivered [18]. On the other hand, another study utilising tailored mobile voice messages two times per week delivered to pregnant women throughout their pregnancy and till their babies were one-year-old led to a positive impact on infant birth weight and maternal knowledge [19]. So, if we compare the two, delivering tailor-made messages to the mother was likely to be more effective. We had to initiate telemedicine services suddenly, and there were no outreach services, specially designed software or special training for the patients or other healthcare workers.

There have been concerns regarding limitations in access to care due to the rapid transition to telemedicine during the COVID 19 pandemic. A study from the United States of America has shown that among patients with type 1 diabetes, significantly lower telemedicine adoption rates were seen in non-English-speaking pediatric patients and in those with primary insurance coverage being Medicaid [20]. The authors thus concluded that patients coming from historically marginalised groups merit more attention to ensure access to care through telemedicine.

Our program is convenient, and the expenses at both ends are negligible. A system for taking telemedicine appointments through the hospital website was developed for patients of all specialities. We did not do any formal cost analysis as a part of this study. In India, many telecom companies offer telephone and internet data plans that allow unlimited / (a limited but significant amount of) outgoing calls at a fixed price, and incoming calls are usually free. Thus, there is usually no extra cost involved if the caller and the person receiving the call already have a phone. No specialised software is also necessary. There are many free chat and email applications available that offer an acceptable amount of privacy and security for sharing any personal/medical information. The patients saved on the travelling expenses and time. This kind of model can be used in any resource-limited setting as long as a smartphone/ computer is available at either end with an internet connection.

Resource-rich settings can use more sophisticated resources such as continuous glucose monitoring with mobile applications and software allowing direct data transfer, but we can not say if that will translate into better blood glucose control or patient satisfaction. The limitation of this model was the inability to do a physical examination and assess complications- such as hypertension, diabetic retinopathy etc. The safety of our model will have to be tracked over time. We have to accept that telemedicine may have risks involved in it. Potential risks of teleconsultations can result in missing out on acute and chronic diabetes-related complications. Limited training to the health personnel at nearby health care facilities to manage acute and chronic complications can be helpful. Patients should be encouraged to utilize available locally resources.

Conclusion

The COVID-19 disease has led to disruption of normal lifestyle and increased sedentariness. For children with diabetes mellitus, telemedicine services can be established with minimal resources but it is important to connect patients to these programs and improve access to care. However, there is a possibility of missing out on chronic complications or the development of acute complications. In the post-COVID-19 times, we should anticipate these complications and build programs to deal with them.

Conflict of Interest: The authors have no conflict of interest to declare.

References

1. Kumar R, Bharti N, Kumar S, et al. Multidimensional impact of COVID-19 pandemic in India-Challenges and future direction. J Family Med Prim Care. 2020 31;9:5892-5.
2. Chudasama YV, Gillies CL, Zaccardi F, et al. Impact of COVID-19 on routine care for chronic diseases: A global survey of views from healthcare professionals. Diabetes Metab Syndr. 2020 ;14:965-7.

3. Adolfsson P, Riddell MC, Taplin CE, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Exercise in children and adolescents with diabetes. Pediatr Diabetes. 2018 ; Suppl 27:205-26.

4. Ludvigsson JF. Systematic review of COVID-19 in children shows milder cases and a better prognosis than adults. Acta Paediatr. 2020 ;109:1088-95.

5. Pal R, Bhadada SK. COVID-19 and diabetes mellitus: An unholy interaction of two pandemics. Diabetes Metab Syndr. 2020 ;14:513-7.

6. Khan MA, Shah SM, Shehab A, et al. Screen time and metabolic syndrome among expatriate adolescents in the United Arab Emirates. Diabetes Metab Syndr. 2019;13:2565-9.

7. Anothaisintawee T, Reutrakul S, Van Cauter E, et al. Sleep disturbances compared to traditional risk factors for diabetes development: Systematic review and meta-analysis. Sleep Med Rev. 2016 ;30:11-24.

8. Jaser SS, Foster NC, Nelson BA, et al. Sleep in children with type 1 diabetes and their parents in the T1D Exchange. Sleep Med. 2017;39:108-15.

9. Martinez-Ferran M, de la Guía-Galipienso F, Sanchis-Gomar F, et al. Metabolic Impacts of Confinement during the COVID-19 Pandemic Due to Modified Diet and Physical Activity Habits. Nutrients. 2020;12:1549.

10. Bhuiyan SU, Badran HM, Bhuiyan NT, et al. The Impact of COVID-19 Pandemic on Diabetic Children: A Systematic Review on the Current Evidence. Int jou commu med Health Edu.2020; 105: 1–11.

11. Passanisi S, Pecoraro M, Pira F, et al. Quarantine Due to the COVID-19 Pandemic From the Perspective of Pediatric Patients With Type 1 Diabetes: A Web-Based Survey. Front Pediatr. 2020 31;8:491.

12. Tornese G, Ceconi V, Monasta L, et al. Glycemic Control in Type 1 Diabetes Mellitus

During COVID-19 Quarantine and the Role of In-Home Physical Activity. Diabetes Technol Ther. 2020;22:462-7.

13. Albisser AM, Harris RI, Sakkal S, et al. Diabetes intervention in the information age. Med Inform (Lond). 1996 ;21:297-316.

14. Bellazzi R, Riva A, Montani S, et al. Application report: preliminary evaluation of the T-IDDM project in Pavia. Stud Health Technol Inform. 1999;68:99-101.

15. Agarwal P, Mukerji G, Desveaux L, et al. Mobile App for Improved Self-Management of Type 2 Diabetes: Multicenter Pragmatic Randomized Controlled Trial. JMIR Mhealth Uhealth. 2019 ;7:e10321.

16. Wood CL, Clements SA, McFann K, et al. Use of Telemedicine to Improve Adherence to American Diabetes Association Standards in Pediatric Type 1 Diabetes. Diabetes Technol Ther. 2016 ;18:7-14.

17. Izquierdo R, Morin PC, Bratt K, et al. School-centered telemedicine for children with type 1 diabetes mellitus. J Pediatr. 2009 ;155:374-9.

18. Mohanan M, Giardili S, Das V, et al. Evaluation of a social franchising and telemedicine programme and the care provided for childhood diarrhoea and pneumonia, Bihar, India. Bull World Health Organ. 2017 ;95:343-52E.

19. Murthy N, Chandrasekharan S, Prakash MP, et al. The Impact of an mHealth Voice Message Service (mMitra) on Infant Care Knowledge, and Practices Among Low-Income Women in India: Findings from a Pseudo-Randomized Controlled Trial. Matern Child Health J. 2019 ;23:1658-69.

20. Tilden DR, Datye KA, Moore DJ, et al. The Rapid Transition to Telemedicine and Its Effect on Access to Care for Patients With Type 1 Diabetes During the COVID-19 Pandemic. Diabetes Care. 2021 ;44:1447-50.

Table 1: Challenges faced by the patients in procuring medical supplies

Problem	Rural Area (58)	Urban Area (33)
Difficulty in procuring insulin	6 (10.3 %)	3 (9.1%)
Difficulty in procuring glucometer strips	9 (15.5%)	4 (12.1%)
Difficulty in procuring both	1(1.7%)	0

Table 2: Effect of the COVID 19 Pandemic on the duration of screen time and physical exercise as expressed in Median (IQR) hrs.

	Before	After	p-value (Related Sample Wilcoxon Signed Rank Test)
Non educational screen time	1.00 (0.5-2.0)	2.50(1.0-4.0)	<0.001
Duration of physical exercise	1.50(1.0-2.0)	2.00(0.5-3.0)	0.148