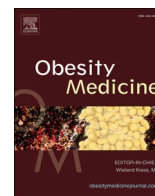




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Changes in self-care behaviors of Iranian patients with type 2 diabetes using insulin pens during COVID-19 pandemic

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ARTICLE INFO

Keywords:

COVID-19
Self-care
Diabetes
Insulin pen

ABSTRACT

Aims: The COVID-19 pandemic as a serious public health concern has been accompanied with changes and restrictions in everyday life. This can affect directly or indirectly health behaviors and disease management, particularly in developing countries with low resources. This study aimed to compare self-care behaviors of patients with type 2 diabetes using insulin pens before and after the COVID-19 pandemic.

Methods: This was a prospective cohort study involving 300 patients with type 2 diabetes who had been referred to a referral tertiary care diabetes clinic during 2018–2019. The Summary of Diabetes Self-Care Activities Assessment (SDSCA) questionnaire was used for the evaluation of 5 self-care activities.

Results: The mean total self-care score before and one year after the onset of the COVID-19 crisis was 37.63 (SD, 10.89) and 26.14 (SD, 10.99), respectively. Before the COVID-19 crisis, 27%, 54.3%, and 18.7% of patients had poor, moderate, and good self-care, respectively. One year after the onset of the epidemic, however, these rates were 66.3%, 29%, and 4.7%, respectively. There was a significant difference between the mean score of 5 indices of self-care behaviors before and after the COVID-19 crisis ($p < 0.01$).

Conclusion: Our findings suggest the deterioration of self-care behaviors amidst the COVID-19 pandemic in an Iranian population. Continuous follow-up of patients with diabetes and the design of effective educational programs for these patient can prevent or delay the long-term consequences of diabetes, especially in the context of the COVID-19 crisis.

1. Introduction

The COVID-19 infection was announced as a pandemic by the World Health Organization (WHO) on 30 January 2020 (Rahman et al., 2021). This unprecedented disaster has had an enormous adverse impact on all aspects of human life, including a significant increase in the rate of mortality and morbidity, disruption of the health system, and imposed extra burdens on communities (Geburu et al., 2021; Menges et al., 2021; Sen et al., 2021). The presence of some co-morbidities including hypertension, cardiovascular disorders, diabetes, and cerebrovascular diseases have been associated with a higher rate and more severe cases of COVID-19 infections, a greater need for hospitalization and intensive care, and poorer related outcomes of the disease (Aberhe et al., 2021; Corrao et al., 2021; Emami et al., 2021; Honardoost et al., 2021). Results of a systematic review and meta-analysis showed that 40.80% of the affected people had co-morbidities. While hypertension is associated with more severe and fatal cases (47.65% and 47.90% respectively),

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diabetes is more prevalent among fatal cases compared with total cases (24.89%)(Gold et al., 2020). Diabetes as one of the most important comorbidities is reported in 5–36% of COVID-19 patients(Corrao et al., 2021). After adjustment for confounders, the risk of severe complications and mortality from COVID-19 is 100–250 percent higher in patients with diabetes compared with people without diabetes(Gregg et al., 2021).

The impact of lockdown and social distancing may lead to changes in everyday life, routine health care, and the management of chronic diseases such as diabetes (Eberle and Stichling 2021). In addition to the direct effects of the COVID-19 epidemic on mortality and morbidity in patients with diabetes, this condition can have indirect adverse effects on the diagnosis, prevalence, and self-management of the disease due to changes in the function of the health care system, social support, and patient's everyday lifestyle and health behaviors (Gregg et al., 2021). These effects include changes in diet and consumption of high-calorie foods, promotion of a sedentary lifestyle, insufficient sleep, increased social and economic problems, and difficult access to hospitals or pharmacies (Lippi et al., 2020; Önmez et al., 2020; Biancalana et al., 2021; Durães et al., 2021; Eberle and Stichling 2021; Karatas et al., 2021).

To better control hyperglycemia and prevent or at least delay the complications in patients with diabetes, the most important components of diabetes self-management that should be taken into account include regular monitoring of blood glucose, following a healthy diet, regular physical activity, and compliance with medication and foot care (Shrivastava et al., 2013; Chamberlain et al., 2016, care 2018). Suboptimal adherence to diabetes self-care activities, particularly in developing countries, has been reported in several studies (Debussche et al., 2009; Shrivastava et al., 2013; Mutyambizi et al., 2020). Self-care behaviors are influenced by various individual, family, and social factors (Shrivastava et al., 2013; Mogre et al., 2020). During the COVID-19 pandemic, the most important challenges of diabetes care management in developing countries include inadequate preventive measures, interrupted traditional methods of relationship with the patient, shortage of medications, disruption of routine diabetic care, and absence of the necessary infrastructure for telehealth services(Noughjah et al., 2020). An upward trend of diabetes prevalence has been reported in Iran, as in many other countries (Esteghamati et al., 2014; Mirzaei et al., 2020). In addition to the challenges associated with diabetes management in developing countries, Iran has faced certain difficulties due to tightening sanctions in the last two years (Gorji 2014; Takian et al., 2020). In fact, the burden of sanctions was doubled during the COVID-19 crisis in Iran (Abdoli, 2020). Shortage or the high prices of drugs such as insulin pens escalated the anxiety of patients with diabetes and complicated the management of their disease during the COVID-19 crisis (Gharebaghi and Heidary 2020; Peimani et al., 2022). Therefore, this study was designed to examine the effect of COVID-19 pandemic on self-care behaviors in patients with type 2 diabetes using insulin. The main hypothesis of this study (H1) was: COVID-19 pandemic has a significant effect on diabetes self-care in patients with type 2 diabetes using insulin pens.

2. Methodology

This ongoing prospective cohort study included 300 patients with type 2 diabetes who had been referred to a referral tertiary care diabetes clinic for training on how to inject pen insulin during one year (2018–2019) were included. The Diabetes Clinic of Golestan Hospital is the only subspecialty referral center for patients with diabetes in Khuzestan province, southwest of Iran. This clinic was established in 2000 and annually welcomes more than 5000 outpatients and inpatients in the internal medicine ward of this hospital. It provides basic training on insulin injection techniques and the related details to nearly 500 new insulin users. This clinic is located in Ahvaz city, the capital of Khuzestan where the incidence of diabetes is particularly high (Latifi et al., 2016). The process of the patient's recruitment is presented in Fig. 1.

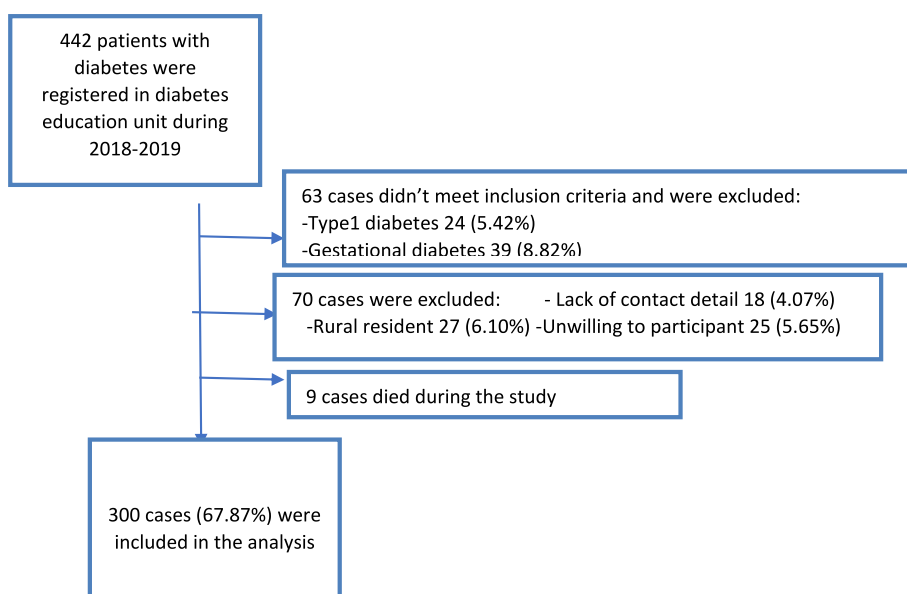


Fig. 1. Flowchart of the patient recruitment process.

A standard questionnaire including demographic information, disease characteristics, and Summary of Diabetes Self-Care Activities Assessment (SDSCA) was completed by trained practitioners through face-to-face interviews before the start of COVID infection as a part of a semi-experimental study (Ghodrati et al., 2019). Contact information of these patients was available and in our prospective study, a questionnaire, a checklist of diabetes tests and complications of diabetes after COVID-19 crisis was completed via phone and social networks. During the COVID-19 outbreak, patients sent photos of their tests and other details of self-management via smart-phone social media messaging apps (WhatsApp and Telegram).

Toobert and Glasgow Diabetes Summary Self-Care Scale was used to measure patients' self-care behaviors before and after the COVID-19 crisis (Toobert et al., 2000). SDSCA contained 12 questions that were scored based on a seven-point Likert scale. We removed the question on smoking because none of the women and only a few men in our study smoked, and most previous studies also focused on the five main areas and eliminated this item (Hurst et al., 2020; Binhardi et al., 2021; Almomani and Al-Tawalbeh 2022). Therefore, we used 11 items which assess five aspects of diabetes self-care activities, including diet (4 questions), physical activity (two questions), insulin injection or proper pill taking (one question), blood sugar self-monitoring (two questions), and foot care (two questions). The questions allow the patients to report the extent and frequency of their diabetes self-care behaviors over the past seven days. The total score of the scale ranges between 0 and 77. In a study conducted by Morwathisharifabad, the content validity of this scale was confirmed using a panel of experts. To determine the internal stability, 45 people were studied. Cronbach's alpha coefficient for the structure of self-care behaviors in the preliminary study and total samples were calculated to be 0.66 and 0.68 respectively (Morwathisharifabad and Rouhani Tonekaboni 2009).

Data were analyzed using SPSS (version 22). The normality of self-care behavior scores were assessed by Kolmogorov-Smirnov test. Non-parametric tests including Kruskal-Wallis and Wilcoxon tests were used for comparison of the mean scores of self-care behaviors.

3. Results

In this study, the self-care behaviors of patients with type 2 diabetes who used insulin pen were compared before and after the COVID-19 epidemic. Within one year of the COVID-19 spread, nine patients who met the eligibility criteria, died, and the analysis was performed on 300 patients.

The mean age of patients was 53.85 (SD, 10.88) years. About half of the patients were female. The mean length of the disease was 11.69 (6.01) years. Also, 12.3% of the patients stopped using insulin pens, and 22.3% changed the type of insulin or the dosage of the drug. In the first 6 months of the epidemic, 6.7% checked their blood glucose in the laboratory within the 6 months following the start of COVID-19 infection, and 31.7% of them checked it within one year. Laboratory plasma glucose testing was reported in 174 (58%) of patients with diabetes before the COVID-19 epidemic, and 226 (75.3%) had glucometers. Regular visits to physicians fell from 63.7% to 45.3% within one year of pandemic situation.

The mean total self-care score before and one year after the onset of the COVID-19 crisis was 37.63 (SD, 10.89) and 26.14 (SD,

Table 1
Self-care scores of patients with diabetes using insulin pen before and after COVID-19 epidemic based on their demographic and clinical characteristics.

Variable	Frequency	Percentage	Self-care score Before COVID-19 Mean (SD)	P value	Self-care score One year After COVID-19 Mean (SD)	P-value
Gender	157	52.3	38.40 (11.02)	0.20	26.75 (11.20)	0.31
Female	143	47.7	36.79 (10.73)		25.47 (10.74)	
Male						
Educational attainment	48	16	38.18 (10.8)	0.82	23.95 (9.99)	0.13
Illiterate	47	15.7	37.57 (10.89)		25.76 (11.82)	
Primary school	55	18.3	38.00 (12.3)		28.94 (11.14)	
Junior high school	95	31.7	36.93 (10.77)		26.76 (11.13)	
High school	55	18.3	37.05(10.24)		24.50 (10.34)	
University degree						
Center for diabetes follow-up	155	51.7	36.91 (10.96)	0.23	24.54 (10.10)	0.009
Public	145	48.3	38.40 (10.81)		27.85 (11.66)	
Private						
Monitoring glucose in a laboratory before the crisis	174	58.0	37.20 (10.16)	0.42	25.28 (10.35)	0.11
Yes	126	42.0	38.23 (11.85)		27.34 (11.75)	
No						
Regular visit to physician before crisis	191	63.7	37.57 (10.13)	0.90	25.55 (10.13)	0.19
Yes	109	36.3	37.73 (12.17)		27.47 (12.31)	
No						
The person responsible for injecting insulin before the epidemic	231	77.0	37.51 (11.30)	0.43**	26.13 (11.26)	0.86
Patient	41	13.7	36.68 (8.58)		25.85 (9.05)	
Son or daughter	28	9.3	40.0 (10.48)		27.03 (11.620)	
Spouse						
Change in or elimination of insulin use	67	22.3	38.37 (10.79)	0.52	26.61 (11.11)	0.69
Yes	233	77.7	37.42 (10.940)		26.01 (10.97)	
No						

10.99), respectively. Before the COVID-19 crisis, 27%, 54.3%, and 18.7% of patients had poor, moderate, and good self-care, respectively. One year after the onset of the epidemic, however, these rates were 66.3%, 29%, and 4.7%, respectively. The mean and standard deviation of self-care behaviors based on some demographic and disease characteristics are presented in [Table 1](#). There was a significant difference between the mean scores of the 5 indices of self-care behaviors before and after the COVID-19 crisis using Wilcoxon test ([Table 2](#)).

4. Discussion

Adherence to recommended self-care behaviors has an important role in the prevention of diabetes complications and improvement of the quality of life in patients with diabetes ([Al-Khaledi et al., 2018](#)). Overall, the results of this study showed that self-care activities in patients with type 2 diabetes using insulin pre-and post-COVID-19 epidemic are not desirable. Before the spread of COVID-19, their self-care status was moderate, but within one year after the start of COVID-19 epidemic, it deteriorated to a low level (27% poor self-care before COVID-19 pandemic which rose to 66.3% after it). In many developing countries which are home to more than 75% of patients with diabetes, self-management of diabetes was accompanied with many challenges before COVID-19 outbreak ([Debussche et al., 2009](#); [Whittemore et al., 2019](#)). Despite the wide variation in the rate of adherence to self-care behaviors in low- and middle-income countries, non-adherence to recommended behaviors is the predominant pattern seen in these countries ([Mogre et al., 2019](#)). Also, [Mogre et al. \(2017\)](#) reported the relatively low rate of adherence to diet, self-monitoring of blood glucose, and foot care in Ghana. ([Mogre et al., 2017](#)). Furthermore, in our previous studies before the COVID-19 crisis, self-care status in patients with type 2 diabetes was at a modest level ([baji et al., 2015](#), [Barasheh et al., 2017](#)).

According to the results of this study, the mean scores of all 5 components of self-care activities (following a diet plan, doing exercise, taking medication, self-monitoring of blood glucose, and foot examination) significantly decreased within one year of the pandemic. Studies on diabetes self-care behaviors following the spread of COVID-19 infections have yielded results which are both similar to and different from ours ([Grabowski et al., 2021](#)). In line with our findings, in some studies, lockdown and social distancing had been associated with negative effects on diabetes self-management, especially paying regular attention to a healthy diet and doing physical activity. The results of a qualitative study conducted by [Grabowski et al. \(2021\)](#) on 20 Danish patients with diabetes showed two different patterns in diabetes self-management during COVID-19 lockdown, namely interruption in diabetes self-care and the ability to maintain routine care. They reported impaired physical activity and increased food intake as two important lifestyle changes in patients with diabetes ([Grabowski et al., 2021](#)).

In a systematic review study by [Stockwell et al., in 2021](#), reduced physical activity and increased sedentary behaviors during COVID-19 pandemic across the most reviewed population was reported ([Stockwell et al., 2021](#)). [Khader et al. \(2020\)](#) in a cross-sectional study reported a decline in physical activity and an increase in food intake in 69.07% and 46.88% of Indian patients with diabetes during lockdown ([Khader et al., 2020](#)). [Ghosh et al. \(2020\)](#) studied 150 patients with type 2 diabetes in north India and reported increased carbohydrate consumption, decreased physical activity, and reduced self-monitoring of blood glucose within 45 days of lockdown ([Ghosh et al., 2020](#)).

On the other hand, some studies reported no effect or positive effects of pandemic lockdown on self-management of diabetes. Maintaining or modifying routine care was reported by [Nachimuthu et al. \(2020\)](#) in an online pilot survey in India. Based on their findings, 80 percent of patients with diabetes followed regular exercise and healthy diet control during the lockdown although a regular check of blood glucose levels was done in 28% of the participants ([Nachimuthu et al., 2020](#)).

[Maddaloni et al. \(2020\)](#) found no changes in glycemic control during the first 14 days of COVID-19 lockdown in Italian insulin-treated patients ([Maddaloni et al., 2020](#)). Improvement in control of hyperglycemia was reported in some studies which was explained by having more time to focus on self-care activities, the possibility of having a more regular lifestyle, and using digital diabetes management ([Fernández et al., 2020](#); [Gregg et al., 2021](#)).

[Bonora et al. \(2020\)](#) found improvement of glycaemic control in 20 patients with type 1 diabetes who stayed at home due to cutting back on their routine daily activities ([Bonora et al., 2020](#)). Also, [Fernández et al.](#) reported better glycemic control in 307 Spanish patients during the first weeks of lockdown, which was explained by having extra time for focusing on self-management ([Fernández et al., 2020](#)). It is interesting to note that most of the publications which have addressed the positive effects of lockdown during the COVID-19 pandemic on diabetes management are confined to developed countries ([Gregg et al., 2021](#)). Also, most studies have examined the short period of quarantine. As the epidemic continues, different results may be obtained.

Table 2

The mean scores of the 5 indices of self-care behaviors of patients with type 2 diabetes using pen insulin before and after one year of the COVID-19 crisis.

Variable	Achievable score range	Earned score range before COVID-19	Earned score range after COVID-19	Before COVID-19	One year after COVID-19	P value
Following a healthy diet	0–28	6–28	1–26	19.30 (5.15)	12.51 (5.72)	<0.001
Physical activity	0–14	2–14	0–13	4.22 (2.96)	2.01 (2.48)	<0.001
Monitoring blood glucose	0–14	1–14	0–14	2.98 (3.34)	1.79 (3.04)	<0.001
Adherence to medication	0–7	1–7	0–7	6.38 (1.68)	5.32 (2.82)	<0.001
Foot care	0–14	0–14	0–14	4.74 (4.98)	4.50 (4.75)	<0.001
Total self-care score	0–77	16–69	1–60	37.63(10.89)	26.14 (10.99)	<0.001

5. Strength and limitations

This study is one of the few studies in the field of self-care of patients with diabetes conducted during the COVID-19 crisis. Another strength of this study lies in the comparison of self-care behaviors before and after COVID-19 outbreak, which was possible due to our access to previous data of patients. However, one of the weaknesses of this study was the difficult access of some patients to social networks and their information was provided by their children who had less communication with parents due to their limited social communication. Another limitation of our study was comparison of data which were collected using different designs in the pre- and post-COVID-19 crisis.

6. Conclusion

Our findings suggest deterioration of self-care level in an Iranian population amidst the COVID-19 pandemic. However, more studies with a larger sample size are needed to reveal the true pattern of the benefits and harms of lockdown during the COVID-19 period in patients with diabetes in developing and developed countries. The findings of this study show the importance of continuous follow-up of patients with diabetes, especially during the COVID-19 crisis, and can be used to devise effective patient education programs. Further studies are needed to monitor patients' self-care behaviors and resilience to prevent short-term and long-term complications of the disease in the current situation.

Declaration of competing interest

The authors declared no potential conflicts of interest.

Ethical considerations

This study was approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences, (Ref. ID: IR.AJUMS.REC.1399.364). Informed consent, anonymity, and confidentiality of data were observed.

Funding

This study was approved by Ahvaz Jundishapur University of Medical Sciences (Protocol code: D-9906)

Data availability

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

CRediT authorship contribution statement

Sedigheh Noughjah: cooperated in data collection, study conception, Formal analysis, drafting of the manuscript, and performing critical revision of the manuscript. **Hajieh Shahbazian:** Supervision, was involved in planning and supervising the work and critical revision of the manuscript. **Niloofar Ghodrati:** performed data gathering, had communication with participants, Formal analysis, participated in the analysis and interpretation of the data, and helped to draft the manuscript.

Declaration of competing interest

We have no conflict of interest to declare.

Acknowledgments

The authors would like to thank all patients who participated in the study and Dr. Mahmood Maniati for language editing of the manuscript.

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