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Availability and affordability of diabetes healthcare services associated with the frequency of diabetes-related complications

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Abstract

Aims Understanding the healthcare access challenges facing diabetic patients in low- and middle-income countries is very important. The present study investigated the association between availability (physical access) and affordability (economic access) to diabetes healthcare services and the frequency of diabetes-related complications.

Methods A cross-sectional survey study was conducted between February and May 2023 in Qazvin, Iran. Using convenience sampling, 373 type 2 diabetic patients (mean age = 57.99 years; SD = 11.71) referred to diabetic specialists' clinics were surveyed. Demographic characteristics, physical access to diabetes healthcare services, economic access to diabetes healthcare services, and frequency of diabetes-related complications (FDRCs) were assessed. Data were assessed using linear regression analysis.

Results The mean total access score to healthcare services was 17.71 (out of 30; SD ± 4.21; range 6–30). Patients who had more access to healthcare services had less diabetes-related complications ($p < 0.005$). There was a significant negative correlation ($p < 0.01$) between FDRCs and (i) physical access to diabetes-related healthcare services ($r = -0.166$) and (ii) economic access to diabetes-related healthcare services ($r = -0.153$). Linear regression analysis showed that with each unit increase in participants' economic, physical and total access to diabetes-related healthcare services, the FDRCs among participants decreased by 8.7%, 13.5%, and 8.8% respectively.

Conclusion The results indicate that increased physical accessibility (availability) and economic accessibility (affordability) of healthcare services are associated with fewer diabetes-related complications. Therefore, policymakers and healthcare managers need to reduce diabetes-related complications by implementing schemes to increase patient access to diabetes treatment services.

Keywords Diabetic patients, Healthcare system, Physical accessibility, Economic accessibility, Diabetes-related complications

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Introduction

Diabetes is a frequent chronic disease with increasing worldwide prevalence [1]. Based on the International Diabetes Federation Atlas, the 2021 global diabetes prevalence was estimated to be 10.5% among those aged 20–79 years (affecting approximately 536.6 million individuals worldwide), and is expected to rise to 12.2% in 2045 (783.2 million individuals) [2]. Based on this report, in 2021, the highest regional prevalence of diabetes (16.2%) and the highest mortality caused by diabetes (24.5%) was seen in the Middle East and North Africa (MENA) region in which Iran is located (the country where the present study was conducted) [2].

In Iran, the prevalence of both pre-diabetes and diabetes among adults were estimated to be 24.79% and 14.15% respectively in 2021. It has increased by 45.5% compared to 2016 and it is estimated that it will increase considerably by 2030 without effective prevention [3]. Despite the increasing prevalence of diabetes, in an Iranian nationwide surveillance study, a considerable proportion of Iranian diabetic patients were not aware of their condition (20%), were not treated properly (60%), and did not have proper glycemic control (81.5%) [4]. Late onset diagnosis of diabetes and long-term periods of uncontrolled glycemic levels increases the long-term risk of complications [5]. Increased mortality and morbidities, reduced life expectancy, reduced quality of life, severe financial costs for patients, and poor healthcare systems [6, 7] makes diabetes one of the leading causes of mortality and morbidity irrespective of geographical region, age or sex [8].

Diabetes leads to many physical complications (e.g. cardiovascular diseases, nephropathy, and neuropathy) and psychological complications (e.g. depression) as well as affecting social aspects of individuals' daily lives [9–12]. Diabetes-related complications, including cardiovascular disease, kidney disease, neuropathy, blindness, and lower limb amputation, are an important factor in increasing morbidity and mortality among individuals with diabetes and lead to a heavy economic burden for individuals, families and healthcare systems [13, 14]. The high financial burden of treating diabetes-related complications imposes a lot of pressure on the health budget of any country [15]. Despite the importance of timely diagnosis and management of this condition, improper access to diabetes-related healthcare services can lead to late diagnosis or improper treatment until the onset of severe complications of the disease, especially in low- and middle- income countries [16–18].

Diabetes can affect many different organs of the body and gradually and, over time, can lead to serious complications among diabetic patients. Complications caused by diabetes can be classified into two categories: microvascular or macrovascular [13, 19]. Microvascular complications include nervous system damage (neuropathy), kidney system damage (nephropathy) and eye damage (retinopathy) [20–22]. Macrovascular complications include cardiovascular disease, stroke, and peripheral vascular disease [23–25]. Peripheral vascular disease may lead to bruises or injuries that do not heal and may lead to gangrene and eventually amputation. Other complications include dental disease, reduced resistance to infections such as influenza and pneumonia, and other complications of childbirth among pregnant women with diabetes. Although these types of complications are similar for type 1 and type 2 diabetes patients, the frequency or time of occurrence can be different [26].

Zhang et al. [27] showed that limited access to healthcare (especially being uninsured), was significantly associated with diabetic patients missing their treatments. Efforts to increase diabetes diagnosis may therefore need to address issues of access to care [27]. A study in India found a high burden of missed clinic appointments for diabetes among patients with poor socioeconomic status due to high costs for doctors' visit and drugs as well as too much waiting time for doctors' visits [28]. Shobhana et al. [29] reported that the annual cost of diabetes care was significantly higher among diabetic patients with longer duration of diabetes. Therefore, with increased duration of diabetes, the treatment of diabetes becomes more expensive. Consequently, within the framework of socio-economic characteristics of individuals in developing countries, diabetes is a costly disease [29]. In this regard, governments can help reduce inequality by providing financial support in poor areas and creating an insurance system with appropriate financial coverage for receiving high cost medical services [30]. One of the most important measures in this field is the availability and affordability of essential diabetes medication, and this is of even more importance in low-income and poor middle-income countries [31]. The results of a study in Vietnam showed that with the increase in costs, individual's access to diabetes services was affected and outpatient visits decreased significantly, and that the decreased access should be addressed through proper governmental financial support [32]. In an Australian study, approximately 4% of individuals were unable to pay for at least one category of healthcare costs in the past 3 months [33]. Therefore, the inability to pay medical expenses may increase with the number of chronic diseases such as diabetes [33].

Few studies have been conducted in this field in Iran. One Iranian study showed that the low financial ability of patients to cover drug costs was a factor reducing patients' access to diabetes services [34]. Moreover, sometimes Iranian diabetic patients have difficulty in accessing a wide range of services including medicines,

laboratory services, and services from public health centers [35, 36]. Also, their access to care is limited due to long waiting times, inappropriate working hours in outpatient clinics, and crowded centers [37]. Inadequate health insurance, lack of full coverage of equipment and tests related to diabetes, financial pressure related to some expensive drugs and treatments, are all factors that reduce the access of Iranian patients to diabetes treatment and make their disease more complicated [38]. An Iranian study by Esteghamti et al. [39] showed that complications of diabetes account for 53% of the total direct costs of diabetes, which can be the result of reduced access to services. Consequently, diabetes is a costly medical problem in Iran and the care of diabetic patients irrespective of socio-economic status should be accessible, affordable, and of high quality for all diabetic patients [40]. Moreover, this is a shared responsibility of governments and healthcare providers [39].

Poor access to healthcare services is considerably associated with increased morbidity and poorer health outcomes [17]. Access to healthcare is a multidimensional concept including different aspects of acceptability, availability, affordability, accommodation, process of care, service uptake, and quality of care [17]. Accessing and application of healthcare services is influenced by various barriers including financial barriers [40]. The management of diabetes-related complications is generally associated with high cost diabetes treatment in most countries [41]. The high cost of diabetes treatments leads to availability of resources to those who can afford the costs of healthcare services [16]. In this regard, diabetes-related complications can disproportionately affect society's poorer individuals [42]. This is reflected in a higher prevalence of type 2 diabetes in rural and deprived areas with lower socio-economic status, which might be a result of poor access to healthcare services [15]. Social and economic inequality in access to healthcare is a worldwide problem [43]. While it has been reported that individuals with higher economic ability can benefit more easily from timely access to healthcare related to their illness and can afford such treatments more easily [44], the association of between physical and economic access to healthcare services and the frequency of diabetes-related complication is not well studied. Therefore, the present study aimed to investigate the association between access to diabetes healthcare services in Iran and the frequency of diabetes-related complications among Iranian adults with diabetes. Given that the study was exploratory, there were no hypotheses.

Methods

Study design

A cross-sectional study was conducted between February and May 2023 in Qazvin, Iran. The inclusion criteria for this study were that the participants were diagnosed as type 2 diabetics by an endocrinologist and that they had been diagnosed as having diabetes for at least 6 months. The only exclusion criterion was having severe mental and/or emotional problems that may have limited the individual's ability to answer the study questions.

Sample size estimation

Sample size was estimated based on estimated prevalence of diabetes-related complications in newly diagnosed type 2 diabetes in low-and-middle-income countries in a systematic review and meta-analysis by Aikaeli [18]. Based on this systematic review, the median prevalence of retinopathy, nephropathy and neuropathy were respectively 12% (6%−15%), 15% (7%−35%) and 16% (10%−25%) [18]. Considering prevalence (p) of 15%, α: 0.05 and d: 0.25; the required sample size was estimated to be 350 individuals with diabetes. To improve transparency and trust in the collected data, the individuals participating in the study were clearly told about the objectives of the research so that they would answer the questions more accurately. It was also stated to the participants that all their information would remain confidential, and that information such as name and surname would not be needed from them. Therefore, there were no missing data in the study.

Diabetic patients may experience many serious long-term complications. But some of these complications among patients with diabetes begin within a few months after onset, and gradually worsen the individual's health condition. Among individuals with diabetes, careful control of glucose levels in the blood and correct and timely intervention can cause these complications to occur less [45]. Therefore, and after consultation with diabetes specialists, a period of at least six months after being diagnosed with diabetes was determined for individuals to participate in the study.

Sampling procedure and participants

The participants were selected using convenience sampling from endocrinology clinics. A list of patients with diabetes was obtained from each clinic, and then eligible participants (having type 2 diabetes and at least six months of diabetes) were contacted by phone. The objectives of the study were explained to the participants in the study, and a meeting was arranged with the diabetic patients who had expressed their consent to participate in this study, and after their presence, the questionnaires

were completed by interviewing them. Data were collected through face-to-face interviews with participants at the clinic. All interviews were conducted by two trained interviewers. A total of 373 individuals with diabetes comprising 129 men and 244 women participated in the study (see Table 1 for all demographics).

Measures

The key variables examined in the present study were participants' demographic and clinical characteristics, their physical and economic access to diabetic's healthcare services, and the frequency of diabetes-related complications.

Demographic and clinical characteristics included questions concerning age, gender, duration of diabetes, level of education, body mass index (BMI), history of diabetes in the family, and perceived economic status of the family.

Physical and economic access to diabetes-related healthcare services were assessed using six self-devised items. Based on Levesque's conceptual framework [46], healthcare access has five different dimensions in the context of healthcare systems. These are approachability, acceptability, availability, affordability, and appropriateness. For the purpose of present study, two of the most important aspects were examined: availability and affordability [47–49]. These two aspects were selected to assess the extent of physical access (availability) and economic access (affordability) to diabetes-related healthcare services. Economic access to diabetes-related healthcare services was assessed using three items rated on a five-point scale from 1 (*extremely unaffordable cost*) to 5 (*extremely affordable cost*):

- How would you rate the cost of receiving medical services related to a doctor's visit for your diabetes?
- How do you rate the cost of buying medicines for your diabetes?
- How do you rate the cost for receiving diagnostic services (such as laboratory services) for your diabetes?

Physical access to diabetes-related healthcare services was also assessed using three items rated on five-point scale from 1 (*not available at all*) to 5 (*completely available*):

- How do you rate the availability of an endocrinologist for medical visits related to your diabetes?
- How do you rate the availability of diabetes-related laboratory services for your diabetes?
- How do you rate the availability of diabetes-related medications for your diabetes?

Total score in each of the two domains (EA, PA) was the sum of the three items (i.e., a range of 3 to 15). Total access (TA) score was calculated by adding the two domain scores (i.e., a range of 6 to 30). Therefore, higher scores indicated better access of diabetic patients to diabetes-related treatment services.

Because the items were developed by the research team, their face validity and content validity were evaluated and confirmed by seven experts in the field of endocrinology, health science, and health management. The construct validity of the scale was assessed using exploratory factor analysis. The KMO index was 0.67, and there was a significant correlation between pairs of variables based on Bartlett's sphericity test ($p < 0.001$), and confirmed the suitability of conducting exploratory factor analysis. In exploratory factor analysis, two factors of economic access and physical access of services (each with three items) explained 73.13% of the variance. The reliability was 0.78 based on Cronbach's alpha coefficient.

Frequency of diabetes-related complications was assessed using a modified version the Diabetic Complication Severity Index (DCSI) which was developed to assess the severity of diabetes complications at any point in time [28]. The DCSI comprises diabetes-related complications in seven categories: cardiovascular disease, nephropathy, retinopathy, peripheral vascular disease, stroke, neuropathy, and metabolic problems. Each category is classified in two levels (0 = no complications, 1 = having

Table 1 Demographic characteristics of study participants ($n = 373$)

Variable	Mean (SD) or N (%)
Age (in years)	57.9 (11.71)
The number of years with diabetes	9.91 (7.25)
Body mass index	28.25 (4.65)
Gender	
Male	129 (34.6)
Female	244 (65.4)
Educational status	
No formal education	39 (10.5)
Primary school	77 (20.6)
Secondary school	72 (19.3)
Diploma	109 (29.2)
University	76 (20.4)
History of diabetes in the family	
Yes	262 (71.2)
No	106 (28.8)
Perceived household economic status	
Poor	67 (19)
Fair	253 (71.7)
Good	33 (9.3)

complications) or three levels (no complications = 0, some complications = 1, and severe complication = 2) depending on the presence and severity of the complication [50]. In the present study, the modified DCSI was used in which neuropathy was divided to two subcategories of gastric-related complications and sensory/tactile-related complications. Moreover, an item assessing recurrent episodes of infection was added [51, 52]. Given that data were collected based on patient-reported outcomes rather than corroborative data provided by healthcare staff, only the presence (rated as 1) and absence of complications (rated as 0) was assessed, not the severity of the complications. Therefore, the frequency of diabetic-related complications (FDRCs) ranged from 0 to 9 with higher scores indicating greater FDRCs. Because a modified version of the DCSI was used to assess frequency of diabetes-related complications, the face validity and content validity were assessed based on expert opinion (four endocrinologists and two nurses with professor degree). The internal consistency of the modified version was 0.70 (Cronbach's alpha). The complete survey questions are provided in Supplementary File 1.

Statistical analysis

SPSS software (version 25) was used for data analysis. Means and standard deviations were used to report continuous variables. Frequencies and percentages were used to report categorical variables. A number of *t*-tests were used to compare the differences in mean scores of total access with presence or absence of each diabetes complication. A linear regression model was used to examine the relationship between the FDRCs and the variables of economic access to diabetes-related healthcare services, physical access diabetes-related healthcare services, and total access diabetes-related healthcare services. The assumptions of the linear regression model (e.g., normal distribution of the dependent variables, absence of outliers) were confirmed. The value of $p < 0.05$ was considered as the significance level of all tests.

Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board and Ethics Committee in Biological Research (reference code IR.QUMS.REC.1401.247). Informed consent was obtained from all participants. The purpose of the study, the eligibility criteria of the participants, and the confidentiality of the data were explained on the first page of the survey as well as by the interviewer.

Results

Descriptive analysis

One-tenth of participants (10.5%; $n = 39$) were illiterate and 20.4% had been educated to university level ($n = 76$). Almost three-quarters of participants had a family history of diabetes (71.2%; $n = 262$). In relation to current economic status, 19% reported it as poor ($n = 67$), 71.7% as fair ($n = 253$), and 9.3% as good ($n = 33$). The body mass index (BMI) of the participants in the study was 28.25 (SD ± 4.65), and the average number of years of being diagnosed with diabetes was 9.91 years (SD ± 7.25). The average total access score to healthcare services was 17.71 (out of 30; SD ± 4.21) and the average number of diabetic-related complications was 2.25 (SD ± 1.81) (Table 2).

The relationship between healthcare access and diabetes-related complications

The results in Table 3 show that there was a significant relationship between access to healthcare services among diabetic patients and diabetes-related complications such as eye, dental, skin, and infectious complications ($p < 0.01$). The results showed that the average total access score was significantly higher among patients who

Table 2 Mean and standard deviation of participants access to medical services and complications ($n = 373$)

Domain	Item	Mean (SD)	Skewness	Kurtosis	Possible range
Economic access	Cost of receiving medical services related to a doctor's visit for diabetes	2.71 (1.23)	0.29	−0.93	3–15
	Cost of buying medicines for diabetes	2.06 (1.21)	0.90	−0.25	
	Cost for receiving diagnostic services (such as laboratory services) for diabetes	2.42 (1.16)	0.67	−0.36	
Physical access	Availability of diabetes-related medications	3.22 (1.55)	−0.08	−1.50	3–15
	Availability of diabetes-related laboratory services	3.59 (0.72)	−1.06	1.44	
	Availability of an endocrinologist	3.69 (0.84)	−1.46	1.42	
Total access	Sum of economic and physical accessibility scores	17.71 (4.21)	0.46	0.04	6–30
Frequency of diabetic-related complications	Number of complications per patient	2.25 (1.81)	0.59	0.25	0–9

Table 3 The mean difference between participants with and without diabetes-related complications and total access to diabetes-related healthcare services (TA) ($n=373$)

Type of complication		Complications	N (%)	TA Mean (SD)	Sig
Retinopathy		Yes	196 (52.5)	17.10 (4.29)	0.003
		No	177 (47.5)	18.38 (4.02)	
Cardiovascular disease		Yes	102 (27.3)	17.18 (3.82)	0.138
		No	271 (72.7)	17.91 (4.33)	
Sensory and tactile complications		Yes	103 (27.6)	18.27 (4.03)	0.114
		No	270 (72.4)	17.50 (4.26)	
Peripheral vascular disease	Oral and dental	Yes	70 (18.8)	16.15 (3.74)	0.001
		No	303 (81.2)	18.07 (4.23)	
	Leg/foot	yes	139 (37.3)	17.43 (4.03)	0.333
		no	234 (62.7)	17.87 (4.31)	
Skin		Yes	38 (10.2)	15.92 (4.19)	0.005
		No	335 (89.8)	17.91 (4.17)	
Gastric related complication		Yes	114 (30.6)	17.12 (3.71)	0.072
		No	259(69.4)	17.97 (4.39)	
Nephropathy		Yes	60(16.1)	16.98 (3.90)	0.143
		No	313 (83.9)	17.85 (4.25)	
Recurrence episodes of infection		Yes	31 (8.3)	15.83 (3.90)	0.009
		No	342 (91.7)	17.88 (4.20)	

Table 4 Linear regression model presenting the predicting role of patients' total access to diabetes-related healthcare services in frequency of diabetes-related complications

Predictor	Unstandardized Coefficients		Standardized coefficients	Sig
	B (95% CI)	Std error	beta	
Economic access	−0.087 (−0.144; −0.029)	0.029	−0.153	0.003
Physical access	−0.135 (−0.216; -.0053)	0.042	−0.166	
Total access	−0.088 (−0.45; −0.131)	0.022	−0.204	< 0.001

did not have diabetes-related complications. The results also showed that eye complications were the most common diabetes-complications that participants suffered from (52.5%; $n=196$). Linear regression was used to predict the FDRCs among diabetic patients. There was also a significant negative correlation ($p<0.01$) between FDRCs and (i) physical access to diabetes-related healthcare services ($r=-0.166$) and (ii) economic access to diabetes-related healthcare services ($r=-0.153$) (Table 4). In this model (Table 4), each unit increase in participants' economic, physical, and total access (TA) to diabetes-related healthcare services, the frequency of diabetes-related complications (FDRCs) among participants decreased by 8.7%, 13.5%, and 8.8%, respectively. This indicated a negative and significant relationship between total access to diabetes-related healthcare services and FDRCs (β −0.204, ($p<0.001$).

Discussion

The purpose of the present study was to evaluate the association between access to diabetes-related healthcare services and the frequency of diabetes-related complications among Iranian adults with diabetes. The results indicated that there was significant negative correlation between the frequency of diabetes-related complications (FDRCs) and (i) physical access to diabetes-related healthcare services (PA), (ii) economic access to diabetes-related healthcare services (EA), and (iii) total access to diabetes-related healthcare services. Consistently, a higher number of diabetes-related complications was found among those from underprivileged populations and those with lower access to diabetes-related healthcare services. Similar findings have been reported in

other countries. Based on a review by Spanakis and Golden, minorities in the United States (e.g., Native Americans, Mexican and Hispanic Americans) are more likely to develop micro-vascular complications of diabetes and lower limb amputation [53]. A recent systematic review [54] concluded that low socio-economic status was associated with increased risk of diabetes complications, especially retinopathy and cardiopathy. One of the reasons for this was reduced access to diabetic-related healthcare services [54].

In Qatar (one of MENA countries where the highest mortality is caused by diabetes), diabetes has a significant disease burden and it is expected that this rate will continue to increase. Many diabetic patients in Qatar face significant challenges in accessing diagnosis and treatment, which contributes to higher diabetes-related complications and higher mortality [55]. Hsu et al. [56] reported that poverty is associated with increased incidence of diabetes among the Asian population, particularly among Asian women. Moreover, income disparity appears to predispose individuals with diabetes to receive unequal diabetes care, including delayed recognition of diabetes cases and inadequate follow-up. Therefore, improving access through comprehensive and universal health coverage is needed to eliminate disparities in diabetes care. Other ways to ensure high-quality diabetes care include improving health literacy among those with diabetes, increasing access to diabetes care, optimizing the performance of primary care physicians, and strengthening the accountability of healthcare providers [56].

The association between physical and economic access to healthcare services and diabetes-related diagnosis, treatment, and complications has been reported in both developed and developing countries [57]. In a European survey based on 'All of Us' nationwide survey data, 10%–20% of patients with diabetes reported several reasons for avoiding or delaying care, including financial concerns and lack of access to transportation [58]. The results of a US survey comprising 6177 adults aged 25 years or older with diabetes, showed that socioeconomic status, such as having the lowest level of education and poor financial wealth, were strong predictors of the risk of death among adults with diabetes [59]. When healthcare services are provided based on patients' payments, this payment by the patient can create financial barriers to access healthcare services, with the poor being less likely to seek healthcare than those who are rich. Therefore, in order to solve this problem, attention should be paid to (i) general financing of services for the poor, especially through the modification of the service package, (ii) improving the quality and use of available primary healthcare services, and (iii) using an insurance system with appropriate coverage of medical costs to improve the access of people in need [60].

Therefore, the results of the present study were consistent with the results of these previous studies and highlight the importance of accessibility for receiving diabetes-related medical services. The evidence shows that with the increase in the burden of disease, the change in the pattern of diseases, and the spread of chronic diseases such as diabetes, it is necessary to focus attention on ensuring individuals' access to medicines. Public healthcare offers a unique opportunity to address the issue of access to medicines and the specific issue of access to diabetes healthcare [61]. Given that there is reduced access for individuals needing important diabetic medicines (e.g., insulin, metformin) in low-income countries, and that poor people cannot afford to buy basic diabetes medications, these individuals face increased diabetic-related complications [31].

Due to the worldwide increasing prevalence of diabetes and the costly services for treatment of diabetes and its complications, it has been proposed that a substantial proportion of the annual healthcare budget of countries should be spent on diabetes and related diseases [62]. In line with results from present study and the extant literature, lower access (both financially and physically) to diabetes-related healthcare services is associated with higher diabetes-related complications especially among those from low- and middle-income countries [53–56, 58, 59]. Diabetes among individuals with poor healthcare status is associated with higher costs for medical services due to greater financial barriers to accessing services and lack of health insurance [63]. Therefore, diabetes-related health policies should specifically address the problem of healthcare needs and barriers of access to related healthcare services for this group, otherwise, the inequality in accessing healthcare services will be associated with increased complications among diabetic individuals [63]. To prevent and eliminate disparities in access to diabetes-related healthcare services, the best way to do so is to design interventions that reduce disparities and improve quality of care. Therefore, interventions that target patients, providers, healthcare organizations, and the community will be useful. Addressing and eliminating health inequalities in diabetes and its complications will eventually improve global health [53].

Limitations

The present study has some limitations. First, the study was cross-sectional, which at best can only describe the relationship between the study variables. Secondly, the participants in the study were those who were referred to endocrinologists' clinics affiliated with the University of Medical Sciences. Therefore, the results cannot

be generalized to all Iranians with diabetes. Third, the study employed convenience sampling to recruit participants and therefore may not be representative of Iranians who have diabetes. Fourth, all study variables were assessed using self-report measures combined with patient records, which may be subject to biases such as social desirability. Finally, one of the most important limitations of the study was the lack of information on the severity of diabetes-related complications. Therefore, only the number of diabetes complications among the study participants rather than the severity of problems could be evaluated.

Conclusion

The results of the present study showed that the physical accessibility (availability) and economic accessibility (affordability) of healthcare services related to diabetes are important and necessary issues in providing services to diabetic patients, and that reduced availability and lack of affordable medication can significantly increase the frequency of complications among diabetic patients. Therefore, policymakers and healthcare managers can benefit from the results of the present study by implementing schemes to increase the access of patients to diabetes treatment services. Based on the present study's results, increasing access to diabetes services will likely reduce the complications of diabetes among diabetic patients. Moreover, future interventions can be designed to increase diabetics patients' physical and economic access to diabetic-related health services and future research is needed to investigate the long-term effect of these interventions on frequency of diabetic complications and the efficacy of specific interventions to enhance access.

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

Z.A., M.A. & S.H. contributed to the conception and design of this research; F.A., S.S., L.M., & H.G. contributed to the acquisition; Z.A. and M.A. contributed to the analysis and interpretation of the data; Z.A. and M.A. drafted the manuscript. M.D.G. provided contributions to the literature review and discussion and prepared the final version of the manuscript. M.D.G. revised the final version of manuscript and copy-edited the manuscript. All authors critically revised the manuscript, agreed to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript to be published. All authors met the criteria for authorship and that all entitled to authorship were listed as authors in the title page.

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Data availability

Data and materials will be provided upon email to corresponding author.

Declarations

Ethics approval and consent to participate

All the research was performed in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board and Ethics Committee of Qazvin University of Medical Sciences, Qazvin, Iran (decree code: IR.QUMS.REC.1401.247). Written informed consent was obtained.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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