Check for updates

Factors Associated With the Frequency of Medical Consultations in Patients With Various Types of Diabetes Mellitus

Victor Juan Vera-Ponce[a, b, c] , Joan A. Loayza-Castro[a] , Rafael Tapia-Limonchi[a, b] ,
Enrique Vigil-Ventura[a, b]

Abstract

Background: Proper management of diabetes mellitus (DM) is essential to prevent long-term complications, improve patients' quality of life, and reduce the economic burden on healthcare services. The aim of this study was to determine the factors associated with the number of medical consultations received in the last quarter by patients with different types of diabetes, who were affiliated with the Comprehensive Health Insurance (SIS: acronym in Spanish) in Peru.

Methods: A cross-sectional analysis of the database of patients with DM affiliated with SIS in Peru was conducted. Two robust variance regression models were used to identify potential associated factors.

Results: Data from 1,355,354 patients were analyzed. In model 1, which included comorbidities as separate variables, it was found that men, older individuals (especially those aged 60 - 69), and residents of the jungle region had a higher probability of receiving more medical consultations. The presence of obesity/dyslipidemia, hypertension, and mental health disorders also increased the likelihood of more consultations. In comparison, patients with type 2 DM had fewer consultations compared to those with type 1 DM. The findings were consistent with the first model in model 2, which included the total number of comorbidities instead of each separately. Additionally, a higher total number of comorbidities was associated with an increased number of medical consultations.

Conclusions: Several vital factors influencing the frequency of medical consultations received by DM patients have been identified. Adapting healthcare services to address regional disparities in access to and use of medical services is crucial.

Introduction

Diabetes mellitus (DM) is a chronic disease that affects millions of people worldwide and poses a significant challenge to healthcare systems [1]. Proper diabetes management is essential to prevent long-term complications, improve patients' quality of life, and reduce the economic burden on healthcare services [2].

   Patients with this condition require continuous monitoring and regular medical attention to control their blood glucose levels, manage comorbidities, and prevent acute and chronic complications [3]. However, medical care frequency and quality vary considerably among patients, influenced by clinical, demographic, and socioeconomic factors [4-7]. There is a need to understand whether different aspects such as sex, age, duration of diagnosis, and the presence of comorbidities like obesity and hypertension (HTN) can influence the frequency of medical consultations. This need is particularly pronounced in different geographical contexts and healthcare systems, where the reach of patient care access is limited in some areas, as is the case in Peru [8].

   Therefore, the primary objective of this study is to determine the factors associated with the number of medical consultations received in the last quarter by patients with different types of diabetes affiliated with the Comprehensive Health Insurance (SIS: acronym in Spanish) in Peru.

Materials and Methods

Type and study design

This is an analytical cross-sectional study. An open-access database providing detailed information on the demographic and clinical characteristics of patients with DM affiliated with SIS in Peru was analyzed.

Population, sample, and eligibility criteria

The study sample consisted of patients who met the following

selection criteria: 1) patients affiliated with SIS with a definitive diagnosis of DM (type 1 (T1DM), type 2 (T2DM), or other types of diabetes); 2) patients who received medical consultations in the last 3 months according to SIS database records.

Variables and measurement

The dependent variable in this study is the number of medical consultations received by DM patients in the last quarter. This variable was categorized into two groups: patients who received up to two medical consultations and those who received three or more in the previous quarter.

The independent variables in this study were selected based on their potential influence on the number of medical consultations received by DM patients. The first of these variables is the patient's sex, classified as male or female. The patient's age was categorized into groups: under 18 years, and then every 10 years up to 70 years and older. The geographical region was divided into Metropolitan Lima, the rest of the coast, the highlands, and the jungle. The time since diagnosis, referring to the duration since the DM diagnosis, was categorized in yearly intervals up to 6 years and more. Additionally, the presence of comorbidities such as DM with obesity/dyslipidemia, DM with HTN, and DM with mental health disorders were included. Finally, the type of DM diagnosed was classified into T1DM, T2DM, and other specific types of diabetes.

Procedures

The open-access SIS database of Peru was downloaded from the website of the Peruvian Government Open Data Portal. This database contains nominal information on active affiliates with a definitive diagnosis of DM, including details on medical consultations received in the last 3 months. The downloaded data were analyzed, and valuable variables for the study were integrated.

Patients registered in the database were evaluated and classified according to their type of DM (T1DM, T2DM, or other types). Additionally, it was determined if the patients had HTN, and laboratory tests were performed to measure their glucose, lipid levels, and other relevant variables. Patients' weight and height were measured to calculate their body mass index (BMI) and classify those with obesity (BMI $\geq$ 30 kg/m^2). Mental health was also assessed. These evaluations were conducted in the regions where SIS operates, and the results were stored in the database used for this study.

The study sample included patients affiliated with SIS with a definitive diagnosis of DM who had received at least one medical consultation in the last 3 months. Patients whose DM diagnosis was not specified as T1DM, T2DM, or other specific types were excluded to ensure data accuracy. The International Classification of Diseases, 10th Revision (ICD-10) was used for comorbidity classification. DM with obesity/dyslipidemia was classified under ICD-10 codes E660-E669 and E780-E785. DM with HTN was classified under ICD-10 codes I10X, I150, I151, I152, I158, and I159. DM with mental health disorders was classified under ICD-10 codes F000-F09X and F100-F259, F300-F99X, respectively.

Statistical analysis

An initial descriptive analysis was conducted to characterize the study sample. This analysis included describing demographic and clinical variables such as sex, age, region of residence, time since diabetes diagnosis, presence of comorbidities, and the number of medical consultations received in the last quarter. A bivariate analysis was also performed to explore the relationships between the dependent variable (number of medical consultations received) and each independent variable.

Finally, a Poisson regression analysis with robust variance was conducted to obtain adjusted prevalence ratios (aPRs). Each association measure was accompanied by its respective 95% confidence interval (95% CI) to estimate the precision of the results. Additionally, two distinct models were developed.

Model 1 (comorbidities separately)

In this model, comorbidities such as HTN, obesity, and mental health problems were included as separate variables. This approach allows for identifying the specific impact of each comorbidity on the number of medical consultations received.

Model 2 (total number of comorbidities)

This second model included a variable summarizing the total number of comorbidities. This variable represents a cumulative measure of the comorbidity burden, simplifying the model and facilitating the interpretation of the total burden. This approach allows the evaluation of the combined effect of comorbidities rather than their individual effects.

Performing both approaches provides robust verification. Comparing the results of both models will determine if the conclusions are consistent regardless of the approach used. If both models produce consistent results, confidence in the findings will be strengthened. Conversely, if the results differ, it may indicate that how comorbidities are modeled significantly affects the results. This difference is crucial for interpretation and will help better understand how the comorbidity burden influences the number of medical consultations received.

Ethical aspects

The study adhered to all ethical and privacy regulations. Although an open-access database was used, patient data confidentiality and anonymity were guaranteed. These procedures enabled a thorough and rigorous analysis, providing valuable information to improve the management and care of this disease within the healthcare system.

Institutional Review Board approval

This study used publicly available secondary data from an anonymous database provided by the Peruvian government. As the data is completely anonymized and freely accessible to the public, the Institutional Review Board approval was not required for this analysis.

Results

The study sample consisted of 1,355,354 patients. The majority of the patients were female (66.13%). Regarding age distribution, the largest group was patients aged 50 - 59 (24.35%). In terms of diabetes type, an overwhelming majority of patients had T2DM (91.80%). Geographically, Metropolitan Lima housed 37.37% of the total; as for comorbidities, 64.46% of patients had obesity or dyslipidemia, while 38.70% had HTN. Mental health disorders were less common, affecting 21.78% of patients. Finally, only 9.14% presented all three comorbidities considered in the study when observing the total number of comorbidities. (Table 1).

In Model 1 (Table 2), comorbidities were included as separate variables. Men, older individuals (especially those aged 60 - 69), and residents of the jungle had a higher probability of receiving more consultations. Patients with T2DM had a lower probability compared to those with T1DM. Additionally, the presence of obesity/dyslipidemia, HTN, and mental health disorders was significantly associated with an increase in consultations.

Model 2 (Table 2) included a variable representing the total number of comorbidities, instead of each comorbidity separately. The findings were consistent with the Model 1, and it was also found that a higher total number of comorbidities was strongly associated with increased medical consultations.

Discussion

Sex and number of consultations

This study showed that men with DM are more likely to receive more medical consultations in the last quarter than women. This finding could be explained by several reasons. Firstly, men may experience a higher incidence of diabetes-related complications, requiring more medical consultations. Previous studies have suggested that men with diabetes may have a higher prevalence of comorbidities, such as cardiovascular and renal diseases, which could increase the need for frequent medical care [9, 10]. Another possible explanation is that men might have more time or availability to attend medical appointments, especially if they have fewer family or work responsibilities that interfere with their ability to seek medical care [11].

It is also important to consider that cultural and social factors may influence these differences. In some contexts, men may be more willing to report severe symptoms or insist on re-ceiving medical care. At the same time, women may prioritize the needs of other family members over their own, resulting in fewer medical visits for themselves [12].

Age and medical consultations

The study showed that the probability of receiving three or more medical consultations in the last quarter increases with age, peaking in the 60 - 69 age group, with a slight decrease in this probability for patients aged 70 or older. Several explanations for this trend are possible. Firstly, patients aged 60 - 69 are often at a critical stage in the progression of diabetes and its complications. In this age group, diabetes-related comorbidities such as cardiovascular diseases, neuropathy, and nephropathy tend to manifest with greater severity, requiring more frequent medical consultations for management. These patients may be more active and willing to seek medical care to maintain their quality of life and prevent severe complications [13, 14].

In contrast, the slight decrease in the probability of receiving more consultations among patients aged 70 or older could be due to several reasons. As people age, they may face greater physical and logistical barriers to accessing healthcare services, such as mobility issues, lack of adequate transportation, and physical limitations that make frequent medical visits difficult. Additionally, older patients may have different priorities and approaches to healthcare. Some may prefer less intensive and more palliative approaches focused on symptom management and quality of life rather than continuous medical monitoring. It is also possible that some older patients perceive a lower need for frequent medical care, especially if they believe that medical interventions will not significantly improve their quality of life [15-17].

Region and medical consultations

Patients residing outside Metropolitan Lima are more likely to receive three or more medical consultations in the last quarter, with this probability being exceptionally high in the Jungle region. This finding may be due to several interrelated factors influencing access to and demand for healthcare services in the different areas of the country.

Firstly, the higher probability of receiving more consultations in the Jungle may be related to the epidemiological and demographic characteristics of the region. In rural and remote areas such as the Jungle, the prevalence of infectious diseases and other chronic conditions may be higher, increasing the need for frequent medical consultations. Additionally, the population in these regions may have more comorbidities that require more intensive follow-up and management [18]. Similarly, specialized services outside Lima may be limited, leading patients to receive more consultations at local health centers to compensate for the lack of specialist access [19].

Socioeconomic conditions may also play a role. Patients in regions like the Jungle may have fewer economic resources to access private services or pay for expensive treatments,

Table 1. Univariate and Bivariate Descriptive Characteristics of the Study Sample

Characteristics	Total	Number of medical consultations	
	N = 1,355,354	< 3 (n = 1,318,874)	≥ 3 (n = 36,480)
Sex			
Female	896,302 (66.13%)	871,516 (66.08%)	24,786 (67.94%)
Male	459,052 (33.87%)	447,358 (33.92%)	11,694 (32.06%)
Age group			
Under 18 years	30,146 (2.22%)	30,010 (2.28%)	136 (0.37%)
18 - 29 years	63,267 (4.67%)	62,913 (4.77%)	354 (0.97%)
30 - 39 years	104,003 (7.67%)	102,552 (7.78%)	1,451 (3.98%)
40 - 49 years	218,914 (16.15%)	214,032 (16.23%)	4,882 (13.38%)
50 - 59 years	329,998 (24.35%)	320,204 (24.28%)	9794 (26.85%)
60 - 69 years	321,288 (23.71%)	309,964 (23.51%)	11,324 (31.04%)
70 years and older	287,494 (21.22%)	278,956 (21.15%)	8,538 (23.41%)
Type of diabetes			
Type 1 diabetes	90,380 (6.67%)	87,131 (6.61%)	3,249 (8.91%)
Type 2 diabetes	1,244,198 (91.80%)	1,211,615 (91.87%)	32,583 (89.32%)
Other specified types of DM	20,776 (1.53%)	20,128 (1.53%)	648 (1.78%)
Region			
Metropolitan Lima	506,526 (37.37%)	495,520 (37.57%)	11,006 (30.17%)
Rest of the Coast	496,984 (36.67%)	485,047 (36.78%)	11,937 (32.72%)
Highlands	189,034 (13.95%)	182,011 (13.80%)	7,023 (19.25%)
Jungle	162,810 (12.01%)	156,296 (11.85%)	6,514 (17.86%)
Time since diagnosis			
0 to 1 year	50,569 (3.73%)	48,936 (3.71%)	1,633 (4.48%)
1 to 2 years	288,794 (21.31%)	281,428 (21.34%)	7,366 (20.19%)
2 to 3 years	239,160 (17.65%)	234,321 (17.77%)	4,839 (13.26%)
3 to 4 years	149,786 (11.05%)	146,639 (11.12%)	3,147 (8.63%)
4 to 5 years	202,075 (14.91%)	197,731 (14.99%)	4,344 (11.91%)
5 to 6 years	243,926 (18.00%)	237,618 (18.02%)	6,308 (17.29%)
More tan 6 years	181,044 (13.36%)	172,201 (13.06%)	8,843 (24.24%)
DM + obesity/dyslipidemia			
No	481,688 (35.54%)	475,789 (36.08%)	5,899 (16.17%)
Yes	873,666 (64.46%)	843,085 (63.92%)	30,581 (83.83%)
DM + hypertension			
No	830,800 (61.30%)	815,672 (61.85%)	15,128 (41.47%)
Yes	524,554 (38.70%)	503,202 (38.15%)	21,352 (58.53%)
DM + mental health disorder			
No	1,060,093 (78.22%)	1,035,952 (78.55%)	24,141 (66.18%)
Yes	295,261 (21.78%)	282,922 (21.45%)	12,339 (33.82%)
Number of comorbidities			
0	300,438 (22.17%)	297,786 (22.58%)	2,652 (7.27%)
1	540,215 (39.86%)	529,119 (40.12%)	11,096 (30.42%)
2	390,837 (28.84%)	375,817 (28.50%)	15,020 (41.17%)
3	123,864 (9.14%)	116,152 (8.81%)	7,712 (21.14%)

Data are presented as n (%).

Table 2. Factors Associated With the Frequency of Medical Consultations in Patients With Diabetes Mellitus: Regression Models 1 and 2

Characteristics	Model 1		Model 2	
	aPR	95% CI	aPR	95% CI
Sex	Ref.		Ref.	
Female	1.14	1.12, 1.17	1.13	1.11, 1.16
Male				
Age group	Ref.		Ref.	
Under 18 years	1.15	0.94, 1.39	1.15	0.94, 1.40
18 - 29 years	2.54	2.13, 3.02	2.59	2.17, 3.08
30 - 39 years	3.57	3.02, 4.23	3.65	3.08, 4.33
40 - 49 years	4.24	3.58, 5.02	4.32	3.65, 5.11
50 - 59 years	4.5	3.80, 5.32	4.55	3.85, 5.39
60 - 69 years	3.32	2.81, 3.93	3.31	2.80, 3.92
70 years and older				
Type of diabetes	Ref.		Ref.	
Type 1 diabetes	0.71	0.69, 0.74	0.72	0.70, 0.75
Type 2 diabetes	0.91	0.84, 0.99	0.93	0.85, 1.01
Other specified types of DM				
Region	Ref.		Ref.	
Metropolitan Lima	1.11	1.09, 1.14	1.12	1.09, 1.15
Rest of the Coast	1.80	1.74, 1.85	1.81	1.76, 1.87
Highlands	2.09	2.03, 2.16	2.06	2.00, 2.12
Jungle				
Time since diagnosis	Ref.		Ref.	
0 to 1 year	0.71	0.67, 0.75	0.71	0.67, 0.75
1 to 2 years	0.51	0.48, 0.54	0.51	0.48, 0.54
2 to 3 years	0.51	0.48, 0.54	0.51	0.48, 0.54
3 to 4 years	0.53	0.50, 0.56	0.53	0.50, 0.56
4 to 5 years	0.59	0.56, 0.63	0.60	0.57, 0.63
5 to 6 years	0.97	0.93, 1.03	0.99	0.94, 1.04
More than 6 years				
DM + obesity/dyslipidemia	Ref.		-	-
No	2.43	2.36, 2.50	-	-
Yes				
DM + hypertension	Ref.		-	-
No	1.69	1.65, 1.73	-	-
Yes				
DM + mental health disorder	Ref.		-	-
No	1.56	1.53, 1.59	-	-
Yes				
Number of comorbidities			Ref.	
0	-	-	2.28	2.19, 2.38
1	-	-	4.09	3.93, 4.27
2	-	-	6.53	6.25, 6.83
3	-	-		

Each factor has been independently adjusted for. Source: self-made. aPR: adjusted prevalence ratio; 95% CI: 95% confidence interval; Ref.: reference.

leading them to rely more on the public health system and thus have more visits to government-funded health centers [7].

Time since diagnosis and number of consultations

The analysis revealed that as the time since diabetes diagnosis increases, the probability of receiving three or more medical consultations in the last quarter decreases. This finding may seem counterintuitive, but several possible explanations and factors could contribute to this trend.

Firstly, patients diagnosed more recently may be in a phase of adjustment and stabilization of their condition. During the first few years after diagnosis, it is common for patients to require more frequent follow-up to adjust treatment, monitor response to medications, and receive education on disease management. This initial stabilization phase generally involves more medical visits to ensure blood glucose levels are adequately controlled and to prevent early complications [20]. In contrast, patients with a long-standing diagnosis may have achieved a greater degree of stability in managing their diabetes. These patients likely have established more effective self-care routines and have greater knowledge and experience in managing their condition [21].

Additionally, patients diagnosed longer ago may have developed a stronger relationship with their healthcare team, allowing for more efficient disease management through less frequent but more effective consultations. These patients may also adhere more to their treatments and follow medical recommendations better, reducing the need for frequent medical interventions [22].

It is also important to consider the impact of patient fatigue. Patients with many years of diabetes management may experience "treatment fatigue", where the motivation to attend frequent medical appointments decreases over time. This may lead to fewer medical visits as patients become more comfortable managing their disease independently and seek less regular medical support [23].

Type of diabetes and number of consultations

The study also found that patients with T2DM are less likely to receive three or more medical consultations in the last quarter than those with T1DM. This finding can be attributed to several reasons.

Firstly, the nature and management of T1DM and T2DM differ. T1DM is an autoimmune condition where the pancreas produces little or no insulin, requiring intensive and constant management with exogenous insulin. Patients with T1DM often need more frequent follow-ups to adjust insulin doses, monitor blood glucose levels, and manage health fluctuations. This complex and constant management increases the need for regular medical visits [24]. In contrast, T2DM generally develops more slowly and is associated with lifestyle factors and insulin resistance. While T2DM also requires continuous management, patients can often control their condition with lifestyle modifications, oral medications, and, in some cases,

insulin. The management of T2DM can be less intensive once blood glucose levels stabilize, resulting in fewer frequent medical visits than T1DM [25]. Patients with T1DM and T2DM may also have different perceptions and health-seeking behaviors. Due to the severity and unpredictable nature of their condition, patients with T1DM may be more inclined to seek regular medical care [26] than those with T2DM.

Another possible explanation is the difference in associated complications. Patients with T1DM are at higher risk of acute complications, such as diabetic ketoacidosis, which require immediate and frequent medical attention. While patients with T2DM also face risks of complications, these tend to be more chronic and progressive, such as cardiovascular diseases and neuropathy, which may not require the same level of frequent medical visits once long-term management plans are established [27].

Finally, diabetes management programs and support available may differ between types of diabetes. Healthcare systems may have more structured and intensive support programs for patients with T1DM due to the critical need for close control and continuous monitoring. This may not be as pronounced for patients with T2DM, who may receive a more general approach to managing their condition [28].

Comorbidities and number of consultations

Patients diagnosed with HTN, mental health problems, and obesity are more likely to receive three or more medical consultations in the last quarter. This trend is especially pronounced in patients with obesity. Several possible explanations for these findings exist.

HTN is a common comorbidity in patients with diabetes and can significantly complicate disease management. The presence of HTN requires stricter and more frequent monitoring to prevent complications such as strokes, kidney failure, and heart diseases. Patients with HTN often need regular adjustments in their medication and close follow-up to control both blood pressure and glucose levels, increasing the frequency of medical visits [29].

Mental health disorders, such as depression and anxiety, are common in patients with chronic diseases like diabetes. These problems can complicate diabetes management due to decreased adherence to treatment, lack of motivation for self-care, and reduced ability to follow a rigorous health regimen. Patients with mental health problems may need additional support, including frequent medical consultations to manage their psychological conditions and diabetes. Moreover, mental health problems can increase the perception of symptom severity, leading to greater utilization of healthcare services [30, 31].

Obesity and/or dyslipidemia are significant risk factors for numerous diabetic complications and other chronic diseases. Obese patients often have higher insulin resistance, making blood glucose control more difficult. Additionally, obesity is associated with a higher risk of developing complications such as cardiovascular diseases, sleep apnea, joint diseases, and mobility problems. These complications require intensive and multidisciplinary medical follow-up, increasing the frequency

of medical consultations [32].

It is important to highlight that these comorbidities often do not present in isolation. The simultaneous presence of HTN, mental health problems, and obesity can have a synergistic effect, where the interaction of these conditions exacerbates the severity and complexity of diabetes management. This combination can result in an even greater need for monitoring and treatment adjustment, significantly increasing the frequency of medical consultations [33]. Additionally, each additional comorbidity increases the patient's clinical management complexity. Patients with multiple comorbidities, such as HTN, obesity, and mental health problems, require more intense and coordinated care to manage each of these conditions adequately. This includes frequent medication adjustments, continuous symptom and complication monitoring, and regular visits to assess health status and treatment efficacy [6, 34].

Furthermore, comorbidities often require different treatments that can interact with each other. Managing these pharmacological and therapeutic interactions requires careful and frequent monitoring by healthcare professionals to avoid adverse effects and optimize treatment outcomes. This need for constant adjustment and evaluation of treatment interactions can increase the frequency of medical visits [35, 36].

Contribution to the field

This study significantly contributes to public health by identifying factors that influence the number of medical consultations received by patients with DM. Using a big, varied database from SIS in Peru, it offers detailed understanding into how different demographic, clinical and geographic traits influence healthcare services. These results provide crucial information for planning and optimizing public health resources.

Additionally, the study highlights the importance to considering comorbidity when managing diabetic patients. The proof that those with more than one comorbidity visit doctors more often highlights the necessity for broad and coordinated care approaches. Such findings can guide the design of public health programs addressing both DM and other associated illnesses, boosting medical care efficiency and effectiveness. Identifying obesity as a particular burden emphasizes the urgent importance for targeted weight control interventions in managing diabetic patients effectively.

The results from this study underscore practical implications for healthcare service adaptation across Peru's diverse regions. Our findings of increased medical visits in the Jungle region demonstrate the successful reach of SIS in traditionally underserved areas, while also highlighting the need for specialized diabetes care services in these locations. This suggests the potential benefit of establishing specialized diabetes care units or implementing mobile health services to enhance care accessibility further.

These findings have direct implications for resource allocation and policy development. Healthcare planners can use this information to develop region-specific delivery models, strengthen specialized diabetes services in high-need areas, and implement integrated care programs for patients with

multiple comorbidities. Furthermore, the observed age-related patterns in consultation frequency suggest the need for age-specific healthcare strategies, particularly for patients aged 60 - 69 who show the highest consultation rates. Such evidence-based planning can help ensure more efficient and equitable healthcare delivery across all regions of Peru.

Limitations of the study

Despite this study's significant contributions, several limitations should be considered when interpreting the results. Firstly, while our study provides valuable insights into healthcare utilization patterns among SIS affiliates, it is important to note that SIS's universal coverage model helps minimize the impact of socioeconomic barriers to healthcare access. However, we acknowledge that additional socioeconomic and behavioral factors not captured in our database (such as transportation access, social support networks, and specific health-seeking behaviors) could provide further insights into consultation patterns. Although these factors were not available in our dataset, SIS's commitment to universal coverage helps ensure that basic healthcare access is maintained regardless of socioeconomic status. Future research incorporating these additional variables could enhance our understanding of healthcare utilization patterns among diabetic patients and further inform targeted interventions to improve healthcare delivery.

Conclusions

This study has identified several key factors influencing the frequency of medical consultations received by DM patients affiliated with SIS in Peru. The findings show that male sex, age, residence outside Metropolitan Lima, and comorbidities are significantly associated with more medical consultations.

Adapting healthcare services to address regional disparities in access to and use of medical services is crucial. Public health policies should focus on individuals with specific characteristics or those in certain areas requiring greater care. Improving healthcare infrastructure and ensuring the availability of specialized services in these areas could reduce barriers to access and improve the quality of care.

Acknowledgments

Financial Disclosure

la Universidad Nacional Toribio Rodriguez de Mendoza de Amazonas.

Conflict of Interest

The authors declare no conflict of interest.

Informed Consent

The primary study from which the database was obtained provided the required informed consent; however, for the present study, it was not required.

Author Contributions

Víctor Juan Vera-Ponce: conceptualization, investigation, methodology, software, data curation, formal analysis, writing - original draft, writing - review and editing. Joan A. Loayza-Castro: investigation, resources, project administration, writing - original draft, writing - review and editing. Rafael Tapia-Limonchi: Validation, visualization, funding acquisition, writing - original draft, writing - review and editing. Enrique Vigil-Ventura: supervision, methodology, writing - review and editing.

Data Availability

The data supporting the findings of this study are publicly available in the Peruvian Government Open Data Portal and can be accessed through: https://www.datosabiertos.gob.pe/dataset/afiliados-activos-en-el-seguro-integral-de-salud-con-diagn%C3%B3stico-de-diabetes-mellitus-sis

References

1. Heald AH, Stedman M, Davies M, Livingston M, Alshames R, Lunt M, Rayman G, et al. Estimating life years lost to diabetes: outcomes from analysis of National Diabetes Audit and Office of National Statistics data. Cardiovasc Endocrinol Metab. 2020;9(4):183-185. doi pubmed
2. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, Stein C, et al. Erratum to "IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045" [Diabetes Res. Clin. Pract. 183 (2022) 109119]. Diabetes Res Clin Pract. 2023;204:110945. doi pubmed
3. American Diabetes Association Professional Practice Committee. 4. Comprehensive medical evaluation and assessment of comorbidities: standards of care in diabetes-2024. Diabetes Care. 2024;47(Suppl 1):S52-S76. doi pubmed
4. Goh LH, Siah CJR, Tam WWS, Tai ES, Young DYL. Effectiveness of the chronic care model for adults with type 2 diabetes in primary care: a systematic review and meta-analysis. Syst Rev. 2022;11(1):273. doi pubmed
5. Xu W, Mak IL, Zhang R, Yu EYT, Ng APP, Lui DTW, Chao DVK, et al. Optimizing the frequency of physician encounters in follow - up care for patients with type 2 diabetes mellitus: a systematic review. BMC Prim Care. 2024;25(1):41. doi pubmed
6. Nowakowska M, Zghebi SS, Ashcroft DM, Buchan I, Chew-Graham C, Holt T, Mallen C, et al. The comorbidity burden of type 2 diabetes mellitus: patterns, clusters and predictions from a large English primary care cohort. BMC Med. 2019;17(1):145. doi pubmed
7. Meisters R, Albers J, Sezer B, de Galan BE, Eussen S, Stehouwer CDA, Schram MT, et al. Socioeconomic inequalities in health-related functioning among people with type 2 Diabetes: longitudinal analyses in the Maastricht Study. BMC Public Health. 2024;24(1):73. doi pubmed
8. Calderon-Ticona JR, Taype-Rondan A, Villamonte G, Laban-Seminario LM, Helguero-Santin LM, Miranda JJ, Lazo-Porras M. Diabetes care quality according to facility setting: A cross-sectional analysis in six Peruvian regions. Prim Care Diabetes. 2021;15(3):488-494. doi pubmed
9. Venditti V, Bleve E, Morano S, Filardi T. Gender-related factors in medication adherence for metabolic and cardiovascular health. Metabolites. 2023;13(10):1087. doi pubmed
10. Huyser KR, Rockell J, Wilson C, Manson SM, O'Connell J. Healthcare utilization, diabetes prevalence, and comorbidities: examining sex differences among American Indian and Alaska Native Peoples. In: Kronenfeld JJ (ed.), Race, Ethnicity, Gender and Other Social Characteristics as Factors in Health and Health Care Disparities, Volume 38. Emerald Publishing Limited; 2020. p. 33-47. doi
11. Kramer HU, Ruter G, Schottker B, Rothenbacher D, Rosemann T, Szecsenyi J, Brenner H, et al. Gender differences in healthcare utilization of patients with diabetes. Am J Manag Care. 2012;18(7):362-369. pubmed
12. Alfano V, Cavaliere C, Di Cecca A, Ciccarelli G, Salvatore M, Aiello M, Federico G. Sex differences in functional brain networks involved in interoception: An fMRI study. Front Neurosci. 2023;17:1130025. doi pubmed
13. Kirkman MS, Briscoe VJ, Clark N, Florez H, Haas LB, Halter JB, Huang ES, et al. Diabetes in older adults. Diabetes Care. 2012;35(12):2650-2664. doi pubmed
14. Gates BJ, Walker KM. Physiological changes in older adults and their effect on diabetes treatment. Diabetes Spectr. 2014;27(1):20-28. doi pubmed
15. Bastani P, Mohammadpour M, Samadbeik M, Bastani M, Rossi-Fedele G, Balasubramanian M. Factors influencing access and utilization of health services among older people during the COVID - 19 pandemic: a scoping review. Archives of Public Health. 2021;79(1):190. doi
16. Doumat G, Daher D, Itani M, Abdouni L, El Asmar K, Assaf G. The effect of polypharmacy on healthcare services utilization in older adults with comorbidities: a retrospective cohort study. BMC Prim Care. 2023;24(1):120. doi pubmed
17. Zhang X, Dupre ME, Qiu L, Zhou W, Zhao Y, Gu D. Age and sex differences in the association between access to

medical care and health outcomes among older Chinese. BMC Health Serv Res. 2018;18(1):1004. doi pubmed

18. Anticona Huaynate CF, Pajuelo Travezano MJ, Correa M, Mayta Malpartida H, Oberhelman R, Murphy LL, Paz-Soldan VA. Diagnostics barriers and innovations in rural areas: insights from junior medical doctors on the frontlines of rural care in Peru. BMC Health Serv Res. 2015;15:454. doi pubmed

19. Lack of Access to Quality Healthcare in Peru [Internet]. Ballard Brief. Disponible en: https://ballardbrief.byu.edu/issue-briefs/lack-of-access-to-quality-healthcare-in-peru.

20. Harris LT, Haneuse SJ, Martin DP, Ralston JD. Diabetes quality of care and outpatient utilization associated with electronic patient-provider messaging: a cross-sectional analysis. Diabetes Care. 2009;32(7):1182-1187. doi pubmed

21. Recchia DR, Cramer H, Wardle J, Lee DJ, Ostermann T, Lauche R. Profiles and predictors of healthcare utilization: using a cluster-analytic approach to identify typical users across conventional, allied and complementary medicine, and self-care. BMC Health Serv Res. 2022;22(1):29. doi pubmed

22. Hostetter J, Schwarz N, Klug M, Wynne J, Basson MD. Primary care visits increase utilization of evidence-based preventative health measures. BMC Fam Pract. 2020;21(1):151. doi pubmed

23. Heckman BW, Mathew AR, Carpenter MJ. Treatment burden and treatment fatigue as barriers to health. Curr Opin Psychol. 2015;5:31-36. doi pubmed

24. Akil AA, Yassin E, Al-Maraghi A, Aliyev E, Al-Malki K, Fakhro KA. Diagnosis and treatment of type 1 diabetes at the dawn of the personalized medicine era. J Transl Med. 2021;19(1):137. doi pubmed

25. American Diabetes Association Professional Practice Committee. 6. Glycemic goals and hypoglycemia: standards of care in diabetes-2024. Diabetes Care. 2024;47(Suppl 1):S111-S125. doi pubmed

26. Combs P, Duffy E, Modic MB. Promoting type 1 diabetes self-care management in the hospital: can it be done? Clin Nurse Spec. 2023;37(6):266-271. doi pubmed

27. Syed FZ. Type 1 Diabetes Mellitus. Ann Intern Med. 2022;175(3):ITC33-ITC48. doi pubmed

28. Abdraimova A, Besancon S, Portocarrero J, Ramaiya K, Dunganova A, Ewen M, Hogerzeil H, et al. Management of type 1 diabetes in low- and middle-income countries: Comparative health system assessments in Kyrgyzstan, Mali, Peru and Tanzania. Diabet Med. 2022;39(8):e14891. doi pubmed

29. Jia G, Sowers JR. Hypertension in diabetes: an update of basic mechanisms and clinical disease. Hypertension. 2021;78(5):1197-1205. doi pubmed

30. Diabetes Canada Clinical Practice Guidelines Expert Committee, Robinson DJ, Coons M, Haensel H, Vallis M, Yale JF. Diabetes and mental health. Can J Diabetes. 2018;42 Suppl 1:S130-S141. doi pubmed

31. Alzahrani O, Fletcher JP, Hitos K. Quality of life and mental health measurements among patients with type 2 diabetes mellitus: a systematic review. Health Qual Life Outcomes. 2023;21(1):27. doi

32. Ruze R, Liu T, Zou X, Song J, Chen Y, Xu R, Yin X, et al. Obesity and type 2 diabetes mellitus: connections in epidemiology, pathogenesis, and treatments. Front Endocrinol (Lausanne). 2023;14:1161521. doi pubmed

33. Eilat-Tsanani S, Margalit A, Golan LN. Occurrence of comorbidities in newly diagnosed type 2 diabetes patients and their impact after 11 years' follow-up. Sci Rep. 2021;11(1):11071. doi pubmed

34. Rozario SS, Masho SW. The associations between mental health status, hypertension, and hospital inpatient visits in women in the United States. Am J Hypertens. 2018;31(7):804-810. doi pubmed

35. Teck J. Diabetes-Associated Comorbidities. Prim Care. 2022;49(2):275-286. doi pubmed

36. Markle-Reid M, Ploeg J, Fraser KD, Fisher KA, Bartholomew A, Griffith LE, Miklavcic J, et al. Community program improves quality of life and self-management in older adults with diabetes mellitus and comorbidity. J Am Geriatr Soc. 2018;66(2):263-273. doi pubmed