

Barriers to Accessing Quality Health Coverage and their association with Medication Adherence in patients with Type 2 Diabetes Mellitus at a hospital in Peru

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ABSTRACT

Background: Diabetes mellitus is a major challenge faced by health systems around the world, especially in low- and middle-income countries where, besides chronic non-communicable diseases, there is an overlap of infectious diseases.

Aim: To determine the barriers to accessing health services associated with treatment adherence in patients with T2DM.

Methodology: Analytical cross-sectional study. We conducted a structured survey to address sociodemographic and clinical aspects as well as access to health services and adherence to treatment according to the Tanahashi model and the Morisky-Green test. The survey was administered to 240 patients diagnosed with T2DM who attended the Daniel Alcides Carrión National Hospital in the region of Callao from January to June, 2019. The factors were determined through logistic regression, and odds ratios (OR) and 95% confidence intervals (CI) were calculated.

Results: Sociodemographic, clinical and health care access factors were determined in the multivariate analysis with medication non-adherence: male gender (OR=9.89; CI95%: 5.70-18.95; p=0.000); schooling: without formal education (OR=14.50; IC95%: 5.88-17.56; p=0.001); obesity (OR=10.50; IC95%: 3.81-13.50; p=0.003); having a comorbidity (OR=3.80; IC95%: 2.57-4.37; p=0.001); not trusting health care staff (OR=8.51; IC95%: 5.2-12.50; p=0.002); considering that the prescribed treatment will not improve their health (OR=6.54; IC95%: 3.71-10.13; p=0.003); not having taken the medication because they lacked money to buy it at some point (OR=4.74; IC95%: 2.79-9.51; p=0.003), not having attended consultation due to lack of money for transport at some point (OR=4.71; CI95%: 3.60-9.52; p=0.003); considering that waiting time for health care is inadequate (OR=5.61; CI95%: 2.60-8.15; p=0.000); considering that health personnel are not trained to perform their health care (OR=3.76; CI95%: 1.51-4.80; p=0.001).

Conclusion: Access to quality health services is a priority to control T2DM, which if left unattended, could become the greatest global health challenge in the future.

Keywords: Diabetes Mellitus, Health Services Accessibility, Treatment Adherence and Compliance. (MESH)

INTRODUCTION

Diabetes mellitus is a major challenge to health systems around the world, especially in low- and middle-income countries where, besides chronic non-communicable diseases, there is an overlap of infectious diseases. In 2019, it was estimated that aging processes, inadequate lifestyles, high prevalence of obesity and sedentary lifestyles would cause about 463 million adults to have diabetes, who represent 9.3% of the population between 20-79 years old. About 90% of them, correspond to type 2 diabetes mellitus. Also, 2% will die and more than 80% of those deaths will occur in low- and middle-income countries^{1,2,3}.

In the region of the Americas, approximately 62 million people have T2DM and, to make matters worse, one out of two does not know. In addition, 50-75% of those diagnosed do not have the disease controlled, most of them because of non-complying with therapy, which cause

a high risk of neuropathy, blindness, renal, cardiac and cerebrovascular disease, in addition to amputations and deaths that could be prevented⁴.

Peru, a South American country, rich in different resources, which aims to ensure universal access to quality public services by 2021⁵, reported 23,117 cases of T2DM in 2018, which correspond to 97% of all the cases; 43% were patients who had not controlled the disease -25% decompensated and 18% with complications- additionally, 75.3% were reported by hospital health facilities. In 67% of new cases, glycosylated hemoglobin levels were above 7%, something similar was found in prevalent cases^{6,7}. With regard to mortality rates, they are not reflected to their full extent because people with diabetes die from the complications - renal, cardiac, cerebrovascular and acute or chronic infections - that are reported as the basic cause of death⁷.

On the other hand, T2DM is a problem that is affecting more people, impoverishing them and their

families, and placing an enormous burden on health systems. Not only are the poor and vulnerable people who are affected the most - given that they are the population at high risk and with difficulties in accessing diagnosis and treatment-but they also receive a very weak response from the health system, based on an approach with excessive medicalization that becomes a considerable burden on national economies and, thus, causing more poverty. Taking into account this circular inefficiency scenario, it is appropriate to implement cost-effective measures based on the best epidemiological, clinical and management evidence, which would make it possible to identify the most representative barriers and fight against them^{8,9,10}.

Therefore, we need to deepen our knowledge of the factors that prevent the control of the disease so that the evidence can be used to successfully address them. That is why the objective of this study was to determine the barriers to accessing health services associated with treatment adherence in patients with T2DM.

MATERIAL AND METHODS

This is an analytical cross-sectional study. Sociodemographic and clinical aspects and access to health services were addressed through a structured survey, using The Tanahashi model¹¹ to address health access and to evaluate four dimensions of the quality coverage process: availability, accessibility, acceptability and contact. Adherence to treatment was measured through the Morisky-Green test⁽¹²⁾, considering those who answered NO to all four questions adherent patients and those who answered YES to one or more nonadherent patients.

Data collection was carried out from January to June 2019 by people previously trained in the use of the instrument. Two hundred and forty patients who knew their T2DM diagnosis were included into our study and were selected through a probabilistic sampling. They were 45 or older and attended endocrinology and cardiology outpatient consultation services at the Daniel Alcides Carrion National Hospital in the region of Callao, Peru. Every patient surveyed was additionally evaluated on their weight and height for the calculation of the Body Mass Index (BMI). We excluded adults with severe comorbidity, mental health problems and/or sequelae of cerebrovascular disease that prevented them from responding to the survey.

The information collected in the field was processed using SPSS 25 software. Initially, a descriptive analysis was conducted that included the frequency distribution for sociodemographic, clinical, and adherence variables, and health care access dimensions. The bivariate analysis was then performed, producing contingency tables, using odds ratio (OR) with its corresponding 95% confidence interval (CI) and the p-value using through the Chi-square test. The statistical significance level was established with a value of $p < 0.05$. Finally, multiple logistic regression analysis was performed to determine those variables that explained the model.

The study was analyzed and approved by the research Ethics Committee at the institution where the study was undertaken, and it obtained the authorization from the facility's director. All participants signed an informed

consent, prior to the implementation of the survey. The anonymity of the patients was guaranteed and the use of the data was for research purposes only.

RESULTS

In terms of socio-demographic and clinical characteristics, there was a predominance of women on the studied sample. The median age was 61 years \pm SD 2.5, and 89.2% of the cases were over the age of 55, being mostly in the group of 45 to 64 years. Likewise, 67.5% were married/cohabiting and 77.9% reported to have regular basic education. The 88.8% did not have a permanent job, had an independent job and unemployed/retired. Those who said to have an independent job, it involved casual labor and those who claimed to be unemployed or retired sometimes had casual jobs as well or were housewives. For this reason they are placed in the same category. Also, 84.6% reported a monthly family income equal to or less than 265 dollars. With regard to BMI, 77.5% of cases showed a cumulative result > 25 which indicated overweight and obesity, where 48.3% had a 25-27 BMI corresponding to overweight category and 29.2% had a BMI > 27 , which indicates obesity; in both cases, the majority were women. In addition, 67.9% had < 10 years having this disease and 85% had one or multiple comorbidities. We can emphasize that the information was obtained directly from the primary source, that is, by the patients. We did not cross-check data with medical records and the data was based on the patient's knowledge of the diagnosis given by the physician and/or the medications they were receiving. According to the information collected, 65% had one type of comorbidity and 35%, two or more. In the total sample, we found that 42.5% had hypertension and 30.1%, dyslipidemias. Additionally, they reported some complications such as retinopathies (17.5%), neuropathies (12.5%), nephropathies (10%), depression (2.5%); 41.5% of the patients said they were taking two or more medications; 62.8% of them were taking drugs for diabetes and comorbidity. Most of them were treated for hypertension and the most frequently hypoglycemic drug used was metformin (Table 1).

According to the Morisky Green scale, 37.3% of patients showed a cut-off ≥ 1 , which indicates that they were not adherent to the drug treatment (Table 2).

Table 3 shows socio-demographic and clinical characteristics, which were associated with non-adherence to treatment. These were: men (OR 6.8, 95% CI 4.00-11.54, $p = 0.000$); age > 65 years (OR 8.23, 95% CI 4.54-14.91, $p = 0.000$); without formal education (OR 6.44, CI 95% 1.74-23.84, $p = 0.003$), regular basic education (OR 3.47, CI 95% 1.28-9.37, $p = 0.01$); unemployed/retired (OR 4.71, CI 95% 1.84-12.01, $p = 0.000$); monthly household income up to \$265 (OR 4.71, 95% CI 1.18-5.61, $p = 0.01$); BMI > 25 (OR 5.41, 95% CI 2.32-12.59, $p = 0.000$); 11 or more years of the disease (OR 7.15, 95% CI 2.88-17.70, $p = 0.000$); having a comorbidity (OR 3.72, 95% CI 1.50-9.22, $p = 0.001$); being taking two or more medicaments (OR 3.78, 95% CI 1.77-8.0, $p = 0.000$).

Table 1: Sociodemographic and clinical characteristics of patients with diabetes

| Characteristics | n= 240 | % |
|---------------------------------|--------|------|
| Gender | | |
| Male | 92 | 38,3 |
| Female | 148 | 61,7 |
| Age | | |
| 45-64 | 139 | 57,9 |
| > 65 | 101 | 42,1 |
| Civil status | | |
| Single | 48 | 20,0 |
| Married/ cohabiting | 162 | 67,5 |
| Divorced/separated | 30 | 12,5 |
| Schooling | | |
| Without formal education | 19 | 7,9 |
| Basic education | 187 | 77,9 |
| Technical/Higher education | 34 | 14,2 |
| Labor modality | | |
| Dependent | 27 | 11,2 |
| Independent | 99 | 41,3 |
| Unemployed/ retired | 114 | 47,5 |
| Family income (Dollars) | | |
| Up to 265 | 203 | 84,6 |
| From 266 to 429 | 37 | 15,4 |
| Nutritional status (BMI) | | |
| Normal (18,5-24,9) | 54 | 22,5 |
| Overweight/ Obesity (>25) | 186 | 77,5 |
| Years with the disease | | |
| <10 years | 163 | 67,9 |
| 11 or more years | 77 | 32,0 |
| Comorbidities | | |
| Yes | 204 | 85,0 |
| No | 36 | 15,0 |
| Number of medicaments | | |
| One | 140 | 58,5 |
| Two or more | 100 | 41,5 |

Table 4 shows that barriers to accessing health, according to availability, accessibility, acceptability and contact, and their indicators are associated with non-adherence to treatment, with the exception of the "time taken to reach hospital is greater than 30 minutes" indicator of the accessibility dimension which was not associated

with medication non-adherence (OR 1.10, 95% CI, 0.88-1.37, p=0.433).

Table 5 shows the factors associated with the highest probability of non-adherence to treatment in patients with diabetes according to the final model obtained through multiple logistic regression analysis. We estimated ORs and calculated 95% confidence intervals and p-values using a significance level of 0.05: men 9.89 (95% CI 5.70-18.95); with no formal education 14.50 (95% CI 5.88-17.56); income up to \$265 2.50 (95% CI 1.43-3.78); obesity 10.50 (95% CI 3.81-13.50); comorbidity 3.8 (95% CI 2.57-4.37); considering that health personnel are not trained to perform their care 3.76 (95% CI 1.51-4.80); considering that the time they wait to receive care for laboratory, nephrology, cardiology, ophthalmology and internal medicine services is inadequate 5.61 (95% CI 2.6-8.15); having not attended the consultation because of lack of money for transport 4.71 (95% CI 3.60-9.52); having not taken the medications because of lack of money to buy them 4.74 (95% CI 2.79-9.51); considering that the prescribed treatment will not improve their health 6.54 (95% CI 3.71-10.13); not trusting the staff that treats them 8.51 (95% CI 5.2-12.50); not considering the quality of care in the hospital good 9.27 (95% CI 5.44-15.80).

Table 2: Medication adherence according to the Morisky-Green predictive scale (n=240)

| Questions | Patines with diabetes | |
|---|-----------------------|-----------------|
| | Yes | No |
| Do you ever forget to take your medicine to treat your disease? | 109(45.5%) | 131(54.5%) |
| Do you take your medicine at the right time? | 128(51.2%) | 112(46.7%) |
| When you feel fine, do you stop taking your medication? | 123(51.2%) | 117(43.8%) |
| If you are feeling bad, do you stop taking your medication? | 112(46.7%) | 128(53.3%) |
| Cutt off | n | Category |
| Less tan 1 | 150(62.7%) | Adherent |
| More or equal to 1 | 90(37.3%) | Non adherent |

Table 3: Sociodemographic and clinical characteristics of patients with diabetes and adherence to treatment

| Characteristics | Adherence to treatment | | OR - IC 95% | P value |
|---|------------------------|---------------|-------------------|---------|
| | Adherence | Non adherence | | |
| Gender | | | | |
| Male | 14(9.3%) | 78(86.7%) | 6,8(4,00-11,54) | 0,000 |
| Female | 136(90.7%) | 12(13.3%) | 1 | |
| Age | | | | |
| 45-64 | 114(76%) | 25(27.8%) | 1 | 0.000 |
| >65 | 36(24%) | 65(72.2%) | 8,23(4,54-14,91) | |
| Marital status | | | | |
| Single/ Divorced/separated | 50(33.3%) | 28(31.3%) | 1 | 0,722 |
| Married/cohabiting | 100(66.7%) | 62(68.9%) | 1,11 (0,63-1,94) | |
| Schooling | | | | |
| Basic education | 9(6%) | 10(11.1%) | 6,44 (1,74-23,84) | 0.003 |
| Basic education | 112(74.6%) | 75(83.2%) | 3,47(1,28-9,37) | 0.01 |
| Higher and technical education | 29(19.3%) | 5(5.5%) | 1 | |
| Labor modality | | | | |
| Dependent | 20(13.3%) | 7(7.7%) | 1 | |
| Independent | 87(58%) | 12(13.4%) | 0,394 (0,13-1,0) | 0.070 |
| Unemployed/Retired | 43(28.6%) | 71(78.9%) | 4,71(1,84-12,01) | 0.000 |
| Monthly household income (dollars) | | | | |
| Up to 265 | 120(80%) | 83(92.2%) | 2,57 (1,18-5,61) | 0.01 |

| | | | | |
|---------------------------------|------------|-----------|-------------------|-------|
| From 266 to 429 | 30(20%) | 7(7.8%) | 1 | |
| Nutritional status (BMI) | | | | |
| Normal (18-25) | 47(31.3%) | 7(7.8%) | 1 | |
| Overweight/Obesity (>25) | 103(68.7%) | 83(92.2%) | 5,41 (2,32-12,59) | 0.000 |
| Years with the disease | | | | |
| <10 years | 143(95.3%) | 20(22.2%) | 1 | 0.000 |
| 11 or more years | 7(4.7%) | 70(77.8%) | 7,15 (2,88-17,70) | |
| Comorbidities | | | | |
| Yes | 119(79.3%) | 85(94.4%) | 3,72 (1,50-9,22) | 0,001 |
| No | 31(20.7%) | 5(5.6%) | 1 | |
| Number of medicaments | | | | |
| One | 128(85.3%) | 12(13.3%) | 1 | |
| Two or more | 22(14.7%) | 78(86.7%) | 3,78 (1,77-8,0) | 0.000 |

Table 4: Barriers to health care access and medication adherence

| Health facility barriers | | Adherence n= 150 | | Non-Adherence n= 90 | | OR Confidence intervals 95% | P value |
|---|-----|---------------------|------|---------------------|------|-----------------------------------|---------|
| | | n | % | n | % | | |
| DISPONIBILITY | | | | | | | |
| Do you consider the environments where you receive care comfortable and clean? | Yes | 92 | 61,3 | 20 | 22,2 | 5,55 (3,10-10,10) | 0,000 |
| | No | 58 | 38,7 | 70 | 77,8 | | |
| Do you think the health care setting has adequate equipment and materials to deliver the care? | Yes | 112 | 74,7 | 32 | 35,6 | 5,34 (3,03-9-41) | 0,000 |
| | No | 38 | 25,3 | 58 | 64,4 | | |
| Do you believe that health personnel are fully trained to perform the care? | Yes | 77 | 51,3 | 27 | 30,0 | 2,46 (1,42-4,28) | 0,001 |
| | No | 73 | 48,7 | 63 | 70,0 | | |
| Do you consider the opening hours adequate? | Yes | 101 | 67,3 | 30 | 33,3 | 4,12 (2,36-7,18) | 0,000 |
| | No | 49 | 32,7 | 60 | 66,7 | | |
| Did you receive timely medical attention for consultations and follow-up examinations? | Yes | 103 | 68,7 | 29 | 32,2 | 4,61 (2,63-8,08) | 0,000 |
| | No | 47 | 31,3 | 61 | 67,8 | | |
| Accessibility | | | | | | | |
| Does it take more than 30 minutes to get to the hospital? | Yes | 56 | 37,3 | 39 | 43,3 | 1,10 (0,88-1,37) | 0,433 |
| | No | 94 | 62,7 | 51 | 56,7 | | |
| Do you use public transportation to get to the hospital? | Yes | 100 | 66,7 | 72 | 80,0 | 1,67 (1,10-2,67) | 0,020 |
| | No | 50 | 33,3 | 18 | 20,0 | | |
| Did you have any difficulty with administrative paperwork for receiving care? | Yes | 67 | 44,7 | 64 | 71,1 | 1,91 (1,34-2,73) | 0,000 |
| | No | 83 | 55,3 | 26 | 28,9 | | |
| Do you consider the waiting time for care in services such as laboratory, nephrology, cardiology, ophthalmology and internal medicine inadequate? | Yes | 49 | 32,7 | 75 | 83,3 | 4,04 (2,51-6,49) | 0,000 |
| | No | 101 | 67,3 | 15 | 16,7 | | |
| Did you ever not attend a consultation due to lack of money for transportation? | Yes | 60 | 40,0 | 73 | 81,1 | 3,17 (2,03-4,97) | 0,000 |
| | No | 90 | 60,0 | 17 | 18,9 | | |
| Did you ever not take your medication because you did not have the money to buy it? | Yes | 54 | 36,0 | 65 | 72,2 | 2,54 (1,79-3,60) | 0,000 |
| | No | 96 | 64,0 | 25 | 27,8 | | |
| Acceptability | | | | | | | |
| Do you think the prescribed treatment will improve your health? | Yes | 94 | 62,7 | 22 | 24,4 | 5,188 (2,89-9,30) | 0,000 |
| | No | 56 | 37,3 | 68 | 75,6 | | |
| Do you think the health workers who treat you have sufficient knowledge to improve your health? | Yes | 88 | 58,7 | 23 | 25,6 | 4,13 (2,32-7,34) | 0,000 |
| | No | 62 | 41,3 | 67 | 74,4 | | |
| Do you trust the health care staff that treats you? | Yes | 115 | 76,7 | 37 | 41,1 | 4,71 (2,67-8,28) | 0,000 |
| | No | 35 | 23,3 | 53 | 58,9 | | |
| Do you have a good relationship with your health care providers? | Yes | 88 | 58,7 | 9 | 10,0 | 12,77 (5,96-27,35) | 0,000 |
| | No | 62 | 41,3 | 81 | 90,0 | | |
| Contact | | | | | | | |
| Do you think the hospital's quality of care is good? | Yes | 97 | 64,7 | 23 | 25,6 | 5,33 (2,98-9,52) | 0,000 |
| | No | 53 | 35,3 | 67 | 74,4 | | |
| Did the health care staff address your concerns about your disease and/or treatment? | Yes | 117 | 78,0 | 36 | 39,9 | 5,32 (3,00-9,42) | 0,000 |
| | No | 33 | 22,0 | 54 | 59,9 | | |
| Did the health staff explain what the disease was about? | Yes | 100 | 66,7 | 36 | 40,0 | 3,00 (1,74-5,15) | 0,000 |
| | No | 50 | 33,3 | 54 | 60,0 | | |
| Did the health staff explain what the treatment was about? | Yes | 85 | 56,7 | 35 | 38,9 | 2,10 (1,21-3,50) | 0,007 |
| | No | 65 | 43,3 | 55 | 61,1 | | |
| Were you satisfied with the explanation? | Yes | 83 | 55,3 | 23 | 25,6 | 3,61 (2,10-6,39) | 0,000 |
| | No | 67 | 44,7 | 67 | 74,4 | | |

Table 5: Factors associated with medication non-adherence in patients with diabetes according to the logistic regression model

| Characteristics | OR Adjusted (IC95%) | Value P |
|--|---------------------|---------|
| Sociodemographic and Clinical | | |
| Male: gender | 9,89 (5,70-18,95) | 0,000 |
| Schooling: no formal education | 14,50 (5,88-17,56) | 0,000 |
| Economic income: up to 265 dollars | 2,50 (1,43-3,78) | 0,001 |
| Obesity | 10,50 (3,81-13,50) | 0,003 |
| With comorbidity | 3,8 (2,57-4,37) | 0,001 |
| Access to health care | | |
| Considering that health personnel are not trained to perform their care | 3,76 (1,51-4,80) | 0,001 |
| Considering the waiting time for laboratory, nephrology, cardiology, ophthalmology and internal medicine services inadequate | 5,61 (2,6-8,15) | 0,000 |
| Not attending the consultation due to lack of money for transportation at some point. | 4,71 (3,60-9,52) | 0,003 |
| Not taking the medications because they did not have the money to buy them at some point. | 4,74 (2,79-9,51) | 0,001 |
| Thinking that the prescribed treatment will not improve his/her health | 6,54 (3,71-10,13) | 0,003 |
| Not trusting his/her health care providers | 8,51 (5,2-12,50) | 0,002 |
| Not thinking that the quality of care in the hospital is good. | 9,27 (5,44-15,80) | 0,000 |

DISCUSSION

Chronic non-communicable diseases compromise the quality of life of millions of people worldwide and has become a serious public health problem¹³ which means that for a significant group of these people, there will be no timely care. This situation can be explained by mentioning the barriers in access to health services or their quality. Consequently, supporting quality of care, one of the fundamental pillars of the health system, has a broad impact because of its importance in addressing chronic diseases¹⁴.

T2DM represents a challenge for any health system due to the high costs as it is a morbid process that requires long-term pharmacological and non-pharmacological treatment to keep the disease under control. Therefore, there is a need to provide quality care that contributes to the therapy fidelity and hence, avoid harmful results for the patient and family¹⁵⁻¹⁸. It is appropriate for health systems to provide strong and innovative solutions, contributing to the improvement of access conditions to health care and making it possible that health needs are met regarding diagnoses, early treatment and patient follow-up using a patient- and community-centered approach that has demonstrated to have a positive impact on the patient's quality of life, reducing mortality, costs and health care burden^{19,20}.

To a large extent, the use of health services by the patient with diabetes is determined by a comprehensive and multifactorial approach that balances factors dependent on the health system, health supply and patient demand. When that balance is lost, there is a lack of adherence to treatment, which contributes to lack of control, resulting in poorer health outcomes and higher mortality²¹⁻²⁵.

In this respect, high quality evidence is required and it is, therefore, convenient to go deeper into the set of factors associated with therapy fidelity, which is essential to improve patient care. Regarding gender, women represent 61.7% of the sample, which coincides with different studies. One explanation for this situation could be the hormonal changes in women during childbearing age, gestation and menopause, which hinder glucose metabolism. Some

authors associate this increase with gender inequalities; others explain it with the higher rate of medical consultation made by women compared to men^{4,7,10,14,26,27}. In the age variable, 57.9% were between 45-64 years old, which is close to what was stated by the International Diabetes Federation-IDF², which indicated that three out of every four people that are in their working age and are younger than 64 years old have diabetes; and one out of every five older adults is in the same situation. Garcia¹⁰ and Pascacio et al¹⁶, in terms of age, found that 65.1% and 68.8%, respectively, were under 65. On the other hand, we should consider that in the classic form of T2DM, older adults have abnormalities in insulin secretion and develop alterations in carbohydrates metabolism and therefore, there is an increase in glycemia. However, this mechanism may actually physiologically occur in the fourth decade of life or earlier, which added to the changes in lifestyles in the world, is allowing much younger people to have this problem^{10,28,29}. Being married/cohabiting represented 67.5% of the sample, which coincided with other studies^{10,30}. Regarding the level of schooling, 77.9% of the sample had completed regular basic education, a result that also coincides with other research that explains that having a lower educational level increases the prevalence of T2DM^{4,8,9,25,31,32}. The Independent/unemployed/retired working modality involves 88.8% of cases given that the highest frequency of diabetes is reported by women. They repeatedly say that they continue performing household activities, which is included in this category^{4,27,28}. The study by Bello et al⁸ showed that the family income was between the first and second quintile of poverty and in the low socioeconomic level there are conditions that do not allow an adequate control of the disease, which is similar to what was found in this study, where 84.6% of the patients received a family income up to 265 dollars per month, corresponding to 9 dollars per day. In Peru, there are 4 people per family on average, which would represent \$2.25 per capita per day. Sandin et al³⁰, when studying gender inequalities, found that in African American and non-Latino white women, socioeconomic level was associated with higher prevalence of T2DM, (OR=2.17, 95% CI 1.77-2.28), which could mean that the prevalence increases with decreasing income and educational level⁽³¹⁾. A body mass

index >25 indicating overweight and obesity compromises health and increases the risk of complications in diabetes, but obesity is also an individual clinical condition that predisposes people to the disease^(31,32). Columbié et al³² found that the metabolic syndrome, characterized by central obesity, dyslipidemia, abnormal glucose metabolism and hypertension, is an independent risk factor for T2DM. In terms of time since diagnosis of T2DM, Garcia et al³³ reported 11.75 years (95% CI; 10.84-12.66), which is a constant in all studies^{16,31} optimistically expressing the quality of clinical practice guidelines for the management of diabetes and comorbidities, but it also tells us about the opportunity offered by preventive promotional programs for early diagnosis. Comorbidity is constantly reported in T2DM and demonstrating its symptomatic or subclinical presence is crucial, this is why early diagnosis can delay organic deterioration, arterial hypertension is frequently reported in different studies^{32,33}. In T2DM, the frequent use of several drugs is required, which involves out-of-pocket expenses and economic resources of the health system, a situation that can have a negative result on therapy fidelity^{9,16}. Garcia et al³³ found that the average number of medicaments was 6.43 units per day (95% CI, 6.15-6.71). This study showed that 41.5% of the patients reported taking two or more medications. In regard to these medications, 62.8% take them for diabetes and comorbidity.

Therapy fidelity involves the commitment of the patient to collaborate with their health when receiving treatment, which helps produce an optimal result. Unlike Bello et al⁸, who found that 48.28% of older adults did not follow their treatment, our study showed 37.3% of non-adherent patients. Ramos et al³⁴ reported 63% non-compliance with therapy. Castillo et al⁹ mentioned that, in chronic diseases, only 50% complied with treatment and in developing countries this would be higher. Another study put non-compliance at between 30 and 51%^{35,36}.

According to logistic regression, the final model was determined by identifying factors associated with treatment adherence. Among the sociodemographic and clinical studies, we found that men have different results from what has been reported in other studies, which, by associating gender and adherence, did not offer conclusive results, although Bello et al⁸ and Ramos et al³⁴ suggested that being a woman is a protective factor in treatment adherence explaining that they are more responsible in assuming the disease and treatment. Another variable associated with non-adherence was schooling. Ramos et al³⁴ found that the educational level does not offer differences with compliance/ non-compliance, although other studies show contradictory results in relation to adherence. Seen from an income perspective, another recognized factor, Nam et al¹⁵, Macbriem et al¹⁷ and Oyando et al¹⁹ agree with the results of this research: those patients who had difficulty with medication adherence were more likely to have financial barriers to health care. These involve obstacles to acquiring medications for both T2DM and comorbidities, receiving an appropriate diet, and additional resources for transportation to the hospital, which produce a stronger association in those under 65. Regarding obesity, the results offered by Camacho et al³⁷ and Rojas³⁸ are aligned with this study, they found that

obesity is a good predictor of adherence and stated that patients unable to control stress-generating situations, are unable to control efficiently compliance with therapy and this is reflected in the increase in their BMI. Martínez et al³⁹ showed an association between metabolic control and medication adherence.

According to the final model, besides the sociodemographic and clinical factors mentioned above, barriers related to access to health services were identified, allowing us to visualize the problem from the providers' perspective. Although it was not part of the research objective, we considered it a limitation for the patient's involvement. Garcia et al.⁽¹⁰⁾, in this regard, recognize that two-thirds of the factors are related to the provider, without excluding the patient, who must be convinced and motivated about treatment compliance.

Access to quality services for diabetic patients will depend on the health system, the provider and the user. Health institutions have the obligation to provide comprehensive quality care and the provider has the obligation to comply with therapeutic indications; if this formula is not followed, both will be affected.

Orozco et al³⁵ and Yashadiana et al⁴⁰ coincide with the results of this study, highlighting that good training of health personnel, adequate waiting time for consultation, commitment and coordination of all hospital personnel involved in the care of the patient with T2DM, and a good personal health-patient relationship that facilitates communication, are key elements detected to intervene adequately in adherence. Similarly, Hirmas et al¹¹, in an investigation on access to health services in general, found the following among the most frequent barriers: cost of medications, medical consultations and examinations; health teams and prescribed treatment distrust. In this regard, we can add that external users perceive barriers in the acceptability and accessibility dimensions more often, while providers identify availability and contact barriers. The access to quality health services disparity makes the need to develop multisectoral strategies a priority. In addition, a series of measures should be included that involve coordinated work between health workers and the general population to address this growing problem, which if left unattended, could become the greatest global health challenge in the future.

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