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TÍTULO:

"CALIDAD DEL CONTROL DE DIABETES MELLITUS 2 DE ACUERDO AL NIVEL DE ATENCIÓN: UN ESTUDIO TRANSVERSAL EN SEIS REGIONES DEL PERÚ"

DIABETES CARE QUALITY ACCORDING TO FACILITY SETTING: A CROSS SECTIONAL ANALYSIS IN SIX PERUVIAN REGIONS

ALUMNA:

GEORGINA YESSICA VILLAMONTE LAZARTE

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Presidenta: Dra. Meylin Aphang Lam

Secretaria: Dra. Natali Leiva Reyes

Vocal: Dra. Elsa Neira Sanchez

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ASESOR

Dr. Juan Jaime Miranda Montero

Director Centro de Excelencia en Enfermedades Crónicas

DEDICATORIA

Dedico el presente trabajo a mi madre y a mi padre, gracias por su amor incondicional.

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A Dios, a mi familia y a todos los investigadores partícipes de este estudio por su generosidad.

DECLARACIONES Y CONFLICTO DE INTERÉS

Los autores declaran no tener conflictos de interés

ÍNDICE

Pág.

RESUMEN

Objetivo: Describir la calidad de cuidado de diabetes de acuerdo al nivel de atención en seis regiones peruanas.

Métodos: Estudio transversal de pacientes con diabetes mellitus tipo 2 en establecimientos de salud de diferentes niveles de atención en seis regiones del Perú. La data fue recolectada por personal de salud entrenado entre 2012 y 2016. Estudiamos seis parámetros de calidad de control de diabetes y cuatro parámetros de adecuado control de diabetes considerando al nivel de atención como el evento de interés. Estimamos la razón de prevalencia a intervalos de confianza de 95% utilizando la regresión de Poisson con varianza robusta.

Resultados: Data de 8879 pacientes con diabetes mellitus tipo 2 fue analizada. De ellos, 8096 (91,2%) fueron atendidos en establecimientos de salud del primer nivel. La proporción de pacientes a los que se les realizaba la toma de HbA1c, LDL-c y creatinina/microalbuminuria incrementaba conforme aumentaba el nivel de atención. En general, 39%-56% de pacientes tenían adecuados niveles de HbA1c, siendo mayor el porcentaje de control en el tercer nivel de atención a comparación del primer nivel de atención.

Conclusiones: Conforme mayor es el nivel de atención, mayor es la frecuencia de toma de parámetros laboratoriales de control de la DM2 para 4 de las 5 variables: glucosa en ayunas, HbA1c, LDL-c y creatinina o microalbuminuria. Conforme mayor es el nivel de atención, mayor es la frecuencia de parámetros de adecuado control de diabetes para 3 de las 4 variables: glucosa ≤130 mg/dL, HbA1c≤ 7%, LDL-c <100 mg/dl. Se evidencian severas deficiencias en el primer nivel de atención: tanto para la toma de parámetros de control como para el alcance de objetivos de control de la DM2, generando una calidad de control sub óptima.

Palabras clave: diabetes mellitus tipo 2, sistemas de salud, cuidado de diabetes, cuidado de salud

ABSTRACT

Objective: To characterize diabetes care across healthcare facilities in six Peruvian regions.

Methods: Cross-sectional study of patients with type 2 diabetes mellitus (T2DM), ranging from primary care facilities to hospital-based facilities, in six Peruvian regions. Data was collected by health staff trained between 2012 and 2016.We studied six diabetes care outcomes and four adequate diabetes care outcomes considering the healthcare facility as the exposure of interest. We estimated prevalence ratios (PR) and their 95% confidence intervals (95% CI) using Poisson regression with robust variance.

Results: Data from 8879 patients with T2DM, mean age 59.1 years (SD ± 12.2), 53.6% males, was analyzed. Of these, 8096 (91.2%) were treated at primary care facilities. The proportions of patients who had HbA1c, LDL-c, and creatinine/microalbumin test performed increased with the setting of the healthcare facility. Overall, 39%–56% of patients had an adequate HbA1c control, being higher in hospital-based facilities with specialists in comparison to primary care facilities.

Conclusions: We observed that the higher the setting of the facility, the higher the rate of the assessed diabetes care outcomes and adequate

diabetes care for four of the six targets (fasting glucose, HbA1c, LDL-c and creatinine or microalbumin) and for three of the four targets (glucose≤130 mg/dL, HbA1c ≤7%(53 mmol/mol) and LDL-c <100 mg/dL), respectively. Substantial gaps were observed at the primary care facilities, calling for the strengthening of diabetes care.

Keywords: type 2 diabetes mellitus, health systems, diabetes care, healthcare

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Diabetes care quality according to facility setting: A cross-sectional analysis in six Peruvian regions

Jorge R. Calderon-Ticona[a,b,**], Alvaro Taype-Rondan[c], Georgina Villamonte[d], L. Max Labán-Seminario[c], Luis M. Helguero-Santín[f], J. Jaime Miranda[c,d], Maria Lazo-Porras[c,e,*]

[a] Endocrinology Service, Hospital Nacional Arzobispo Loayza, Ministerio de Salud, Lima, Peru
[b] School of Medicine, Universidad Nacional Mayor de San Marcos, Lima Peru
[c] CRONICAS Center of Excellence in Chronic Disease, Universidad Peruana Cayetano Heredia, Lima, Peru
[d] School of Medicine, Universidad Peruana Cayetano Heredia, Lima, Peru
[e] Division of Tropical and Humanitarian Medicine, Geneva University Hospitals & University of Geneva, Switzerland
[f] Escuela de Medicina, Universidad Nacional de Piura, Peru

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ABSTRACT

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Results: Data from 8879 patients with T2DM, mean age 59.1 years (SD ± 12.2), 53.6% males, was analyzed. Of these, 8096 (91.2%) were treated at primary care facilities. The proportions of patients who had HbA1c, LDL-c, and creatinine/microalbumin test performed increased with the setting of the healthcare facility. Overall, 39%–56% of patients had an adequate HbA1c control, being higher in hospital-based facilities with specialists in comparison to primary care facilities.
Conclusions: We observed that the higher the setting of the facility, the higher the rate of the assessed diabetes care outcomes and adequate diabetes care for four of the six targets (fasting glucose, HbA1c, LDL-c and creatinine or microalbumin) and for three of the four targets (glucose≤130 mg/dL, HbA1c ≤7%(53 mmol/mol) and LDL-c <100 mg/dL), respectively. Substantial gaps were observed at the primary care facilities, calling for the strengthening of diabetes care.

1. Introduction

Type-2 diabetes mellitus (T2DM) is a major public health problem, with about 422 million cases in 2014 worldwide, of which 46% are not aware of their diagnosis [1]. Diabetes care includes glycaemic and metabolic control in order to diminish morbidity and mortality from diabetic complications [2], and guidelines recommend that nonpregnant adults with diabetes have regular assessments of fasting glucose, glycated haemoglobin (HbA1c), plasma serum low density lipoprotein cholesterol (LDL-c), creatinine or microalbumin, foot evaluation, and eye evaluation [3].

Regretfully, diabetes care has its limitations, primarily but not limited to low- and middle-income countries (LMICs) [4–6], due to deficiencies in health systems [1], barriers to access, poor health care quality [7,8], financial and human resources limitations in primary health care facilities where there is no clinical practice guideline for management of diabetes complications [9,10], and emphasis on higher complex facilities [11]. Data from a monitoring program of the quality of care of persons with T2DM (QUALIDIAB) from six Latin America countries, including Argentina, Brazil, Chile, Colombia, Paraguay, and Uruguay, have shown a deficit in the access to diabetes care and a poor metabolic control, defined as

* Corresponding author at: Universidad Peruana Cayetano Heredia, Av. Armendáriz 445, Miraflores, Lima 18, Peru.
** Corresponding author at: Universidad Nacional Mayor de San Marcos, Av Arnaldo Marquez 1031, Jesus Maria, Lima 11, Peru.
E-mail addresses: jcalderont@gmail.com (J.R. Calderon-Ticona), maria.lazo@upch.pe (M. Lazo-Porras).

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HbA1c <6.5% (48 mmol/mol) and LDL < 100 mg/dl, in 13,513 registries [4].

Peru is a LMIC with a rise in T2DM prevalence, similar to other countries across the Americas which it has been two times larger in 2014 than in 1980, especially in English-speaking Caribbean countries [12], and an increase in diabetes-related mortality in recent decades [13,14]. Yet, few studies on diabetes care have been conducted throughout the country. An epidemiological surveillance performed in five Peruvian cities included 2864 patients with T2DM and reported that between 66%–73% of patients with T2DM had HbA1c ≥7% (53 mmol/mol) [15]. Also, a study at a Peruvian public hospital in Lima included 123 patients with T2DM, and found that only 15% had adequate HbA1c, blood pressure, and adequate lipid control according to the international guidelines [16].

A systematic review has reported deficiencies in the quality of diabetes care in LMICs of Asia and the Middle East, such as Nepal and Bangladesh, in which data of primary health care facilities were underrepresented [17]. Likewise, similar findings were reported in Central and South America, with a limited number of studies focusing on diabetes care in rural areas [18]. Evidence about diabetes care arising from countries with a diversity of geographical regions, including urban and rural areas, and the range of facilities where care is provided, is needed. The absence of this information hampers a comprehensive assessment of diabetes care and limits the design of interventions to improve diabetes care, especially in primary health care. Thus, our study aims to describe diabetes care and adequate diabetes care and compare it across facility settings in six Peruvian regions.

2. Methods

2.1. Design and setting

This is a cross-sectional study, a secondary analysis of the data collected as part of a diabetes educators training project (FREDI Project) [19]. The FREDI Project aimed to improve the knowledge of diagnosis and management of diabetes among health care professionals of different facilities, in six Peruvian regions, i.e. Piura, La Libertad, Lambayeque, Lima, Arequipa, and Cusco. These regions were selected because of their high prevalence of diabetes (see Supplementary Table 1).

Primary care facilities in the Peruvian Health system have concentrated 96.5% of the medical insurance offered by the Ministry of Health (MOH) in 2017; and the provision of care has been more frequent at primary care facilities and secondary health care facilities with 82.3% and 11.4%, respectively.

2.2. Patients

Subjects were patients with T2DM that attended outpatient consultations with health professionals trained by the FREDI Project between 2012 and 2016. For the present analysis, we included adults ≥18 years old who attended the Ministry of Health (MoH) facilities and who had at least one year of diagnosis of T2DM. The MoH is one of the main actors in the Peruvian health system, which serves about 54.3% of the Peruvian population [20].

2.3. Data collection

For the FREDI project, a multidisciplinary team of International Diabetes Federation (IDF) composed of certified professionals (endocrinologists, nurses, and nutritionists); trained 1095 health professionals (general physicians, specialists, nurses, and nutritionists) from 326 MoH health facilities including primary care, secondary health care, and hospital-based facilities, of the six Peruvian regions mentioned previously.

The training consisted of a face-to-face workshop course of 36 h of duration, performed in each region during 2012. The course included lectures of screening, diagnosis, non-pharmacological and pharmacological treatment of T2DM, and patient education about diabetes and diabetic foot, based on the latest American Diabetes Association (ADA) guidelines. In addition, health professionals were trained in effective methodologies for the collection of clinical data applying the QUALIDIAB epidemiological survey [4] in their outpatients. After the training, health care professionals were asked to collect information from their T2DM patients using a standardized survey. Between 2012 and 2016, all trained health professionals were asked to apply the QUALIDIAB survey to their patients with diabetes. The survey sheets were then sent to the MoH Regional Coordinator for non-communicable diseases and later sent to ADIPER each month for their quality evaluation and entry into a database.

2.4. Study variables

We used the QUALIDIAB epidemiological survey, developed by the QUALIDIAB network and designed to evaluate the quality of diabetes care in Latin America [4]. This tool collects sociodemographic, clinical, therapeutic, and diabetes care data. We evaluated six outcomes of diabetes care, all of which were collected as dichotomous variables according to whether they had been measured anytime during the last year: fasting glucose, HbA1c, LDL-c, creatinine or microalbumin, foot evaluation, and eye evaluation. Trained health professionals who were in charge of filling the surveys collected these data retrospectively through patient interviews and the review of clinical records.

Also, through the evaluation of the clinical records, we were able to construct four outcomes of adequate diabetes care during the past year: fasting glucose >80 mg/dL and <130 mg/dL, HbA1c <7% (53 mmol/mol), LDL-c <100 mg/dL, and the estimated glomerular filtration rate (eGFR) calculated using the MDRD formula ≥90 mL/min/1.73 m [2]. These cutoff values were obtained from the ADA guidelines [3]. The proportion of patients with adequate values were calculated from those who had these evaluations. The most recent values registered in the last 12 months were used.

We also assessed the setting of the facility where the patient received care, which was categorized using Peru's technical norm of categories of MoH health facilities [21] as i) Primary care facilities, which should perform the diagnosis and first treatment of frequent low-complexity health problems, lacks day hospitalization and endocrinologists; ii) Secondary health care facilities, which have day hospitalization and is based on the attention of four basic specialties, e.g. internal medicine, gynecology, general surgery, and pediatrics; iii) Hospital-based facilities without specialists, those who have physicians of different specialties that provide comprehensive, highly specialized care to ambulatory and hospitalized patients, but lacks endocrinologists; and, iv) Hospital-based facilities with specialists, facilities with endocrinologists, as the previous one but with at least one endocrinologist.

Other variables of interest were the Peruvian region where the survey was applied (Arequipa, Cusco, La Libertad, Lambayeque, Lima, or Piura), age, gender, obesity (body mass index ≥30 kg/m2), and years since diabetes diagnosis (1–5, 6–14, and ≥15 years).

2.5. Statistical analysis

Variables were described using frequencies. Bivariate analyses between sociodemographic and clinical characteristics and facility settings were performed using chi-squared tests.

Six diabetes care outcomes and four adequate diabetes care outcomes were compared across facility settings using crude and adjusted prevalence ratios (PRs) and their 95% confidence inter-

vals (95% CI), which were estimated using Poisson regression with robust variance. The models were adjusted by region, age and years since diagnosis. All analyses were performed with the software STATA v14 (StataCorp LP, College Station, TX, EE. UU).

2.6. Ethical considerations

The FREDI Project database did not collect names or other variables that allowed the identification of individuals. The protocol of this secondary analysis was approved by the ethics committee of the Hospital Nacional Arzobispo Loayza in Lima, Peru.

3. Results

3.1. General characteristics of study participants

A total of 1095 healthcare professionals participated in the study. Each healthcare professional surveyed a median of 8 patients (interquartile range 3–24), reaching a total of 10,973 participants, from which 2094 were excluded from the analysis: 51 had no data regarding facility setting, 154 were <18 years old, 310 had type 1 diabetes, 1577 had less than one year of T2DM diagnosis, and two were not seen at MoH facilities. Therefore, data from 8879 patients were analyzed (Fig. 1).

Among the 8879 included patients, 8096 (91.2%) were treated at primary care facilities, 254 (2.9%) in secondary health care facilities, 285 (3.2%) in hospital-based facilities without specialists, and 244 (2.8%) in hospital-based facilities with specialists. The mean age of participants was 59.1 ± 12.2 years, 4762 (53.6%) were males, 5034 (56.7%) had between 1 to 5 years living with a diagnosis of T2DM, and the regions with the highest number of patients were Lima (52.7%) and Lambayeque (28.5%). Some patient characteristics were heterogeneous across facilities types (Table 1).

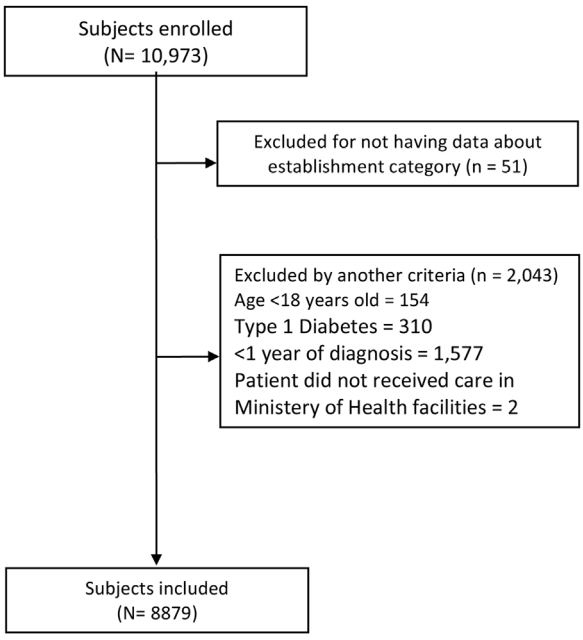

Fig. 1. Flow chart of study participants.

3.2. Diabetes care in the last 12 months

In the primary care facilities only 38% of the patients received medication and 13% had self-blood glucose monitoring (Fig. 2).

Across the four types of healthcare facilities, the proportion of patients with each evaluation assessed during the last year ranged between 79%–94% for fasting glucose, 22%–53% for HbA1c, 28%–48% for LDL-c, 31%–51% for creatinine/microalbumin, 5%–13% for foot evaluation, and 4%–11% for eye evaluation (see Supplementary Fig. 1).

Table 1
Characteristics of studied population by care facility setting.

Characteristic	Total (n = 8879)	Healthcare facility categories				
		Primary care facility (n = 8096)	Secondary health care facility (n = 254)	Hospital-based facility without specialist (n = 285)	Hospital-based facility with specialist (n = 244)	p-value
Age in years (mean ± SD)	59.1 ± 12.2	58.9 ± 12.2	61.5 ± 10.9	60.4 ± 11.7	61.3 ± 12.5	<0.001
Age in years						<0.001
≤ 30	146 (1.6)	139 (1.7)	1 (0.4)	3 (1.1)	3 (1.2)	
31–59	4238 (47.8)	3914 (48.4)	98 (38.6)	134 (47.0)	92 (37.7)	
≥ 60	4495 (50.6)	4043 (49.9)	155 (61.0)	148 (51.9)	149 (61.1)	
Sex						0.005
Males	4762 (53.6)	4364 (53.9)	148 (58.3)	142 (49.8)	108 (44.3)	
Females	4115 (46.4)	3730 (46.1)	106 (41.7)	143 (50.2)	136 (55.7)	
BMI categories						0.439
Underweight	123 (1.5)	112 (1.5)	3 (1.4)	3 (1.1)	5 (2.1)	
Normal weight	2174 (27.4)	1972 (27.2)	60 (27.0)	76 (29.1)	66 (28.6)	
Overweight	3120 (39.2)	2824 (39.0)	104 (46.8)	101 (38.7)	91 (39.4)	
Obesity	2543 (31.9)	2338 (32.3)	55 (24.8)	81 (31.1)	69 (29.9)	
Years since diabetes diagnosis						0.011
1–5	5034 (56.7)	4633 (57.2)	144 (56.7)	138 (48.4)	119 (48.8)	
6 to 14	2757 (31.0)	2491 (30.8)	78 (30.7)	103 (36.2)	85 (34.8)	
≥ 15	1088 (12.3)	972 (12.0)	32 (12.6)	44 (15.4)	40 (16.4)	
Region						<0.001
Lima	4676 (52.7)	4242 (52.4)	130 (51.2)	166 (58.2)	138 (56.6)	
Lambayeque	2529 (28.5)	2306 (28.5)	57 (22.4)	78 (27.4)	88 (36.1)	
Piura	847 (9.5)	791 (9.8)	22 (8.7)	23 (8.1)	11 (4.5)	
Cusco	484 (5.5)	457 (5.6)	16 (6.3)	11 (3.9)	0 (0.0)	
Arequipa	275 (3.0)	240 (3.0)	21 (8.3)	7 (2.5)	7 (2.8)	
La Libertad	68 (0.8)	60 (0.7)	8 (3.1)	0 (0.0)	0 (0.0)	

Table 2
Prevalence ratios of each of the evaluations according to facility type.

Facility type	Crude PR (95% CI)	Adjusted PR (95% CI)*
	Outcome: fasting glucose during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.03 (0.98–1.08)	1.02 (0.97–1.07)
Hospital-based facilities without specialist	**0.94 (0.88–1.00)**	**0.93 (0.88–0.99)**
Hospital-based facilities with specialist	**1.11 (1.08–1.15)**	**1.12 (1.08–1.16)**
	Outcome: HbA1c during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.11 (0.89–1.38)	1.10 (0.89–1.37)
Hospital-based facilities without specialist	**1.78 (1.53–2.06)**	**1.73 (1.49–1.99)**
Hospital-based facilities with specialist	**2.38 (2.09–2.69)**	**2.42 (2.13–2.74)**
	Outcome: LDL-c during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.11 (0.92–1.34)	1.10 (0.91–1.34)
Hospital-based facilities without specialist	**1.22 (1.03–1.44)**	**1.22 (1.03–1.43)**
Hospital-based facilities with specialist	**1.72 (1.51–1.97)**	**1.74 (1.52–1.99)**
	Outcome: creatinin or microalbumin during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.05 (0.88–1.26)	1.06 (0.89–1.27)
Hospital-based facilities without specialist	**1.40 (1.22–1.60)**	**1.41 (1.22–1.62)**
Hospital-based facilities with specialist	**1.65 (1.45–1.87)**	**1.63 (1.42–1.87)**
	Outcome: foot evaluation during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	0.81 (0.55–1.21)	0.76 (0.51–1.13)
Hospital-based facilities without specialist	1.17 (0.86–1.59)	1.27 (0.94–1.73)
Hospital-based facilities with specialist	**0.48 (0.28–0.82)**	**0.55 (0.33–0.94)**
	Outcome: eye evaluation during the last year	
Primary care facilities	Ref	Ref
Secondary health care facilities	**2.66 (1.84–3.83)**	**2.72 (1.87–3.94)**
Hospital-based facilities without specialist	**1.78 (1.16–2.72)**	**1.76 (1.14–2.69)**
Hospital-based facilities with specialist	1.58 (0.97–2.57)	1.49 (0.92–2.44)

* Adjusted by region, age and years since diabetes diagnosis.

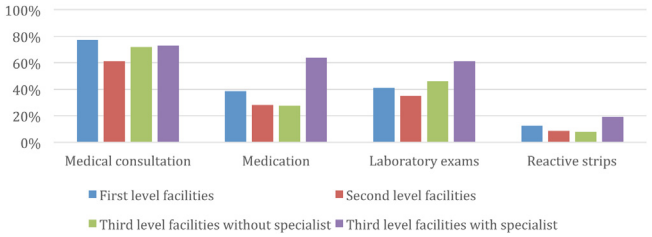

Fig. 2. Frequency of participants that receive medical consultation, medication, laboratory exams and reactive strips by free according to facility type.

The proportion of patients who had HbA1c, LDL-c, and creatinine/microalbumin evaluations during the last year were higher in accordance to the setting of the health facility -the higher the setting, the higher the frequency of evaluations of fasting glucose, HbA1c, LDL-c, and creatinine/microalbumin- but this pattern was not observed for foot evaluation or eye evaluation as this parameter has a better ratio in primary care in contrast to hospital-based facilities with specialist (see Supplementary Fig. 1). In the hospital-based facilities with specialist, in comparison to primary care facilities, the frequency of evaluation of fasting glucose was 12% more, 142% more for HbA1c, 74% more for LDL-c, and 63% more for creatinine/microalbumin, whereas foot evaluation 45% less. The crude adjusted PRs for the associations are shown in Table 2. For GFR, there were no differences between facilities.

3.3. Adequate diabetes care in the last 12 months

Across the four healthcare facility types, the proportion of patients meeting diabetes care targets during the last year ranged from 43%–59%, 39%–56%, 24%–63%, and 35%–46% for adequate levels of fasting glucose, HbA1c, LDL-c, and eGFR, respectively. The proportion of the fasting glucose ≤130 mg/dL, HbA1c ≤7% (53 mmol/mol) and LDL < 100 mg/dL were higher, 30%, 30%, and 66% higher, respectively, in the hospital-based facilities with specialists than in primary care facilities, while there was no evidence of an association for GFR ≥ 90 mg/dL (Table 3).

4. Discussion

This study of quality of diabetes care delivered across healthcare facilities in Peru, and involving nearly 1100 healthcare providers and around 10,000 patients from six regions, found major gaps and missed opportunities during the clinical encounter to achieve adequate diabetes care in Peru. It found that between evaluations performed at primary care facilities one of four patients had HbA1c, one of three had LDL-c and creatinine/microalbumin, whereas patients that received care at hospital-based facilities had twice the frequency of these evaluations. Also, adequate diabetes care was higher in hospital-based facilities with specialists in comparison to the primary care facilities for the following diabetes care facilities for the following diabetes care targets: glucose, HbA1c, LDL-c and creatinine or microalbumin. However, screening for retinopathy and diabetic foot had a better ratio in primary care facilities

Table 3
Laboratory results of the participant according to facility type.

Facility type	Crude PR (95% CI)	Adjusted PR (95% CI)*
	Outcome: glucose ≤130	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.14 (0.99–1.31)	1.10 (0.96–1.26)
Hospital-based facilities without specialist	0.99 (0.85–1.16)	0.99 (0.85–1.15)
Hospital-based facilities with specialist	**1.36 (1.22– 1.52)**	**1.30 (1.16– 1.45)**
	Outcome: HbA1c ≤7 (53 mmol/mol)	
Primary care facilities	Ref	Ref
Secondary health care facilities	0.98 (0.73–1.33)	0.96 (0.71–1.29)
Hospital-based facilities without specialist	0.93 (0.73–1.18)	0.90 (0.71–1.14)
Hospital-based facilities with specialist	**1.34 (1.14– 1.58)**	**1.30 (1.11– 1.53)**
	Outcome: LDL-c <100	
Primary care facilities	Ref	Ref
Secondary health care facilities	1.09 (0.82–1.46)	1.04 (0.79–1.37)
Hospital-based facilities without specialist	0.68 (0.48– 0.98)	0.66 (0.46– 0.95)
Hospital-based facilities with specialist	**1.80 (1.55– 2.09)**	**1.66 (1.43–1.93)**
	Outcome: GFR ≥ 90	
Primary care facilities	Ref	Ref
Secondary health care facilities	0.76 (0.55–1.05)	0.85 (0.62–1.17)
Hospital-based facilities without specialist	0.95 (0.77–1.17)	1.07 (0.88–1.30)
Hospital-based facilities with specialist	0.82 (0.55–1.23)	0.76 (0.49–1.16)

* Adjusted by region, age and years since diabetes diagnosis.

in contrast to hospital-based facilities with specialists. Also, there were no significant differences between facilities for GFR.

These findings provide strong evidence that primary health care in LMIC settings need to be strengthened in order to prevent diabetes complications and contribute to reductions in mortality. The evidence generated from this study raise awareness about the need to improve diabetes care at the primary care in other LMICs with similar health systems, paired with its deficiencies, and with high rates of inequality within the country, for example rural vs. urban areas, and low- vs. high-income regions.

4.1. Diabetes care in the last 12 months

Our results of the proportion of patients from different facility settings with fasting glucose and HbA1c were consistent with those reported in a previous study carried out on patients with diabetes from 18 Peruvian hospitals in 2012 [15]. Furthermore, the HbA1c metric of care in our study, which was between 22%–53%, was much lower than the 85% found in a private university hospital from Argentina [22], the 94% found in primary health care clinics in Saudi Arabia [23], and the 72% found in primary health care facilities from the Netherlands [24]. Additionally, a study conducted in 17 countries from Eastern Europe, Asia, Latin America and Africa found that 36% of T2DM patients never had a HbA1c measurement across a 5-year period [25].

In our study, the fasting glucose test was much more commonly reported than HbA1c, LDL-c, or creatinine/microalbumin tests. This was not surprising since fasting glucose is usually assessed using a glucometer, while the other exams require more equipment and laboratory supplies, many of which may be only available at hospital-based facilities [10]. We also found that the availability of a specialist was linked to higher proportions of participants meeting targets for diabetes care. Despite this, even in these hospital-based facilities with specialists, each of the HbA1c, LDL-c, and creatinine/microalbumin tests were only measured in approximately half the patients, thus signaling further challenges and unmet needs.

The proportion of patients who had an evaluation of the foot during the last 12 months ranged from 5% to 13%, and from 4% to 11% for eye evaluation. These proportions are smaller than other studies performed in the primary care facilities of Saudi Arabia (30% and 28%) [23], the Netherlands (63% and 78%) [24] and Argentina (70% and 38% for foot and eye examination respectively) [15].

Foot evaluation is an easy, fast and low-cost procedure, and the low rate of occurrence reported in this study suggests the need to enhance its implementation in routine care, through different mechanisms, be it training, education or additional nudging and incentives to engage with the practice of foot examination. These activities could be oriented to healthcare providers and also to patients as shown in a recent study conducted in a LMIC setting were >90% of study participants engaged with the habit of regular observation of their feet [26]. Regarding eye evaluation, the low proportion observed in our study could be related to the lack of trained personnel and equipment in Peru [10]. However, some potentially useful implementation strategies are being tested in Peru, such as the screening of diabetic retinopathy using non-mydriatic retinal cameras [27], as well as the investigation of simple tools to approach diabetes-related eye complications [28].

4.2. Adequate diabetes care

The proportion of patients who had fasting glucose ≤130 mg/dL ranged from 43% to 59%, while for HbA1c ≤7% (53 mmol/mol) was from 39% to 56%, indicating poor diabetes control rates. However, these figures were estimated only among those with tests performed, as there was a group of participants without measurements of diabetes care, which may increase the number of people not meeting these targets. Previous studies have found heterogeneous results in glucose control: A study in T2DM patients found that 24% in Colombia and 68% in Chile were controlled with <126 mg/dL for fasting glucose [29]. Another study analyzed health center's records in six hospitals from six Latin American and Caribbean countries and reported poor metabolic control [HbA1c ≥6.5% (48 mmol/mol)] in the range of 28% to 83% [4]. In addition, similar to our results, HbA1c <7% (53 mmol/mol) was found in 52% for T2DM patients from the United States between 2007 and 2010 [30] and 53% in Japan [31], but this figure was 25% in Saudi Arabia [23] and 66% in Argentina [22].

The proportion of patients who had an adequate value of fasting glucose, HbA1c, or LDL-c was higher in hospital-based facilities with specialists. A previous study in Latin America reported specific factors related to adequate diabetes care, such as lack of microvascular complications, health insurance coverage and specialist care

[25]. Some reasons could explain our findings. First, one hypothesis for which foot evaluation had a 0.81 PR in secondary care facilities and 0.48 PR in hospital-based facilities without specialist in comparison to primary care facilities; foot evaluation is mainly a clinical parameter that only require professional expertise and can be easily identified in the first encounter in a medical facility, such as a primary care facility. It does not need further materials or elements for its evaluation apart from medical expertise. For the other four laboratory variables such as fasting glucose, HbA1c, LDL.C, creatinine for which we found a better outcome in higher facilities in contrast to primary care facilities. This could happen because for the measurement of these variables it is required to have a professional in the laboratory, chemical materials, and other physical resources that are much more available in higher facilities in contrast to primary care facilities, specially in a low middle income country such as Peru.

Also, for the outcome of GFR there were no differences between the facilities analyzed in our study. One of the reasons for this to happen is that renal complications occur in a much later stage of the disease, and are often identified in severe cases of patients with a long data of diabetes and no control whatsoever. However, for the other outcomes evaluated such as glucose control, HbA1c control and LDL titles which refer to metabolic alterations that can occur in early stages of the disease and therefore, are more likely to be identified and allow us to make comparisons regarding to diabetes care and control according to the healthcare facility.

4.3. Relevance of this study for public health

The present study has found serious pressing deficiencies that require immediate attention in order to decrease the rise in diabetes-related morbimortality. Interventions are urgently needed at all settings of healthcare delivery, including strengthening the various layers of the health system, specially in the primary care facilities, as well as the implementation of educational health programs for people with T2DM based on evidence and adapted to the context [32]. Interventions performed by educational groups, integrated health care professionals and trained community members has shown to have effects on weight reduction and improve the metabolic control in patients with diabetes [33]. Moreover, interventions based on system-oriented, practitioner-oriented and patient-oriented strategies in high income countries were associated with average declines in HbA1C and it favored the reduction of health care expenditures with a median change of $302 per patient per year in the short term [34]. Thus, working together between government and related health institutions to implement these interventions in primary care should be considered a priority in order to reduce emergency visits in primary care facilities and costs related to complications in the long term.

Promptly, there is a need for: 1) public policies that prioritize T2DM care and prevention, and likewise to promote institutional efforts to monitor the quality of diabetes care, 2) decentralize medical technologies and equipment needed to perform diabetes care tests across different facilities, 3) government investment in educational intervention programs to improve capacity of diabetes care in health professionals, prevention of diabetes and reductions of complications in patients in order to reduce health costs, 4) adequate reference and counter-reference flows, 5) support from funding institutions to promote research in cost-effectiveness interventions. In addition, it would be helpful to manage people with diabetes in units that favor integrated care with well-trained multidisciplinary teams. In the same vein, the management of diabetes does not rely only on the health sector and fit well within a broader set of governmental strategies that guarantee adequate social protection [35].

4.4. Limitations and strengths

Some limitations of the present study merit attention. First, the sampling of participants was not random and our results could be restricted to the studied facilities only, yet we aimed to cover all four settings of healthcare delivery available in the country thus providing an almost complete picture of the health system. Second, the data of diabetes care was collected retrospectively, by interview and review of clinical registries, which could prone to recall bias, to deficiencies in the registering of data or to other unmeasured confounders, such as diabetes treatment, comorbidities, complications of diabetes, primary or secondary cardiovascular prevention, hospitalizations, hospital workload by day, and hospital resources. The absence of adjustment by diabetes treatment underestimate the prevalence ratios, whereas the absence of adjustment by the other mentioned variables overestimate the calculated measures of association. So, it is possible that our prevalence ratios are overestimated.

Despite these limitations, our study secured a large number of participants from different regions across different settings of healthcare facilities, advancing the exploration of diabetes care beyond hospital-setting types of studies. As such, the findings from this study contribute to fill the scientific gap of limited information related to diabetes care available in Latin American countries and similar LMICs.

Conclusions

The prevalence of diabetes care in hospital-based facilities with specialists was higher than in the primary care facilities for fasting glucose, HbA1c, LDL-c and creatinine or microalbumin as well as the prevalence of adequate diabetes care for glucose. However, the different characteristics of the patients and care settings need to be considered to carefully interpret these results. This study can support interventions aimed to reduce access gaps in diabetes care and ensure adequate diabetes care across all types of facility settings in order to prevent diabetes complications, contribute to reductions in morbimortality, diminish costs, and improve quality of life of patients, families and communities.

Contributions

JCT, ATR, and MLP conceived the data analysis approach for this study. JCT was involved in the original study participated in data collection. ATR and JCT analyzed the data. JCT, ATR, LMLS, GV, LMH, JJM and MLP took part in the interpretation of the results, writing up, and provided critical inputs to the manuscript.

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Conflicts of interest

All authors declare no competing interests.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pcd.2020.11.014.

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