

## Quality of Life and Oral Health in Colombian Patients with Type 2 Diabetes Mellitus \*

Calidad de vida y salud oral en pacientes colombianos con diabetes mellitus tipo 2

Qualidade de vida e saúde bucal em pacientes colombianos com diabetes mellitus tipo 2

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### ABSTRACT

**Background:** Type 2 diabetes mellitus (DM2) can affect the quality of life of patients due to oral lesions related to the disease and that would impact their daily activities. **Purpose:** To estimate the impact of oral conditions and lesions on the health-related quality of life (OHRQoL) in patients with DM2 attending the MEDICUS Foundation in Cartagena, Colombia. **Methods:** An analytical study was conducted on 152 patients who filled out a questionnaire to assess sociodemographic variables and the General Oral Health Assessment Index (GOHAI-C), Colombian version. Two calibrated examiners performed the oral clinical assessment. Poisson regression was performed to associate oral clinical and socioeconomic conditions with the domains and total GOHAI score. **Results:** 74.34 % of the patients presented more than 5 years with diagnosed DM2. The multivariate adjusted model showed that patients with DM2 who presented low salivary flow (RR = 1.08;  $p < 0.001$ ) and denture stomatitis (RR = 1.10;  $p = 0.001$ ) were more likely to have a negative impact on total GOHAI scores. On the other hand, other oral lesions such as periodontitis (RR = 0.95;  $p = 0.046$ ), geographic tongue (RR = 0.94;  $p = 0.013$ ), sialosis (RR = 0.85;  $p \leq 0.000$ ) and having <19 teeth in the mouth (RR = 0.94;  $p = 0.006$ ) had a positive impact. **Conclusions:** Sub-prosthetic stomatitis and low salivary flow showed a negative impact on the OHRQoL of the Colombian patients with DM2 studied.

**Keywords:** dental prostheses; dentistry; diabetes mellitus type 2; oral health; periodontitis; quality of life; stomatitis; saliva

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### RESUMEN

**Antecedentes:** La diabetes mellitus tipo 2 (DM2) puede afectar la calidad de vida de los pacientes por las lesiones orales relacionadas con la enfermedad y que impactarían sus actividades diarias. **Objetivo:** Estimar el impacto de las condiciones

y lesiones orales sobre la calidad de vida relacionada con la salud oral (CVRSO) en pacientes con DM2 pertenecientes a la Fundación MEDICUS en Cartagena, Colombia. **Métodos:** Se realizó estudio analítico en 152 pacientes que diligenciaron un cuestionario para evaluar variables sociodemográficas y el Índice de Evaluación de la Salud Oral General (GOHAI-C) versión colombiana. Dos examinadores calibrados realizaron la evaluación clínica oral. Se realizó regresión de Poisson para asociar las condiciones clínicas orales y socioeconómicas con los dominios y el puntaje total del GOHAI.

**Resultados:** El 74,34 % de los pacientes presentaba más de 5 años con DM2 diagnosticada. El modelo ajustado multivariado mostró que los pacientes con DM2 que presentaban bajo flujo salival (RR = 1,08;  $p \leq 0,001$ ) y estomatitis subprotésica (RR = 1,10;  $p = 0,001$ ) tenían una probabilidad mayor de tener un impacto negativo sobre las puntuaciones totales del GOHAI. Por otra parte, otras lesiones orales como periodontitis (RR= 0,95;  $p = 0,046$ ), lengua geográfica (RR = 0,94;  $p = 0,013$ ), sialosis (RR = 0,85;  $p = <0,000$ ) y tener <19 dientes en boca (RR = 0,94;  $p = 0,006$ ) tenían un impacto positivo. **Conclusiones:** La estomatitis subprotésica y el bajo flujo salival mostraron un impacto negativo sobre la CVRSO de los pacientes colombianos con DM2 analizados.

**Palabras clave:** calidad de vida; diabetes mellitus tipo 2; estomatitis; odontología; periodontitis; prótesis dental; saliva; salud oral.

## RESUMO

**Antecedentes:** O diabetes mellitus tipo 2 (DM2) pode afetar a qualidade de vida dos pacientes devido a lesões bucais relacionadas à doença e que impactariam suas atividades diárias. **Objetivo:** Estimar o impacto das condições e lesões bucais na qualidade de vida relacionada à saúde bucal (QVRS) em pacientes com DM2 pertencentes à Fundação MEDICUS em Cartagena, Colômbia. **Métodos:** Foi realizado um estudo analítico com 152 pacientes que preencheram um questionário para avaliar variáveis sociodemográficas e o Índice Geral de Avaliação de Saúde Bucal (GOHAI-C) versão colombiana. Dois examinadores calibrados realizaram a avaliação clínica oral. A regressão de Poisson foi realizada para associar as condições clínicas e socioeconômicas bucais com os domínios e o escore total do GOHAI. **Resultados:** 74,34 % dos pacientes apresentavam mais de 5 anos com diagnóstico de DM2. O modelo ajustado multivariado mostrou que pacientes com DM2 que apresentaram baixo fluxo salivar (RR = 1,08;  $p < 0,001$ ) e estomatite protética (RR = 1,10;  $p = 0,001$ ) tiveram maior chance de ter um impacto negativo nos escores totais do GOHAI. Por outro lado, outras lesões orais como periodontite (RR = 0,95;  $p = 0,046$ ), língua geográfica (RR = 0,94;  $p = 0,013$ ), sialose (RR = 0,85;  $p \leq 0,000$ ) e ter <19 dentes em a boca (RR = 0,94;  $p = 0,006$ ) teve impacto positivo. **Conclusões:** A estomatite subprotética e o baixo fluxo salivar mostraram um impacto negativo na QVRS dos pacientes colombianos com DM2 analisados.

**Palavras-chave:** diabetes mellitus tipo 2; estomatite; odontologia; periodontite; prótese dental; qualidade de vida; saliva; saúde bucal

## INTRODUCTION

Currently, there has been evidence of an increase in chronic noncommunicable diseases due to changes in lifestyles, the concentration of the population in urban centers, and technological development (1). One of these diseases is type 2 diabetes mellitus (DM2), which the International Diabetes Federation (IDF) describes as one of the main causes of death in the adult population  $\leq 60$  years (2).

The National Demographic and Health Survey (ENDS) in Colombia showed a prevalence of DM2 of 11.2% in 2011 (3). In 2019, the number of people with diabetes in Latin America was estimated to be 31.6 million (4). In the case of Colombia, no data is available, but there are currently two registries, the Comprehensive Social Protection Information System (SIPAS) and the High-Cost Account (CAC) that show a prevalence of DM2 between 1.4 % and 12%, although they are limited because they do not cover 100% of the population (3).

Diabetes mellitus or metabolic syndrome is a disease that generates various sequelae in the state of general health and deterioration of oral health (4). Oral conditions such as geographic tongue, dental caries, xerostomia, periodontitis, edentulism, denture stomatitis, lichen planus and oral pain are the most prevalent in DM2. However, such oral lesions and conditions are not pathognomonic of the disease (5) but may have an unfavorable course due to elevated blood glucose levels (4,5). Such is the case of the bidirectional link between DM2 and chronic periodontitis, which results in greater systemic involvement (6).

Studies in Colombia indicate how chronic pathologies such as DM2 and the pharmacological measures for its treatment can impact the oral health of patients (7), which can compromise the daily routine and affect certain individual, family, and social functions and activities. (8, 9). It is recognized that xerostomia can cause difficulty in swallowing food, chewing, or speaking and can increase

susceptibility to caries and oral infections, as well as taste disorders, halitosis, and friability of the oral mucosa in these patients (10). Regarding periodontitis, research in Colombia confirms its character as a chronic inflammatory reaction to the biofilm accumulated around the surfaces of the teeth, which, in the absence of adequate oral hygiene in patients with DM2, generates a greater loss of clinical attachment that contributes to the formation of periodontal pockets, is accompanied by bleeding on probing and ends with tooth loss (11). DM2 is also a source of stress due to the meaning it has for the person to suffer from a chronic disabling disease, which imposes limitations on behavior and predisposes to the appearance of psychopathological disorders such as depression and anxiety (12-13).

Thus, the state of oral health in patients can compromise the different domains related to the concept of oral health-related quality of life (OHRQoL), such as physical, psychosocial, and pain domains, affecting the well-being of people who suffer from DM2 (14). Numerous investigations show important assessments of the social determinants of health and their impact on glycemic control, cost, and quality of life (15). These investigations serve as a precedent for this study and propose to evaluate sociodemographic conditions (social, economic, and health policies), because they impact people's health in the same way as they do on their OHRQoL (15,16).

In Colombia, there are studies that relate oral health and quality of life, in adults without systemic conditions, in which a direct interaction with general health states and a negative self-perception of well-being has been recognized (17). At the end of the search in the scientific literature in relation to the study population, no local studies were found that, exclusively, allow us to answer the question: What is the impact of oral health on the OHRQoL of patients with DM2?

This study is one of the first conducted in Colombia on OHRQoL in patients with DM2. The contribution to knowledge is aimed at the comprehensive care of patients with esDM2, considering physiological and psychosocial aspects of management. Treatments can be conducted from the perspective of the patient, not only from the health professions and, from public health, it becomes a tool to implement more effective cost- and usefulness-based interventions. Also, the study can be replicated in other populations with chronic non-communicable diseases, including oral health as another fundamental aspect in the general health of people.

## **MATERIALS AND METHODS**

An analytical study was conducted in 2018 with patients with DM2, who had been treated at the MEDICUS Foundation. It is a private health care center, located in the city of Cartagena, Colombia, which provides specialized medical care in diabetes mellitus and comprehensive management of its complications. MEDICUS treats approximately 200 patients diagnosed with DM1 and DM2 per month, most of whom are over 50 years of age. The population served comes to MEDICUS from urban and rural areas of the Cartagena district, 90% and 10%, respectively. The ethnic composition of the patients was: white and mestizo 63.2%, Afro-descendant 36.1%, and Indigenous and other 0.7%.

A total of 152 patients participated, for convenience, according to their availability at the time of the study. They met the following inclusion criteria: being over 18 years old, with a single diagnosis of DM2, not having received dental treatment in the previous three months to assess the impact of the injuries on the OHRQoL, agreeing to participate, and not having had less than two years in MEDICUS. Patients with motor or cognitive disabilities were excluded. All patients received information about the purpose of the study and signed the informed consent indicating that there was no health risk.

First, a questionnaire was designed and applied to investigate sociodemographic variables and quality of life related to oral health, before performing the oral clinical examination. The interviews were conducted by two dental assistants who were unaware of the clinical oral examinations of the patients. The interviewers received training in intonation and command of the questionnaire.

Sociodemographic data were then categorized for statistical analysis as follows: age ( $\leq 44$ ;  $\geq 45$  years), sex (male; female), occupation (employed; unemployed), health system affiliation (yes; no), socioeconomic income (measured in terms of the current legal monthly minimum wage [SMMLV])

of Colombia, with a standard for this type of evaluation, which corresponds to approximately US\$233.78 per month, about COP\$908,526 Colombian pesos for the date of completion of this study) ( $\leq 1$  SMMLV;  $\geq 2$  SMMLV), educational level (low,  $<10$  years of study; high,  $\geq 10$  years of study), religious affiliation (yes; no), evolution of T2DM ( $> 5$  years;  $\leq 5$  years) and pharmacological treatment for T2DM (yes; no). There were questions about general oral changes due to diabetes (yes; no), the type of oral changes (xerostomia, changes in food taste, dysphasia, bleeding on brushing, or halitosis), and habits such as smoking and alcohol consumption.

To assess OHRQoL, the General Oral Health Assessment Index (GOHAI) was used, which was originally developed for older adult populations (16). However, in 1998 it was suggested to extend its use to the general adult population, to measure oral function problems described by patients and to quantify the efficacy of dental treatments, but specifically to estimate the psychological impact associated with oral diseases (18).

The GOHAI index provides scores based on responses to 12 questions that ask about reported self-perception of OHRQoL in the past three months (16). Most of the questions are designed on a Likert scale that gives each answer a score ranging from 1 to 5. Questions 1, 2, 4, 6, 8, 9, 10, 11, and 12 display categories Likert from 1 to 5. Questions 3, 5 and 7 display the Likert scale in reverse (19). The associated questions assess three domains of the OHRQoL: physical function (FF), which includes feeding, speaking, and swallowing; psychosocial function (PSF), including oral health worry or worry, dissatisfaction with physical appearance, oral health self-awareness, and avoiding social contact because of oral problems; and pain function (PF), which includes the use of pain- and discomfort-relieving and medications to relieve pain or discomfort in the mouth (20). There are Spanish-language adaptations (18), but for this study the version validated in Colombian Spanish in the adult population was used, which shows excellent psychometric properties (18-20).

Two pre-calibrated examiners who were dental graduates performed the oral evaluation of the patients according to the World Health Organization (WHO) guidelines (18,19). All examiners underwent two-hour training sessions, calibration exercises calculating intra- and inter-examiner Kappa values for all clinical conditions with results of 0.90 and 0.85, respectively.

A pilot test of the instruments was conducted with 10 patients with DM2 from the Dental School of the University of Cartagena with sociodemographic characteristics similar to those of the study population. The oral clinical examination described the number of teeth present ( $\geq 19$  teeth;  $<19$  teeth, according to WHO criteria) (21), presence of retained roots, DMF index (decayed, missing, and filled teeth), presence of gingivitis and periodontitis, presence and types of lesions in hard and soft tissues typical of DM2, use of dental prostheses, temporomandibular disorders (TMD) and salivary characteristics: pH (alkaline; acid) and salivary flow (high; low). Patients were advised to refrain from eating, drinking, chewing gum, smoking and/or rinsing their mouths for one hour before collecting saliva samples for pH assessment using pH 0-14 indicator slides (MQuant® Merck, Darmstadt, Germany). The reading was determined by color change after 5 minutes and compared to the color scale.

Data analysis was performed with the statistical program STATA 11.0 (Stata Corp, College Station, TX, USA), through which absolute and relative frequencies of the total and individual scores of the GOHAI domains were described. Univariate analysis was performed through Poisson regression with robust variance to associate domain scores and GOHAI total score with oral clinical conditions and sociodemographic variables and select variables with a p value  $\leq 0.20$  to enter the final adjusted multivariate model. Only those associations with a p value  $\leq 0.05$  remained in the final model. Relative risks (RR), 95% confidence intervals, and 5% alpha error were calculated.

## **RESULTS**

Most of the patients were in the  $\geq 45$  years of age range (92.11%); 52.63% were female; 27.63% were unemployed; and 96.05% reported being affiliated with the health care system. 82.24% reported economic income of  $\leq 1$  SMMLV, 40.13% had  $\geq 10$  years of schooling, and only 9.21% declared not having religious beliefs. 74.34% of the patients had been diagnosed with DM2 for more than five years.

Regarding the oral diagnosis, 98.68% had missing teeth according to the DMF index and 42.11% had <19 teeth according to the WHO criteria. 48.03% had gingivitis and 32.24% periodontitis. Palatal torus (63.82%) was the most frequent hard tissue feature and geographic tongue was the most frequent soft tissue feature (29.61%). Xerostomia was the main change in the mouth due to DM2 (Table 1).

TABLE 1  
Oral Diagnosis and Related Factors of Patients with DM2

Clinical Variables	Indicators	n (%)
Oral diagnosis	< 19 lost teeth	64 (42.11)
	≥ 19 teeth in mouth	88 (57.89)
	Decayed	88 (57.89)
	Filled	120 (78.95)
	Lost	150 (98.68)
	Root remnants	32 (21.05)
	Gingivitis	73 (48.03)
	Periodontitis	49 (32.24)
	Dental prosthesis	88 (57.89)
	TMD*	32 (21.05)
Hard tissue features	Yes	93 (61.18)
	No	59 (38.82)
Type of hard-tissue features	Torus	97 (63.82)
	Exostosis	29 (19.08)
	Alveolitis	4 (2.63)
	Osteomyelitis	2 (1.32)
Soft tissue features	Yes	61 (40.13)
	No	91 (59.87)
Type of soft tissue features	Sialosis	2 (1.32)
	Candidiasis	11 (7.24)
	Sub-prosthetic stomatitis	17 (11.18)
	Geographic tongue	45 (29.61)
	Lichen	5 (3.29)
	Recurrent aphthous stomatitis	6 (4.00)
Saliva features	pH alkaline	52 (34.21)
	pH acidic	100 (65.79)
Amount of saliva	High flow	68 (44.74)
	Low flow	84 (55.26)
Saliva consistency	Fluid	91 (59.87)
	Viscose	61 (40.13)
Oral changes	Yes	113 (74.34)
	No	39 (25.66)
Type of oral changes	Xerostomia	102 (67.11)
	Food taste changes	53 (34.87)
	Dysphagia	44 (28.95)
	Bleeding when toothbrushing	59 (38.82)
	Halitosis	49 (32.24)
Smoking	Yes	7 (4.61)
	No	145 (95.39)
Alcohol consumption	Yes	9 (5.92)
	No	143 (94.08)

Source. The authors. \* TMD: Temporo-mandibular disorders.

When performing the univariate analysis of the sociodemographic variables, conditions, and oral lesions with the total score and by domains of the GOHAI, the vast majority of the variables showed statistically significant associations (Table 2).

**TABLE 2**  
**Univariate Analysis between Sociodemographic Variables and Oral Clinical Conditions Associated with the Total Score and by Domains of the GOHAI**

Variables		Physical domain		Psychosocial domain		Pain domain		Total GOHAI score	
		RR (IC 95 %)	P	RR (IC 95%)	P	RR (IC 95%)	P	RR (IC 95%)	P
Sociodemographic Variables	≥45 years of age	0.88 (0.81-0.96)	0.005	0.85 (0.82-0.89)	<0.001	0.91 (0.84-0.99)	0.034	0.88 (0.84-0.91)	<0.001
	Male	1.06 (0.99-1.12)	0.055	1.03 (0.98-1.08)	0.149	1.02 (0.97-1.08)	0.300	1.04 (0.99-1.09)	0.065
	Unemployed	0.97 (0.91-1.05)	0.582	1.00 (0.94-1.06)	0.960	0.98 (0.91-1.04)	0.580	0.98 (0.94-1.04)	0.675
	No affiliation to Health care System	1.00 (0.90-1.11)	1.000	1.02 (0.90-1.16)	0.684	0.89 (0.74-1.06)	0.202	0.98 (0.90-1.07)	0.722
	Income ≤ 1 SMMLV	0.95 (0.89-1.02)	0.179	0.94 (0.89-0.99)	0.045	0.98 (0.92-1.04)	0.604	0.95 (0.91-1.00)	0.107
	Low level of schooling	0.93 (0.87-0.99)	0.027	0.93 (0.89-0.98)	0.005	0.96 (0.91-1.02)	0.247	0.94 (0.90-0.98)	0.008
	Not having religious affiliation	0.89 (0.82-0.96)	0.006	1.04 (0.96-1.12)	0.245	0.95 (0.86-1.05)	0.354	0.97 (0.91-1.03)	0.345
	> 5 years evolution of DM2	0.94 (0.88-1.00)	0.061	1.01 (0.94-1.07)	0.745	0.98 (0.92-1.05)	0.641	0.98 (0.93-1.03)	0.456
	Pharmacological treatment of DM2	1.12 (0.96-1.31)	0.137	0.99 (0.83-1.17)	0.935	0.82 (0.80-0.84)	<0.001	0.99 (0.87-1.13)	0.941
	Oral diagnosis	< 19 teeth in mouth	0.90 (0.85-0.96)	0.002	0.98 (0.93-1.03)	0.511	0.99 (0.93-1.05)	0.825	0.95 (0.91-1.00)
Root remnants		0.94 (0.87-1.02)	0.152	0.98 (0.92-1.05)	0.738	0.91 (0.85-0.97)	0.005	0.95 (0.90-1.00)	0.071
Decayed teeth		0.99 (0.93-1.06)	0.915	0.96 (0.91-1.01)	0.192	0.98 (0.92-1.03)	0.517	0.98 (0.93-1.02)	0.399
Filled teeth		0.99 (0.91-1.08)	0.953	0.95 (0.89-1.02)	0.218	0.95 (0.89-1.03)	0.255	0.97 (0.91-1.03)	0.367
Lost teeth		1.18 (0.91-1.53)	0.194	0.89 (0.79-1.01)	0.082	1.05 (0.98-1.12)	0.134	1.01 (0.97-1.05)	0.412
Gingivitis		1.01 (0.95-1.08)	0.526	0.97 (0.93-1.02)	0.415	1.02 (0.96-1.08)	0.424	1.00 (0.95-1.04)	0.884
Periodontitis		0.96 (0.89-1.03)	0.290	0.96 (0.90-1.01)	0.140	0.98 (0.92-1.04)	0.551	0.96 (0.92-1.01)	0.164
Dental prosthesis		0.99 (0.93-1.05)	0.831	1.01 (0.96-1.06)	0.673	1.01 (0.96-1.07)	0.536	1.00 (0.96-1.05)	0.773
TMD*		0.96 (0.89-1.03)	0.341	0.98 (0.91-1.06)	0.665	0.94 (0.87-1.02)	0.189	0.96 (0.91-1.02)	0.299
Hard tissue lesions	Presence	1.03 (0.97-1.10)	0.262	1.01 (0.96-1.07)	0.586	0.99 (0.93-1.04)	0.777	1.01 (0.96-1.06)	0.515

	Torus	1.00 (0.93-1.06)	0.957	0.99 (0.94-1.05)	0.899	0.96 (0.91-1.01)	0.196	0.98 (0.94-1.03)	0.682
	Exostosis	0.92 (0.83-1.01)	0.088	1.01 (0.96-1.07)	0.561	0.95 (0.89-1.01)	0.148	0.96 (0.91-1.02)	0.270
	Alveolitis	1.06 (0.87-1.29)	0.530	1.01 (0.91-1.12)	0.738	0.97 (0.90-1.04)	0.441	1.02 (0.93-1.11)	0.635
	Osteomyelitis	1.00 (0.79-1.41)	1.000	1.04 (0.94-1.15)	0.421	0.99 (0.88-1.11)	0.899	1.01 (0.89-1.15)	0.810
Soft tissue lesions	Presence	0.99 (0.93-1.05)	0.831	1.04 (0.99-1.09)	0.079	0.99 (0.94-1.05)	0.962	1.01 (0.97-1.06)	0.475
	Sialosis	1.03 (0.83-1.27)	0.774	1.09 (0.93-1.27)	0.275	1.07 (1.04-1.10)	<0.001	1.06 (1.04-1.08)	<0.001
	Candidiasis	1.08 (0.95-1.23)	0.194	1.04 (0.95-1.13)	0.357	0.95 (0.87-1.05)	0.392	1.03 (0.95-1.12)	0.401
	Sub-prosthetic stomatitis	1.13 (1.05-1.21)	0.001	1.04 (0.95-1.14)	0.350	1.15 (1.07-1.23)	<0.001	1.09 (1.03-1.17)	0.004
	Geographic tongue	0.90 (0.84-0.97)	0.006	0.97 (0.91-1.02)	0.273	0.93 (0.87-0.98)	0.013	0.93 (0.89-0.98)	0.011
	Lichen	0.98 (0.86-1.13)	0.853	1.05 (0.92-1.20)	0.399	0.87 (0.77-0.98)	0.022	0.98 (0.91-1.07)	0.784
	Aphthous stomatitis	1.00 (0.87-1.16)	0.899	1.03 (0.95-1.11)	0.404	0.97 (0.88-1.08)	0.652	1.01 (0.95-1.07)	0.718
Saliva characteristics	Acidic pH	1.01 (0.97-1.05)	0.465	1.02 (0.98-1.05)	0.171	1.03 (0.99-1.08)	0.068	1.02 (0.99-1.05)	0.126
	Low saliva flow	0.96 (0.90-1.02)	0.242	1.02 (0.97-1.07)	0.341	0.97 (0.91-1.02)	0.286	0.99 (0.94-1.03)	0.696
	Viscose consistency	1.03 (0.97-1.10)	0.239	1.04 (0.99-1.09)	0.112	1.06 (1.01-1.12)	0.015	1.04 (1.00-1.09)	0.042
Type of oral changes due to DM2	Presence	0.89 (0.84-0.94)	<0.001	0.89 (0.85-0.93)	<0.001	0.91 (0.85-0.96)	0.002	0.89 (0.86-0.93)	<0.001
	Xerostomia	0.92 (0.87-0.98)	0.011	0.91 (0.87-0.96)	<0.001	0.92 (0.87-0.97)	0.004	0.92 (0.88-0.96)	<0.001
	Changes in food taste	0.88 (0.82-0.94)	<0.001	0.94 (0.89-0.99)	0.018	0.88 (0.84-0.93)	<0.001	0.91 (0.87-0.95)	<0.001
	Dysphagia	0.90 (0.84-0.97)	0.005	0.93 (0.88-0.99)	0.025	0.86 (0.81-0.91)	<0.001	0.90 (0.86-0.95)	<0.001
	Bleeding while toothbrushing	0.93 (0.87-0.99)	0.043	0.95 (0.91-1.00)	0.105	0.95 (0.90-1.00)	0.101	0.95 (0.90-0.99)	0.032
	Halitosis	0.91 (0.85-0.98)	0.017	0.95 (0.90-1.00)	0.103	0.89 (0.84-0.95)	<0.001	0.92 (0.88-0.97)	0.003
Harmful habits	Smoking	1.12 (1.12-1.23)	0.018	1.10 (1.01-1.20)	0.024	1.10 (1.00-1.21)	0.047	1.11 (1.03-1.18)	0.002
	Alcohol consumption	1.13 (1.06-1.20)	<0.001	1.07 (1.01-1.14)	0.018	1.10 (1.03-1.18)	0.002	1.10 (1.04-1.16)	<0.001

Source. The authors. \*TMD: Temporomandibular disorders.

In the multivariate analysis, the variables that best explain the impact of oral health on the quality of life of patients with DM2, according to the total GOHAI score, were:  $\geq 45$  years of age,  $< 10$  years of schooling, changes in mouth,  $< 19$  teeth in the mouth (WHO criteria), periodontitis, sialosis, geographic tongue, sub-prosthetic stomatitis, and low salivary flow (Table 3).

TABLE 3  
Multivariate Analysis between Sociodemographic Variables and Oral Clinical Conditions Associated with the Total Score and by GOHAI Domains

Variables	Physical domain		Psychosocial domain		Pain domain		Total GOHAI score	
	RR (95% IC)	P						
$\geq 45$ years of age	0.92 (0.85-0.99)	0.032	0.90 (0.86-0.95)	$< 0.001$	*	*	0.91 (0.86-0.96)	0.001
Low schooling level	*	*	0.93 (0.89-0.97)	0.002	*	*	0.94 (0.91-0.98)	0.010
No religious affiliation	0.85 (0.78-0.93)	$< 0.001$	*	*	*	*	*	*
Oral changes	0.89 (0.85-0.94)	$< 0.001$	0.91 (0.87-0.95)	$< 0.001$	*	*	0.91 (0.88-0.95)	$< 0.001$
Pharmacological treatment for DM2	*	*	*	*	0.86 (0.75-0.99)	0.039	*	*
Dysphagia	*	*	*	*	0.88 (0.83-0.93)	$< 0.001$	*	*
$< 19$ teeth in the mouth	0.86 (0.81-0.91)	$< 0.001$	*	*	*	*	0.94 (0.90-0.98)	0.006
Missed teeth (DFM)	*	*	*	*	1.16 (1.06-1.26)	0.001	*	*
Periodontitis			0.94 (0.89-0.99)	0.034	*	*	0.95 (0.91-0.99)	0.046
Saliva acidic pH	*	*	1.02 (1.04-1.05)	0.049	*	*	*	*
Saliva viscous consistency	*	*	1.08 (1.02-1.13)	0.002	1.07 (1.02-1.12)	0.004	1.08 (1.03-1.12)	$< 0.001$
Sialosis	*	*	*	*	*	*	0.85 (0.78-0.92)	$< 0.000$
Sub-prosthetic stomatitis	1.18 (1.09-1.27)	$< 0.001$	*	*	1.12 (1.06-1.20)	$< 0.001$	1.10 (1.04-1.17)	0.001
Geographic tongue	0.90 (0.85-0.96)	0.001	*	*	*	*	0.94 (0.91-0.98)	0.013
Alcohol consumption	*	*	*	*	1.09 (1.02-1.16)	0.004	*	*

Physical domain:  $\chi^2$ : 88.97,  $p < 0.001$ . Psychosocial domain:  $\chi^2$ : 85.54,  $p < 0.001$ .

Pain domain:  $\chi^2$ : 103.05,  $p < 0.001$ . Total score:  $\chi^2$ : 82.71,  $p < 0$ .

Source: the authors.

## DISCUSSION

This is one of the first studies in Colombia to estimate the impact of oral conditions and injuries on the quality of life in people with DM2. The GOHAI, which is a reliable instrument previously validated in the Colombian social and cultural context, was used to collect data about oral health (19). Other instruments, such as the OHIP-14, have been used successfully in other contexts to analyze OHRQoL, but there are no studies in Colombia that have validated that instrument (20).

All patients with DM2 showed a negative impact on their OHRQoL. DM2 impacts the oral health of patients, not only in physical function, but also changes their lifestyle and that of their families (21). Oral affections expand their negative impact to other functions, which hinders interpersonal relationships and the patient's emotions (22). Therefore, it is important to create comprehensive interventions for this population, considering their psychosocial needs beyond the disease, especially since it is a chronic degenerative disease. Therefore, it would be worth delving into other aspects that improve their quality of life in general.

The only oral conditions and injuries that showed a negative impact on the total GOHAI scores were sub-prosthetic stomatitis in the physical function and pain domains, and low salivary flow in the psychosocial function and pain domains. The negative impact of sub-prosthetic stomatitis on OHRQoL in patients with DM2 is related to discomfort with the use of prostheses, which may be maladapted and with poor hygiene (23). Removable dentures are a reservoir of microorganisms that favor the proliferation of fungal cells, causing greater inflammation of the oral mucosa (24). This accentuates discomfort, dissatisfaction and, mainly, the perception of pain that reaches moderate to severe levels, and negatively impacts quality of life (25). It is recommended for future studies to evaluate the satisfaction and acceptance of the prosthesis as it can behave as a confounding variable. Likewise, it is suggested to inquire the interest of this type of population in replacing teeth with this type of removable alternative that, although it solves a functional problem, deserves much more care so as not to further complicate the situation of the disease. This would make us think of other types of treatments that can be offered to patients with chronic diseases that can meet all the patient's needs, considering the feasibility of treatments based on the severity and complexity of the disease suffered.

Regarding low salivary flow and its negative impact on OHRQoL, hyposalivation can compromise the chewing function individually and collectively, for example, during social gatherings, making the chewing of dry and hard foods an unpleasant activity, which can generate feelings of fear and trepidation in such meetings (26,27). It would be valuable to know what types of foods are limited or stopped consuming and that can compromise the psychosocial domain of quality of life in patients with DM2. The disease *per se* generates a modification in the diet to improve its prognosis and course and, if this were added to another modification due to the state of oral health among these patients, there would be a double impact on OHRQoL.

High salivary pH was a variable that negatively impacted only the psychosocial domain. High pH values, in combination with low salivary flow, could contribute to tartar formation (28) and these, in turn, the feeling of hygiene and cleanliness of patients, as well as the clinical presentation of the mouth, which limits some functions such as speech and smiling. The presence or absence of dental tartar was not evaluated, but it is known that gingival inflammation and acidic taste typical of oral alterations, which can be generated by DM2 would modify the enjoyment of food, cause halitosis, and would negatively impact quality of life (27).

Other variables showed a positive impact on the total GOHAI score, such as being  $\geq 45$  years old, low level of schooling ( $< 10$  years of study), changes in the mouth, having  $< 19$  teeth in the mouth (WHO parameter), suffering from periodontitis, and having sialosis and geographic tongue.

A patient over 45 years of age could more maturely accept the emergence of diseases such as diabetes, since many times patients perceive that this also occurs with age changes (29). In the psychosocial domain, having diabetes positively impacts daily activities that would protect the patient, such as exercising and eating a healthy diet (30). Probably in the same sense, having less than 10 years of schooling would generate greater commitment to one's own health by knowing the challenges related to socioeconomic status and, perhaps, people with DM2 would have better attitudes towards self-care (30).

Oral changes, when investigated in a general way, without specifying the type of changes, showed a positive impact on the OHRQoL. It is likely that the patient does not distinguish what kind of changes appear in their mouth due to the disease, but rather appreciates them in a general way and considers them changes related to the disease (30). In this sense, they do not perceive a negative

impact; A variable such as the duration of the disease should be studied for a better understanding of diabetes and its management in future studies (29).

Periodontitis had a positive impact on OHRQoL. This may indicate that patients with DM2 are less concerned about their periodontal condition than about other health problems as part of their treatment (30), or they may be aware of the changes related to said disease and do not see it negatively. There are few studies that analyze the knowledge that a patient with DM2 has about their own disease and how they would face these changes, which would shed light, both for the patient themselves and for health professionals, regarding the best treatment of the disease.

Regarding other conditions such as sialosis and geographic tongue, there are studies that report how patients with DM2 pay more attention to general health than to oral health (31). The need to solve various problems of the disease can lead to better coping with the impacts of oral health problems or, in fact, to a lower expectation of general health (32).

The missing teeth component, according to the DMF index, had a negative impact on quality of life. However, when the number of teeth was analyzed according to the WHO criteria, having fewer than 19 teeth in the mouth had a positive impact on the total GOHAI score and physical function, which explains that, regardless of the number of missing teeth, this can affect people. Dentists are always attentive to restoring the oral health of their patients, but to what extent do patients perceive such a need? The OHRQoL studies offer valid information when offering restorative treatments based on the patient's own perceptions.

Thus, Schmalz, *et al.* (33), in their study conducted on adults, indicated that having at least 10 teeth in the mouth is a protective factor for oral health. However, these results and those found in this study do not discriminate with respect to the position of the missing teeth, which would allow knowing if the impact is related to the position of the missing tooth and that it generates different perceptions of the impact of oral health on quality of life. Some studies show that the loss of teeth in the frontal area has a negative impact on quality of life, by compromising physical appearance and social relationships. For this reason, it is recommended to include this variable for future studies (34).

The alcohol consumption variable had a negative impact on the pain domain. Bijlsma-Rutte, *et al.* (35), establish that the harmful effects that alcohol generates for good glycemic control and the person's feeling of guilt, after consuming it, may be influenced by other variables. Carvalho, *et al.* (37), speak of the existence of cultural components that favor high alcohol consumption in people who live in hot places, as is the case of the patients in this study who lived in the city of Cartagena, Colombia. In this city with a hot climate, alcohol consumption is a pattern of behavior to face high temperatures, it is part of social events and it is consumed with high frequency, even on certain days of the week, due to cultural traditions, such as Sundays, which can complicate the prognosis of DM2.

Worldwide, specifically in Colombia, approximately 48 % of the population over 15 years of age consume alcohol (36,37), a situation that from the perspective of public health represents a risk, not only for the emergence of diseases but also for their treatment and control. It would be worth investigating the cultural practices that could complicate the prognosis of some diseases such as DM2, the perception and importance that patients have of self-care in health and whether, in certain cases, greater importance is given to enjoyment and pleasure than to health as a possible antonym of enjoyment.

This study has several limitations that should be carefully considered when interpreting the results. The cross-sectional design does not allow inferences to be made regarding the direction of the observed associations or the selection of patients belonging to the same private institution (MEDICUS Foundation). This could represent a bias regarding the positive perceptions reported in relation to some variables, probably due to the education and prevention activities received.

## CONCLUSIONS AND RECOMMENDATIONS

Sub-prosthetic stomatitis and low salivary flow showed a negative impact on OHRQoL in patients with DM2 from the city of Cartagena de Indias, Colombia, while other conditions such as periodontitis, geographic tongue, sialosis and having <19 teeth in mouth presented a positive impact.

These results can guide health professionals, specifically those of the MEDICUS Foundation, towards interventions that seek not only the patients' physical care, but also biopsychosocial well-being in relation to their oral health status. This will make it possible to optimize resources and seek health care from the perceptions of the patients and not of the treating professionals.

It is recommended to include other professionals, such as psychologists and social workers, as well as social activities that allow inquiring about social and family situations experienced by patients. These are activities that can complement the treatment conducted in these populations and include the family as a protective nucleus against the disease.

This type of studies promotes the joint, transdisciplinary, and articulated work of the medical professional with other health professionals such as the general dentist and the specialist (e.g., oral rehabilitator, periodontist, and endodontist) in search of the best solution for oral problems that a patient with DM2 may present and have an impact on their quality of life.

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