


Periodontal health of a low socioeconomic level population in Yucatan (Mexico)

A cross-sectional study

Pedro Morales-Ruiz, MSc^a, Alejandro Moreno-Barrera, MSc^a, David Ribas-Pérez, PhD^b, Diego Rodríguez-Menacho, PhD^b, Javier Flores-Fraile, MSc^a, Juan Gómez-Salgado, PhD^{c,d,*} , Antonio Castaño-Seiquer, PhD^b

Abstract

With the objective of assessing the periodontal health status, treatment needs, and oral hygiene habits of the population of Mérida, in Mexico, a descriptive cross-sectional study was performed. Four hundred forty individuals individually completed a questionnaire on oral health, oral hygiene habits, and quality of life. Additionally, a complete clinical dental examination was performed for each. For the statistical analysis, continuous variables (means and standard deviation) and categorical variables (frequencies) were studied. The associations were made using the analysis of variance test for continuous variables and the Chi-square test for categorical variables. The critical value to identify statistically significant differences was $P < .05$. The main concern of the population was the possible untreated caries they thought they had, with 36.21% followed by pain with 14.62%. Possible periodontal issues were the main discomfort for only 9%. The percentage of the sample that required periodontal intervention by a specialist was 21.14%. Statistically significant differences were found between age, place of residence, socioeconomic level, and schooling. There are great deficiencies in oral health in the studied group, which is accompanied by a great need for periodontal treatment. Periodontal health is closely related to oral hygiene, so the related sociocultural level should also be taken into account for the study of oral health in the most vulnerable populations. It is crucial to establish strategies to promote oral health.

Abbreviations: CPI = community periodontal index, DM = diabetes mellitus, HP = *Helicobacter pylori*, PD = periodontal disease, WHO = World Health Organization.

Keywords: caries, dentistry, low socioeconomic level, Mexico, oral hygiene, periodontal health, periodontology

1. Introduction

Oral health is an important determinant of quality of life. The World Health Organization (WHO) itself has integrated oral health into all general health programs.^[1,2] According to the Universal Catalogue of Health Services of Mexico, “CAUSES,” Popular Insurance offers medical coverage against more than 1500 illnesses and up to 284 medical interventions, in which those corresponding to the dental speciality are also included. With respect to dental treatments, there is no reference to periodontal disease (PD).^[3] PD is a chronic inflammatory condition that affects the supporting and protective tissues of the teeth. It is one of the most prevalent pathologies worldwide, affecting more than 10% of the population.^[4–7] The socioeconomic level of the population is related to the prevalence of PD. Several

studies show that the presence of PD is associated with little to lack of knowledge about hygiene and oral health, as well as the availability of resources, schooling, and the economy.^[8,9] Gum diseases are relevant to society because they can cause irreversible functional, aesthetic, and psychological damage to the individual. However, PD begins with the presence of gingivitis, which can be reversible with oral hygiene, prevention and treatment measures.^[10]

Mexican Health Sector has sought new methods to determine the state of oral health when resources are limited. Mexican state has an annual study, called the System of Epidemiological Surveillance of Oral Pathologies Report, which reflects the distribution of the most common oral pathologies in the population, including, in addition to dental caries, the rest of the

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All data generated or analyzed during this study are included in this published article [and its supplementary information files].

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Fundacion Odontologia Social (protocol code 01/2020 and date of approval May 05, 2020).

^a Department of Surgery, Faculty of Medicine, University of Salamanca. Salamanca, Spain, ^b Department of Stomatology, Faculty of Odontology, University of Seville, Seville, Spain, ^c Department of Sociology, Social Work and Public Health, Faculty of Labour Sciences, University of Huelva, Huelva, Spain, ^d Safety and Health Postgraduate Programme, Universidad Espíritu Santo, Guayaquil, Ecuador.

* Correspondence: Juan Gómez-Salgado, Department of Sociology, Social Work and Public Health, Faculty of Labour Sciences, University of Huelva, Avda. Tres de Marzo, S/N, Huelva 21007, Spain (e-mail: salgado@uhu.es).

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diseases that WHO reports as more frequent in the field of dentistry.^[11,12]

According to Treviño-Tamez et al,^[13] the periodontal status of child population from the region of Nuevo León, in Mexico, was worse in the community that had fewer socioeconomic resources. A study carried out in the Yucatan region of Campeche, showed that the level of schooling is a decisively related factor to the frequency of brushing: The more frequently the higher the level of education their parents had.^[14,15] More recently, a study by Taboada et al analyzed 73 people in Mexico City. 100% of the subjects presented a need for oral hygiene. In 75% of them, at least one oral location with signs of PD was found. Furthermore, the older the subject, the worse the periodontal status.^[16] With all these data, the objective of this study was to evaluate the periodontal health status, treatment needs, and oral hygiene habits of the population of the region of Yucatan in Mexico and its relationship with the socioeconomic and educational levels.

2. Materials and methods

2.1. Study design and settings

A descriptive cross-sectional study was carried out during the “Yucatán International Cooperation Project,” developed in the cities of Temax, Hunucmá, Umán and Mérida, Mexico in June 2021.

2.2. Participants, study size and limitation

The study sample consisted of 440 people over 15 years of age who voluntarily requested dental care. They signed an informed consent and completed a questionnaire on oral health, oral hygiene habits, and quality of life. In the case of minors, it was their parents or legal guardians who signed the informed consent form. Additionally, a complete clinical dental examination was performed for each using the WHO criteria for periodontal status.^[17]

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Fundación Odontología Social (protocol code 01/2020 and date of approval May 05, 2020) for studies involving humans.

For the study there was no sample selection per se, but all patients seen in the humanitarian project were those who underwent the investigation, which can be considered a limitation of the study.

2.3. Variables, measurement

The variables analyzed were age, sex, place of residence, socioeconomic level, level of studies achieved, level of concern for oral health, what was the main problem in the individual's mouth, how often they brushed their teeth, and if they use additional oral hygiene products.

The code of the results was obtained after measuring the community periodontal index (CPI) with the criteria recommended by WHO. All patients were examined by one single examiner (a dentist with high experience on periodontal assessment) according to this WHO methodology in order to avoid bias.^[17] The ratio of agreement with the Kappa test (0.85) was measured to analyze the intra-observer consistency of the observations.

2.4. Statistical methods

STATA V15 package (College Station, TX) was utilized for the statistical analysis. Quantitative variables were summarized by their means and standard deviation. The frequency distribution presented categorical variables and simple and cumulative frequencies expressed as percentages. The link between oral health

status and other sociodemographic variables was investigated. Analysis of variance was implemented for continuous variables (the normality of the distribution of these variables was tested using the Shapiro–Wilk test) and the Chi-square test was performed for categorical variables in hypothesis testing. A statistical significance level of $P < .05$ was required to determine statistically significant differences. For post hoc multiple comparisons, the Tukey test was performed because variances were equal.

3. Results

The study sample consisted of 440 people over 15 years of age who voluntarily requested dental care. Sixty-five percent of the population were women, while 35% were men. The rural population was considered as low socioeconomic level and this was represented by 53% of the population. Ten percent of the population studied reported not having studies. Sixty-three percent of the population had completed primary, secondary or high school studies and only 27% of the population studied had reached university studies. The rural and urban environments represented 52,5% and 47,5%, respectively (Table 1).

The main concern of the population was the possible untreated caries they thought they had (36.21%; $n = 155$), followed by pain (14.62%; $n = 63$). Possible periodontal problems were the main discomfort for only 9% ($n = 30$) of the population (Fig. 1).

Toothbrushing 3 times a day was claimed by 54.23% ($n = 237$) of the participants, twice by 34.8% ($n = 152$), and once by 7% ($n = 31$). In 59.77% ($n = 263$) of the population, toothpaste was the primary tool for brushing teeth. Mouthwash was used by nearly 1 in 5 individuals (18.86%), whereas only 14.7% ($n = 65$) of the sample reported using floss (Table 2).

Only 11% ($n = 50$) of the individuals had no problems with their periodontal health, 13% ($n = 58$) required only oral hygiene measures, and 53.64% ($n = 263$) required professional intervention by dental hygiene treatment. The percentage of the sample that required periodontal intervention was 21.14% (Fig. 2).

The average number of sextants that showed absence of periodontal disease (PD) on clinical examination was 1.88 per individual. Regarding the associations between variables, statistically significant differences ($P = .001$) were found between CPI and age, place of residence, socioeconomic level, and level of education.

Table 1
Distribution per socio-demographic data (Oral Health, Mexico—Spain, 2023).

		Frequency	Percentage
Gender	Male	151	34.32%
	Female	289	65.68%
Age group	15–34	199	45.23%
	35–64	204	46.36%
	65 or more	37	8.41%
Place of residence	Urban	209	47.5%
	Rural	231	52.5%
Socioeconomic level	Middle Urban	98	22.27%
	Low Urban	111	25.23%
	Low rural	231	52.50%
Educational level	No studies	45	9.77%
	Primary	69	25.45%
	Secondary or High School	228	51.82%
	University	100	22.73%

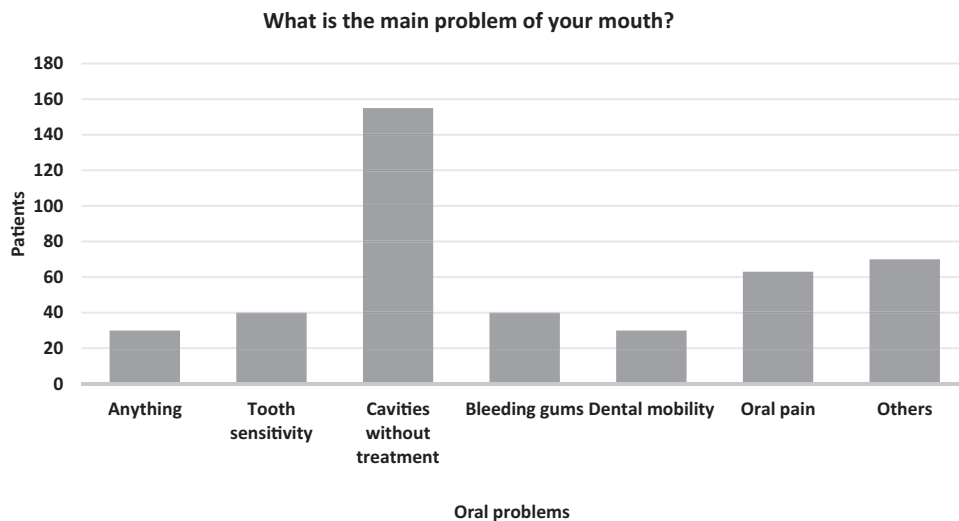


Figure 1. Distribution of self-report on the main oral health problem of the population (Oral Health, Mexico—Spain, 2023).

Higher levels of periodontal health were found the younger the individual were, the higher the socioeconomic level they had and the higher level of education they had reached.

On the other hand, the rural population obtained worse health outcomes than the urban population (Table 3).

When we compare the mean CPI values with the different socio-demographic variables, no statistically significant differences are obtained with regard to gender.

In the age groups with respect to the mean CPI, there are only no statistically significant differences in the values of sextants with pockets larger than 6 mm. In younger people there is a better periodontal health and this difference is statistically significant.

With regard to area of residence there are statistically significant differences for healthy, with calculus and excluded sextants. Urban people have a better periodontal health and this difference is statistically significant.

Socio-economic level shows statistically significant differences for healthy, small gingival pockets and excluded sextants. Finally, educational level shows statistically significant differences for all CPI values except for bleeding (Table 4).

Almost 37% (n = 162) of the population declared in the questionnaire on medical conditions that they had some disease or chronic health problem. When we statistically associated these problems with the sociodemographic variables, we obtained a statistically significant association with age and schooling in persons with diabetes and arterial hypertension (P < 005). We also found a statistical association between people with digestive problems and socioeconomic level. When compared these data with CPI we found statistically significance between CPI and diabetes as well as arterial hypertension (Table 5).

4. Discussion

4.1. Limitations of the study

Cross-sectional studies are closest to obtaining an instant record of a population. We analyze multiple associations without being able to know which of the “associated” variables is the cause or consequence of the other. Cross-sectional studies are particularly susceptible to certain biases. For example, we may be faced with a situation where a variable that appears to be the cause of an event is actually a consequence of the event, or they are just associated.^[18]

Notwithstanding these limitations, the study provides relevant information on the prevalence and severity of periodontal disease and on care needs, and helps to identify associations

Table 2

Distribution per oral hygiene habits (Oral Health, Mexico—Spain, 2023).

		Frequency	Percentage
Frequency of tooth-brushing	3 times a day	237	54.23%
	Twice a day	152	34.78%
	Once a day	31	7.09%
	No brushing	17	3.89%
Use of products for oral health	Toothpaste	263	59.77%
	Mouthwash	83	18.86%
	Dental floss	65	14.77%
	None	29	6.6%
Type of brush	Manual	436	99.32%
	Electric	1	.23%

DISTRIBUTION OF THE MAXIMUM VALUE OF CPI IN THE POPULATION

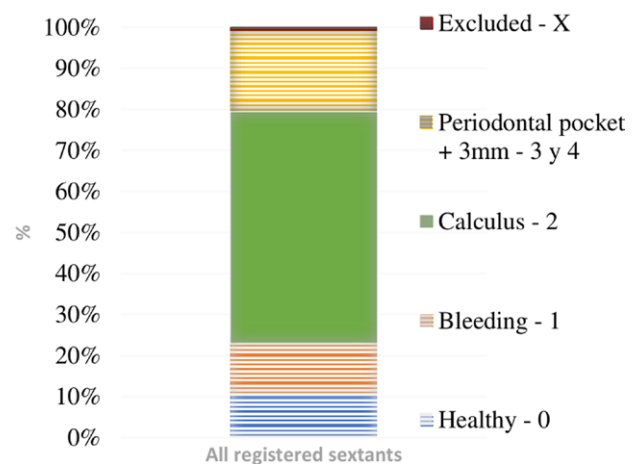


Figure 2. Distribution of the maximum value of CPI found in the population (Oral Health, Mexico—Spain, 2023).

between periodontal status in urban and rural groups and to detect the impact of socioeconomic status.

Another limitation of our study has derived from the estimation of the sample. In spite of having studied a significant

Table 3

Analysis of CPI (mean, SD and CI 95%) and its relationship with other variables (Oral Health, Mexico—Spain, 2023).

Variable	Category	Mean value of CPI	SD	Confidence interval (95%)	P value
Gender	Man	1.92	.94	1.76–2.07	.540
	Woman	1.86	.93	1.75–1.97	
Age group	15–34	1.61	.96	1.47–1.74	.001
	35–64	2.07	.85	1.96–2.19	
	More than 65	2.28	.89	1.98–2.59	
Residence	Urban	1.68	.94	1.55–1.81	.001
	Rural	2.06	.90	1.94–2.11	
Socio-economic level	Middle urban	1.52	.97	1.32–1.71	.001
	Low urban	1.82	.89	1.65–1.99	
	Low rural	2.06	.90	1.94–2.18	
Level of education	None	2.29	.87	2.01–2.56	.001
	Primary	2.26	.80	2.07–2.45	
	Secondary	2.01	.86	1.90–2.22	
	University	1.62	.88	1.44–1.79	

Table 4

Mean values of each value of the CPI per sociodemographic variables (Oral Health, Mexico—Spain, 2023).

		Healthy	Bleeding	Calculus	Depth 3–6 mm	Depth > 6 mm	Excluded
Gender	Male	1.79	1.35	2.17	.46	.079	.12
	Female	1.67	1.49	2.12	.34	.076	.27
Age group	15–34 years	2.36***	1.51**	1.80***	.23***	.04	.03***
	35–64 years	1.19	1.51	2.50	.51	.10	.16
	> 65 years	1.10	.70	1.94	.54	.08	1.62
Residence	Urban	2.27***	1.89	2.17**	.31	.05	.11**
	Rural	1.21	2.86	2.12	.45	.09	.32
Socio-economic level	Middle urban	2.76***	1.31	1.65**	.20	.01	.05*
	Low Urban	1.83	1.37	2.11	.40	.09	.17
	Low rural	1.21	1.53	2.36	.45	.09	.32
Level of education	No studies	.55***	1.51	1.93*	.83***	.34**	.81***
	Primary	1.00	1.10	2.55	.46	.14	.73
	Secondary	1.42	1.50	2.45	.52	.025	.05
	University	2.31	1.57	1.91	.16	.04	.01

*P < .05.

**P < .01.

***P < .001.

number of patients, these patients came to the project requiring dental treatment. This means that we did not have a totally representative sample, which should be taken into account when interpreting the results. The authors believe that it serves to show a snapshot of the periodontal status of this population.

4.2. Oral hygiene products

In relation to the products used to reinforce oral hygiene, 4 of each 10 individuals used toothpaste accompanied by other additional hygiene products, while 61% only used toothpaste. The rural population and participants with a lower educational level used only toothpaste with more frequency than the others. Other authors have previously reported that there is an association between toothpaste use and additional products for oral hygiene in terms of economic status.^[19–21]

4.3. Most frequent values and averages by sextants

The most frequently found CPI value in our study was 2 in all sextants, except in sextant 2, corresponding to the anterior maxillary region, coinciding with what was collected in the most current System of Epidemiological Surveillance of Oral Pathologies report published in 2018.^[22]

Other studies on periodontal disease prevalence using a similar method show disparate values in relation to the overall CPI analysis. The most commonly used form of discussion has generally been to establish an average value of the sextants in need of treatment as we have reflected in our study.

Regarding the average CPI value found in our sample, 1.88 sextants had a healthy periodontium, while 1.44 had signs of gingivitis. The highest average value found was the presence of calculus, with values of 2.14 sextants per patient. Although the population does not present a worrying incidence of severe levels of the disease, the need for periodontal treatment in some of its phases is 4.12 sextants per individual, which is high.

Considering that professional care consists of dental professional hygiene and periodontal surgical procedures, authors such as Hamasha et al and Doncel et al studied this variable in young people and young adults and found that 1.57 and 1.46 sextants of the population studied required professional periodontal treatment, respectively.^[23,24] However, Mexican authors such as Marianela Garza and García Conde et al, who studied this variable in populations with greater diversity in age groups, show much higher values. For Garza, value 3 was the most frequent value in the register of sextants, while for García Conde et al up to 3.6 sextants on average needed professional periodontal treatment.^[25,26]

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Table 5
Distribution of systemic pathologies in the sample (Oral Health, Mexico—Spain, 2023).

Problems of health	Percentage	Association (P < .05)*	CPI (Mean)	Association (P < .05)**
Diabetes	8.41%	Age, education	13.37	Yes
Arterial hypertension	11.59%	Age, education	7.34	Yes
Cholesterol	4.77%	No	.80	No
Digestive pathology	7.73%	SE level	4.03	Yes
Depression	2.73%	No	—	—
Anxiety	2.73%	No	—	—

*Relationship with other variables.

**Association between CPI and problems of health.

In our sample, the most frequent value found in the sextants was the presence of calculus, while the average number of sextants needing professional care was 2.68. This reveals that, although the need for treatment is high, the levels of periodontal disease in our population are slightly better than in other studies in Mexico.

4.4. Maximum CPI

In the study group only 11.36% had all sextants periodontally healthy. The presence of calculus as a maximum value was recorded in more than half of the study group and periodontal pockets were detected in more than one fifth of the participants. This information is important because it allows us to identify a high need for periodontal care and not only for calculus removal but also for more complex interventions due to the presence of periodontal pockets.

The national and international literature finds in the need for periodontal treatment an ally in the comparisons. The presence of dental plaque is considered a risk factor for the development of periodontal disease, and can be considered a need for a particular treatment. Although there are studies that do not look at CPI, the presence of bacterial plaque in an individual implies a need for at least reinforced oral hygiene care.

In terms of the need for some form of periodontal treatment, 89% of the population studied needed at least some oral hygiene instruction in one of their sextants. This shows that there are generally poor oral hygiene habits, although no statistically significant differences were found between variables with respect to the maximum CPI value found per individual. Below is a comparative table regarding the need for “at least oral hygiene education” from the main reference authors for similar studies (Table 6).

Epidemiological studies on periodontal disease show that the need to propose improvements in oral hygiene is evident in the population. Chen X et al,^[30] Hamasha et al,^[23] and Doncel et al^[24] have some of the lowest values in the table assuming that they are already high. This could be due to the fact that the populations studied by these authors range from 14 to 23 years of age, have a better periodontal status.

However, in studies whose populations were broader in terms of age groups, higher values were found. Although our population did not present a worrying severity in terms of PD levels, we found a high need for treatment. Taking these data into account and considering that, as mentioned above, according to the results of our study, the oral hygiene self-care of the population analyzed is poor. As a consequence of this, it is necessary to propose ideas to improve the oral health of the population.

Another way of interpreting the CPI values could be the need for professional action regarding periodontal disease. Performing a tartrectomy is a professional operative act that is not included in the Catálogo Universal de Servicios de Salud (Universal Catalogue of Health Services of Mexico) catalogue,^[31]

and it would be useful to assess the need for it in the population. Considering “at least needs tartrectomy,” the values for relevant authors in the field are presented in Table 7.

The results found in the international literature are varied, although they all end up translating into a high need for professional intervention. For authors such as Garza,^[26] Galindo-Lartigue^[27] and Holde,^[33] who show the lowest values in our table, approximately 5 out of 10 patients need a periodontal consultation. The high needs (92%) shown by authors such as Tascon et al may be due to the low socio-cultural and economic level shown in their population, all of whom are dental school patients.^[32]

In our population, more than 7 out of 10 patients required at least one tartrectomy, showing that there is a high need for periodontal treatment in the Yucatecan population that is not being addressed by the Mexican Health System.

4.5. Periodontal disease and socioeconomic status

The fact that the rural population tends to be associated with a worse periodontal status could be due to the lower socioeconomic status of populations far from the city.^[28,29,35]

In the population studied in our study, we found a statistically significant relationship between the mean CPI value and socioeconomic status (P = .001), with a strong association between healthy, calculus and excluded sextants (P < .05) with the same variable. Levels of periodontal disease were worse the lower the income level, with a strong tendency for all CPI levels to be worse the lower the socioeconomic level.

On the other hand, periodontal health levels are better the higher the socioeconomic status. This coincides with Galindo work, which associates socioeconomic status with the severity of periodontal disease, being worse the lower the purchasing power.^[27] For the group of Chen et al the worse the socioeconomic level, the greater the presence of calculus and bleeding.^[30]

Although our population presented very low socioeconomic levels, dietary habits, together with the frequent use of “chewing gum” in the rural Yucatecan population as a method of self-chewing, could explain why our values were slightly lower than those of other studies published in Mexico and Chile.^[25,28,34,36]

4.6. Periodontal disease and systemic pathology

Periodontitis has been linked to an increased risk of the onset and/or progression of a number of systemic diseases, including rheumatoid arthritis, diabetes, certain respiratory illnesses, cardiovascular disease, obesity, and metabolic syndrome, as well as pregnancy-related issues like preterm birth or low birth weight infants.^[37]

In our research, statistically significant differences were found between the average CPI value and diabetes (P < .05), with better periodontal outcomes in patients without diabetes compared to those with it.

Diabetes mellitus (DM) is the most common metabolic disorder, with approximately 14% of the population suffering from it. According to a recent study by Rojas-Martinez et al in Mexico the prevalence of diabetes by medical diagnosis is 9.2% of the population.^[38] Our results are along similar lines, showing a prevalence of 8.41% DM in the study group. Periodontal disease has been proposed for years as the sixth complication of DM.^[39]

Since there is thought to be a two-way relationship between the 2 disorders, having this systemic disorder has been linked to an increased incidence, severity, and progression of periodontitis. Similar to people with diabetes, those with periodontitis have worse glycaemic control and a higher risk of acquiring systemic consequences from their chronic condition.^[40]

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Table 6

Comparative literature on the need for “at least oral hygiene education” (Oral Health, Mexico—Spain, 2023).

Author	Year	Country	% of CPI > 0
Hamasha et al ^[23]	2006	India	72%
Doncel-Pérez et al ^[24]	2008	Cuba	61%
Galindo-Lartigue ^[27]	2009	Mexico	38 and 54%
García-Conde et al ^[25]	2010	Mexico	94%
Fuentes et al ^[28]	2014	Chile	100%
García-Pérez et al ^[29]	2016	Mexico	88.5%
Chen X et al ^[30]	2018	China	61%
Taboada-Aranza et al ^[16]	2018	Mexico	100%

Table 7

Comparison of international literature on the need for “at least tartrectomy” (Oral Health, Mexico—Spain, 2023).

Author	Year	Country	% of CPI > 1
Tascon et al ^[32]	2006	Colombia	92%
Doncel et al ^[24]	2007	Cuba	>50%
Garza ^[26]	2009	Mexico	45%
Galindo-Lartigue ^[27]	2009	Mexico	47%
García-Pérez et al ^[29]	2010	Mexico	89%
Holde et al ^[33]	2015	Norway	49.5%
Taboada-Aranza et al ^[16]	2018	Mexico	75%
Islas Granillo et al ^[34]	2019	Mexico	80%

According to authors such as Borgnakke et al, patients with advanced periodontitis have an increased risk of developing diabetes. In addition, it has been shown that the treatment of periodontitis is able to exert beneficial effects on glycemic control in diabetics, with an average reduction of 36% in glycosylated hemoglobin levels.^[41,42]

The systemic inflammation resulting from chronic infectious processes that generate oxidative stress, such as PD, promotes the activation of the vascular endothelium, favoring the formation of atheromatous plaques, the main triggers of cardiovascular accidents.

On the other hand, in the literature we found studies that state that the treatment of periodontitis could have a beneficial effect on vascular function.^[43]

In our sample, 12% of the population reported suffering from Hypertension, representing 32% of those suffering from some pathology and showing lower results than the national prevalence.^[44] In our sample, an association ($P < .05$) was found between PD and arterial hypertension, with worse periodontal outcomes per mean CPI value in those individuals with it.

Most current epidemiological data show an association between hypertension and periodontitis, although, to date, there is no definitive evidence to indicate that periodontal disease is a risk for increased blood pressure, although it is a risk for other pathologies such as DM.^[45,46]

We have also obtained a curious association between the CPI value and digestive pathology. Inflammatory bowel diseases often present oral manifestations that help in their diagnosis. In addition, due to the increased oxidative stress and the proinflammatory state they produce in their acute stages, patients develop a greater tendency to suffer from oral inflammatory diseases, such as PD.^[47] Additionally, some recently introduced compounds have been demonstrated having a significant influence on oral environment: the use of probiotics,^[48] lysates,^[49] and postbiotics^[50] can modify clinical and microbiological parameters in periodontal patients, so further studies involving these products should be considered in future clinical trials, to evaluate their possible effects on periodontal conditions in various populations.

The presence of *Helicobacter pylori* (HP) has also been studied in the international literature, showing evidence of clinical improvement in patients with HP after periodontal treatment. One of the reservoirs of this bacterium in our body is the oral cavity, specifically in the gingival sulcus. This is why active periodontal therapy is recommended in HP eradication treatments.^[51,52]

According to the results obtained in the current research, there are great deficiencies in the education of oral health within the Mexican population. The highest CPI value is significantly associated with age, place of residence, economic level, and educational level, which worsened as participants grew older, lived in rural environments, had low economic status, and in populations with lower educational level. It is crucial to establish strategies to promote oral health to increase the quality of life of the population.

Author contributions

Conceptualization: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Data curation: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Formal analysis: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Investigation: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Methodology: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Project administration: Pedro Morales-Ruiz, David Ribas-Pérez, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Resources: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Software: Pedro Morales-Ruiz, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Supervision: Pedro Morales-Ruiz, David Ribas-Pérez, Diego Rodríguez-Menacho, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Validation: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Visualization: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Writing – original draft: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

Writing – review & editing: Pedro Morales-Ruiz, Alejandro Moreno-Barrera, David Ribas-Pérez, Diego Rodríguez-Menacho, Javier Flores-Fraile, Juan Gómez-Salgado, Antonio Castaño-Seiquer.

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