

# Demographic, Clinical, and Microbial Aspects of Chronic and Aggressive Periodontitis in Colombia: A Multicenter Study

Gloria Inés Lafaurie,\* Adolfo Contreras,† Alexandra Barón,\* Javier Botero,† Isabel Mayorga-Fayad,\* Adriana Jaramillo,† Astrid Giraldo,† Ferney González,§ Sergio Mantilla,|| Alejandro Botero,¶ Luz Helena Archila,|| Antonio Díaz,# Tatiana Chacón,\*\* Diana Marcela Castillo,\* Marisol Betancourt,† Maria Del Rosario Aya,\* and Roger Arce†

**Background:** The microbial profile of periodontal disease varies among different human populations. This study evaluated the demographic, clinical, and microbiologic aspects of periodontitis in a multi-geographic sample in Colombia.

**Methods:** Three hundred twenty-five patients with chronic periodontitis (CP), 158 patients with aggressive periodontitis (AgP), and 137 healthy-gingivitis controls from five regions of the country were studied. Clinical, microbial, and sociodemographic data were collected. Microbiologic identification was performed using polymerase chain reaction 16S rRNA gene on pooled subgingival samples, and the presence of Gram-negative enteric rods was evaluated by culture. Bivariate and multivariate logistic regression analyses were conducted.

**Results:** *Porphyromonas gingivalis* occurred in 71.5% of individuals with periodontitis, *Tannerella forsythensis* occurred in 58.5%, *Campylobacter rectus* occurred in 57.5%, *Actinobacillus actinomycetemcomitans* occurred in 23.6%, and enteric rods occurred in 34.5%. *P. gingivalis* was more common in CP and AgP than controls. *A. actinomycetemcomitans* was increased in AgP compared to controls and patients with CP. *T. forsythensis*, *C. rectus*, and *Eikenella corrodens* had a low presence in the West Pacific and Central regions, and enteric rods were increased in the Central region ( $P < 0.05$ ). Other sociodemographic factors were not associated with these microorganisms.

**Conclusions:** Geographic regions do not influence the microbiota, but the microbiota may vary by geographic region. *P. gingivalis*, *T. forsythensis*, and *C. rectus* are the most prevalent periodontopathic microorganisms in Colombia. *A. actinomycetemcomitans* was more common in AgP, and a large percentage of the population studied had enteric rods in the subgingival plaque. *J Periodontol* 2007;78:629-639.

## KEY WORDS

*Actinobacillus actinomycetemcomitans*; chronic periodontitis; Gram-negative rods; periodontitis; *Porphyromonas gingivalis*.

The infectious nature of periodontal disease has been recognized since the 1960s.<sup>1,2</sup> Later, it was confirmed by microbiologic studies of periodontal disease worldwide; a set of anaerobic, Gram-negative, and microaerophilic microorganisms was increased significantly in the subgingival plaque of patients with periodontitis.

Some of these identified microorganisms are *Porphyromonas gingivalis*,<sup>3-12</sup> *Actinobacillus actinomycetemcomitans*,<sup>3-12</sup> *Tannerella forsythensis*,<sup>6,8,10,12</sup> *Eikenella corrodens*,<sup>7,12</sup> *Campylobacter rectus*,<sup>6,12</sup> *Micromonas micros*,<sup>6,12</sup> *Treponema denticola*,<sup>12</sup> and *Prevotella intermedia*.<sup>3-12</sup> The majority of studies on periodontal microflora in different populations found a common pattern in the bacterial component in patients with periodontitis. However, there are differences in the reported prevalences of the main microorganisms associated with chronic and

\* Basic Oral Research Unit Institute, El Bosque University, Bogotá, Colombia.

† Periodontal Medicine Group, Valle University, Cali, Colombia.

‡ School of Dentistry, Health Science Institute, Medellín, Colombia.

§ School of Dentistry, Metropolitana University, Barranquilla, Colombia.

|| School of Dentistry, Santo Tomas University, Bucaramanga, Colombia.

¶ School of Dentistry, Antioquia University, Medellín, Colombia.

# School of Dentistry, Cartagena University, Cartagena, Colombia.

\*\* School of Dentistry, Autónoma de Manizales University, Manizales, Colombia.

aggressive periodontitis among various populations.<sup>8,13-16</sup> Important differences also are observed regarding the colonization of specific microorganisms in some geographic areas, such as the high colonization of *A. actinomycetemcomitans* in Chinese and Korean populations<sup>17-19</sup> and the presence of enteric rods in patients with periodontitis in developing countries.<sup>8,20-22</sup> These differences may have an important influence on periodontal therapy and may be associated with ethnic aspects, dietary habits, use of over-the-counter antimicrobials, development level, and sanitation conditions.

Colombia is a multicultural country with very large geographic, climatic, cultural, and socioeconomic differences. These variations warrant the need to evaluate the epidemiological behavior of periodontal disease, taking into account the various geographic regions that constitute the territory. The National Study on Oral Health (ENSAB III)<sup>23</sup> indicated that ~50% of the Colombian population >35 years of age had loss of attachment, and generalized periodontal disease was present in 30% of these adults. In terms of severity, 14% of the population close to 35 years of age had moderate to severe loss of attachment; this increased to 40% at 60 years of age. This study demonstrated that there were significant differences in the prevalence and severity of periodontal disease among regions and suggested the need for an evaluation of the factors associated with these differences.

Few studies have been able to evaluate large population samples and the influence of sociodemographic factors on the prevalence of the most important microorganisms associated with periodontitis. Alpagot et al.<sup>24</sup> and Sirinian et al.<sup>25</sup> compared these variables among ethnic groups in the United States, a country with a very high immigration rate; however, there are no reports from countries with low immigration rates that allow for the establishment of differences between regions, cultures, and socioeconomic levels and their effects on the composition of the periodontal microflora. The purpose of this study was to report on the clinical, microbial, and sociodemographic aspects of patients with chronic and aggressive periodontal disease in Colombia.

## MATERIALS AND METHODS

### Study Population

Six hundred and twenty patients were evaluated: 325 patients with chronic periodontitis (CP), 158 patients with aggressive periodontitis (AgP), and 137 healthy controls. These patients attended the clinics of the schools of dentistry at the El Bosque University (Bogotá DC), Santo Tomas University (Bucaramanga: East region), Valle University (Cali: West Pacific region), Metropolitana University (Barranquilla: North Atlantic region), Cartagena University (Carta-

gena: North Atlantic region), Antioquia University (Medellin: Central region), Health Science Institute (Medellin: Central region), and Autonoma de Manizales University (Manizales: Central region) and were seen in the private practices of periodontists who participated in the study between July 2003 and November 2005.

Exclusion criteria included diabetes, periodontal therapy during the last year, and the use of antimicrobials or non-steroidal anti-inflammatory drugs in the 6 months before clinical examination and sample collection. This study was approved by the institutional review board of each university, and all participants signed a written consent form.

### Clinical Evaluation

Medical history and clinical and radiographic examination were conducted for each patient. A full periodontal examination was carried out by periodontists from the different universities. The diagnoses of CP and AgP were made based on criteria defined at the workshop sponsored by the American Academy of Periodontology (AAP) in 1999.<sup>26</sup> Individuals with varying degrees of gingival inflammation but without periodontal pockets were used as controls. The following clinical parameters were recorded: probing depth (PD), clinical attachment level (CAL), and percentage of sites with bleeding on probing (BOP). A marked probe<sup>††</sup> was used in all instances. All clinical researchers underwent a calibration session on the diagnosis criteria examining 15 patients, including clinical history, radiographs, laboratory examinations, clinical photographs, and a later discussion. Calibration exercises yielded an agreement  $\geq 91\%$  for PD and  $\geq 82\%$  for CAL.

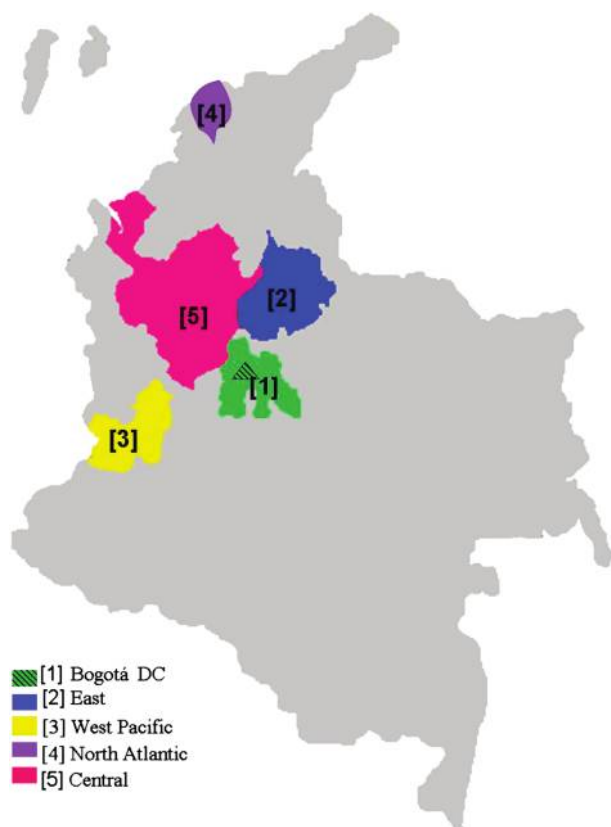
### Sociodemographic Factors

Sociodemographic data included region (Fig. 1), age (years), gender (female/male), race (mixed ethnicity/black), and socioeconomic status (low, medium, or high) according to the classification used by the Department of National Planning, which is based on the housing infrastructure and is adopted by public service institutions for all regions in Colombia.<sup>27</sup>

### Microbial Sampling

Microbial sampling on periodontitis patients was performed on pockets >5 mm. The deepest six pockets were selected for patients with periodontitis, whereas one site in each sextant was chosen for control patients. After removing supragingival plaque with cures and isolating the area with cotton pellets, two paper points were inserted into each periodontal pocket for 20 seconds. One paper point from each pocket was transferred to an empty sterile tube to obtain a pool of samples for polymerase chain reaction (PCR) processing and identification of *P. gingivalis*,

†† UNC-15, Hu-Friedy, Chicago, IL.



**Figure 1.**

Geographic distribution of populations studied.

*A. actinomycetemcomitans*, *T. forsythensis*, *E. corrodens*, *C. rectus*, *P. intermedia*, and *P. nigrescens*. The other paper point was transferred to a tube with Viability Medium Göteborg Anaerobically (VMGA) III medium for the identification of enteric rods. All samples were labeled properly and sent immediately to the reference laboratories (Oral Microbiology Labs, Basic Oral Research Unit Institute, Universidad El Bosque, and Universidad del Valle) by certified mail. All samples were processed within 48 hours. Laboratory techniques for PCR were calibrated. A protocol for extracting DNA was defined, and the reproducibility in conducting the technique reached 100% agreement between the laboratories. Culture techniques for the identification of enteric rods also were calibrated among the reference laboratories.

#### Microbiologic Analysis

**PCR.** PCR was performed as described by Ashimoto et al.<sup>28</sup> and Saiki et al.<sup>29</sup> *P. gingivalis* American Type Culture Collection (ATCC) 33277, *C. rectus* ATCC 33238, *T. forsythensis* ATCC 43037, *E. corrodens* ATCC 23834, *A. actinomycetemcomitans* ATCC 29522, *P. intermedia* ATCC 25611, and *P. nigrescens* ATCC 33563 reference strains were used. *P. gingivalis* was identified by the presence of an amplified pro-

duct in the 404-base pair (bp) band, *C. rectus* by an amplified product in the 598-bp band, *T. forsythensis* by an amplified product in the 641-bp band, *E. corrodens* by an amplified product in the 688-bp band, *P. intermedia* by an amplified product in the 575-bp band, and *P. nigrescens* by an amplified product in the 804-bp band. The primers used were the ones described by Ashimoto et al.,<sup>28</sup> which were selected with the assistance of the Ribosomal Database Project program.

**Isolation of Gram-negative enteric rods by culture.** For the isolation of enteric bacteria, MacConkey agar was used and incubated in aerobic atmosphere at 37°C for 24 to 48 hours. A Gram stain was performed on colonies that grew on MacConkey agar medium for verification.

#### Statistical Analysis

Univariate and bivariate analyses were conducted to test the distribution of the different variables (frequency distribution for categorical variables and mean, median, and standard deviation for continuous predictors) and the association between bacterial profiles, sociodemographic characteristics, and clinical parameters. Demographic information included region, age (<30 years/≥30 years), gender (female/male), socioeconomic status (low, medium, or high), smoker (yes/no), type of dental practice (public/private), and race (mixed ethnicity/black). Clinical information included PD (shallow, moderate, or deep) and CAL (low, moderate, or severe). Depending on the nature of the variables, statistical tests used to assess bivariate associations included  $\chi^2$ , Fisher exact test, and analysis of variance. All variables that reached a significance level <0.05 in the bivariate analyses were used to model the presence/absence of periodontopathic microorganisms. Multivariate logistic regression models were fitted using *P. gingivalis*, *T. forsythensis*, *A. actinomycetemcomitans*, *C. rectus*, and *E. corrodens* as dependent variables. Statistical significance was set at  $P < 0.05$  for all tests at the modeling stage.

#### RESULTS

Table 1 depicts the sociodemographic aspects of the studied sample. The average age was 37.4 years, with significant differences between the patient groups and the controls ( $P < 0.05$ ). Patients with CP were older than patients with AgP. Controls had a higher average age than those with AgP but lower than CP patients. In most regions, more women than men and more individuals from low and middle socioeconomic levels were evaluated.

Analyses of clinical indicators were person based and not site based, expressed as the average of all sites examined clinically. There were significant differences

in all clinical parameters between patients with periodontitis and controls ( $P < 0.0001$ ). There were no differences between the periodontitis groups, except for PD of sites selected for microbiologic evaluation, and BOP, which was more severe in AgP ( $P < 0.05$ ). The frequency of smokers was similar for AgP and control groups, and there was a higher frequency of smokers among CP patients, which was significantly different from the control group ( $P < 0.05$ ) (Table 2).

The distribution of bacteria among different regions in all subjects is shown in Figure 2. With the exception of *P. gingivalis* and *P. intermedia*, there were significant differences in all of the bacteria among regions.

The biggest differences were observed for *T. forsythensis*, *C. rectus*, and *E. corrodens* ( $P < 0.0001$ ). *A. actinomycetemcomitans* and *P. nigrescens* also showed differences among regions ( $P < 0.05$ ).

Figure 3 shows the percentage distribution of microorganisms studied among the different diagnoses. *P. gingivalis* was the most common (71.5%) bacteria in patients with periodontitis. Specifically, it was found in 68.2% of CP patients, 74.6% of AgP patients, and 14.5% of controls. *T. forsythensis* was found in 58.5% of CP patients, 58.1% of AgP patients, and only 3.1% of controls. *C. rectus* was present in 57.5% of patients with periodontitis and 22.7% of controls; lower

**Table 1.**

### Demographic Characteristics by Clinical Diagnosis

Variable	CP	AgP	Healthy/Gingivitis	Total
Subjects (N)	325	158	137	620
Age (years, mean $\pm$ SD)	45.6 $\pm$ 10.6*	28.0 $\pm$ 6.8*	28.9 $\pm$ 10.3	37.4 $\pm$ 12.9
Gender (%)	F: 53.5 M: 46.5	F: 62.0 M: 38.0	F: 61.3 M: 38.7	F: 57.4 M: 42.6
Socioeconomic status (%) <sup>†</sup>	1: 33.9 2: 55.7 3: 10.4*	1: 44.3 2: 48.1 3: 7.6 <sup>‡</sup>	1: 40.9 2: 36.3 3: 22.8	1: 38.1 2: 49.6 3: 12.3
Race (%)	M: 95.4 B: 4.6 <sup>‡</sup>	M: 96.2 B: 3.8	M: 99.3 B: 0.7	M: 96.5 B: 3.6
Type of practice (%)	Pu: 81.2 Pr: 18.8	Pu: 88.0 Pr: 12.0 <sup>‡</sup>	Pu: 75.4 Pr: 24.6	Pu: 81.7 Pr: 18.3

M = mixed; B = black; Pu = public; Pr = private.

P values derived from *t* or  $\chi^2$ /Fisher exact tests. Unless otherwise noted, comparisons had no statistical significance.

\* Comparison versus healthy ( $P < 0.0001$ ).

<sup>†</sup> 1 = low; 2 = middle; 3 = high.

<sup>‡</sup> Comparison versus healthy ( $P < 0.05$ ).

**Table 2.**

### Clinical Indicators and Smoking Status by Diagnosis

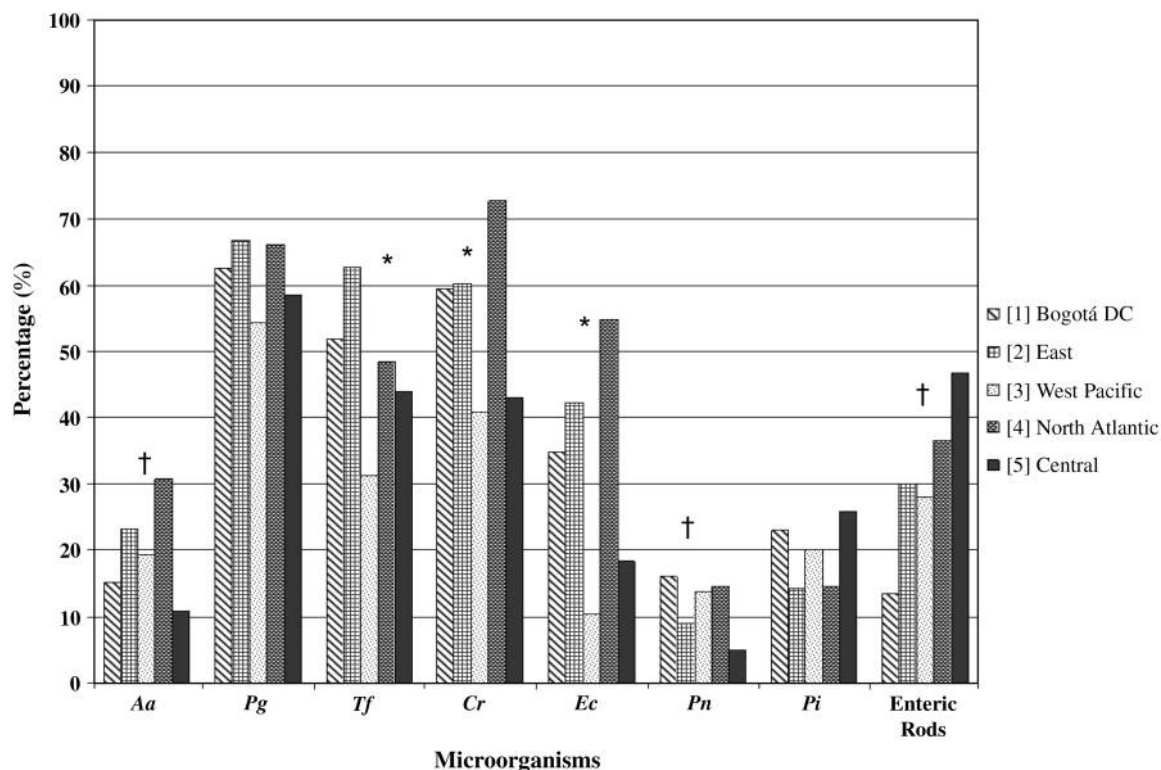
Variable	CP	AgP	Healthy/Gingivitis	Average
Subjects (N)	325	158	137	620 (total N)
PD (mm) (mean $\pm$ SD)	3.9 $\pm$ 1.1*	3.8 $\pm$ 0.9*	1.8 $\pm$ 0.4	3.4 $\pm$ 1.3
CAL (mm) (mean $\pm$ SD)	4.2 $\pm$ 1.6*	4.0 $\pm$ 1.4*	1.0 $\pm$ 1.2	3.4 $\pm$ 1.9
PD sites sampled (mean $\pm$ SD)	7.5 $\pm$ 1.1* <sup>†</sup>	7.9 $\pm$ 1.5* <sup>†</sup>	2.1 $\pm$ 0.6	6.3 $\pm$ 2.7
BOP (% positive)	53.50* <sup>†</sup>	59.30* <sup>†</sup>	20.00	48.00
Smoking status (% positive)	18.70 <sup>‡</sup>	14.70	9.20	15.60

P values derived from *t* or  $\chi^2$ /Fisher exact tests. Unless otherwise noted, comparisons had no statistical significance.

\* Comparison versus healthy ( $P < 0.0001$ ).

<sup>†</sup> Comparison chronic versus aggressive ( $P < 0.05$ ).

<sup>‡</sup> Comparison versus healthy ( $P < 0.05$ ).



**Figure 2.**

Distribution of microorganisms by region. P values for differences in proportion of microorganisms among regions are from  $\chi^2$ /Fisher exact test. Aa = *A. actinomycetemcomitans*; Pg = *P. gingivalis*; Tf = *T. forsythensis*; Cr = *C. rectus*; Ec = *E. corrodens*; Pn = *P. nigrescens*; Pi = *P. intermedia*. \*P < 0.0001; †P < 0.05.

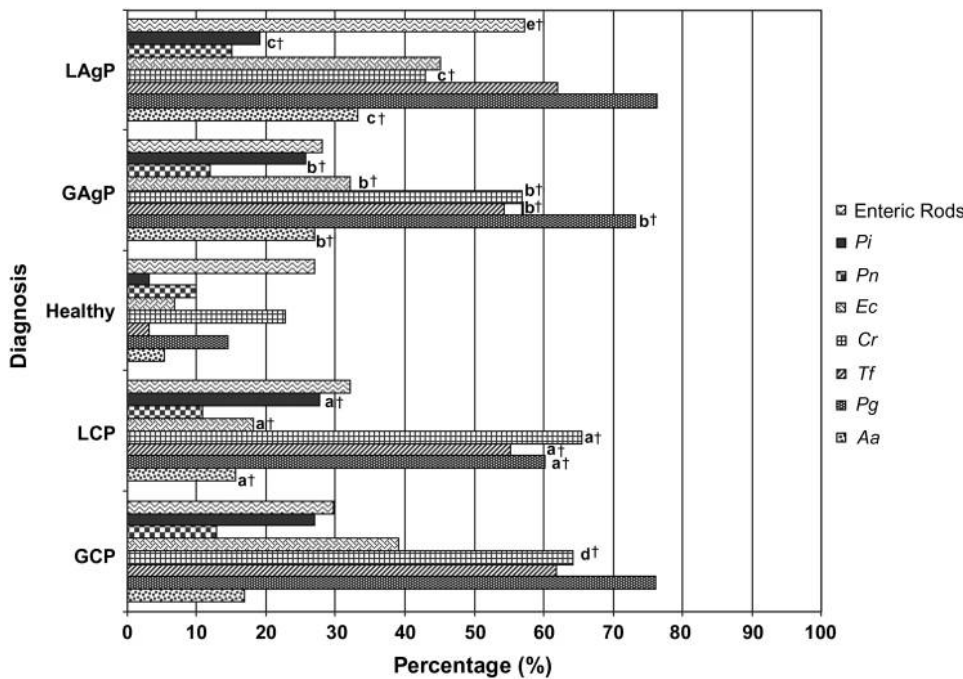
levels of *E. corrodens*, *P. intermedia*, and *P. nigrescens* were observed in periodontitis patients. *A. actinomycetemcomitans* was present in 23.6% of patients with periodontitis: 16.5% of CP patients and 30.1% of AgP patients. Among patients with chronic and aggressive periodontitis and controls, differences were observed for all bacteria, except *P. nigrescens*. Between both periodontitis groups, differences were found only for *A. actinomycetemcomitans*, *C. rectus*, and *P. intermedia* ( $P < 0.05$ ). There was a higher frequency of *A. actinomycetemcomitans* in patients with AgP; however, these differences were not significant between the localized and generalized forms of the disease ( $P > 0.05$ ). There were no differences in the frequency of microorganisms based on race, smoking status, gender, and socioeconomic status.

Enteric rods were present in 29.8% of all patients, including controls. In patients with periodontitis, a prevalence of 34.5% was observed. There were no differences between CP, AgP, and controls, except for the localized form of AgP, which showed significant differences compared to the other groups studied ( $P < 0.05$ ). The presence of enteric rods was similar among regions; however, the Central region showed a significant difference compared to other regions

( $P < 0.05$ ; Fig. 2). Age, gender, socioeconomic status, smoking status, and race were not associated with the presence of enteric rods (Table 3).

Table 3 shows the bivariate analysis for *P. gingivalis*, *A. actinomycetemcomitans*, *T. forsythensis*, *C. rectus*, *E. corrodens*, *P. intermedia*, *P. nigrescens*, and enteric rods. Diagnosis and PD were some of the variables that were associated strongly with the presence of these microorganisms ( $P < 0.0001$ ); region, age, socioeconomic status, and CAL were associated with some bacteria and were included in the multivariate analysis. Some variables, such as gender, race, and smoking status, did not show any association and were excluded from further logistic regression analyses.

*A. actinomycetemcomitans* showed an association with AgP. This bacteria was 6.4 times higher in individuals who had a diagnosis of AgP compared to healthy subjects after adjusting for other variables in the model (odds ratio [OR], 6.40; 95% confidence interval [CI]: 1.77 to 11.6) and 2.95 times more frequent in individuals with CP (OR, 2.95; 95% CI: 0.71 to 12.3). When the reference level was modified from controls to CP, *A. actinomycetemcomitans* was two times more frequent in the AgP group compared to



**Figure 3.**

Distribution of microorganisms by diagnosis. LAgP = localized aggressive periodontitis; GAgP = generalized aggressive periodontitis; LCP = localized chronic periodontitis; GCP = generalized chronic periodontitis; Pi = *P. intermedia*; Pn = *P. nigrescens*; Ec = *E. corrodens*; Cr = *C. rectus*; Tf = *T. forsythensis*; Pg = *P. gingivalis*; Aa = *A. actinomycetemcomitans*. <sup>a</sup>P value for differences in proportions of bacteria comparing chronic (localized versus generalized) versus healthy. <sup>b</sup>P value for differences in proportions of bacteria comparing aggressive (localized versus generalized) versus healthy. <sup>c</sup>P value for differences in proportions of bacteria comparing chronic (localized versus generalized) versus aggressive (localized versus generalized). <sup>d</sup>P value for differences in proportions of bacteria comparing chronic (localized versus generalized). <sup>e</sup>P value for differences in proportions of bacteria comparing aggressive (localized versus generalized). <sup>t</sup>P <0.05.

observed for *E. corrodens* for both regions (OR, 0.35; 95% CI, 0.19 to 0.66 and OR, 0.24; 95% CI, 0.11 to 0.49, respectively) (Table 4). *P. intermedia* and *P. nigrescens* did not show important differences among regions after adjustment of the regression model (data not shown).

**DISCUSSION**

The 1999 AAP<sup>26</sup> conference on periodontal disease established that there are large differences in the composition of subgingival plaque between CP and AgP. The conference also established the association between AgP and high levels of *A. actinomycetemcomitans*. The results from this study showed that *P. gingivalis*, *T. forsythensis*, and *E. corrodens* were isolated more frequently among patients with both CP and AgP in Colombia. *P. gingivalis* and *T. forsythensis* have been associated with loss of attachment in patients with periodontitis.<sup>30-32</sup> *P. gingivalis* is highly prevalent among sub-

jects with CP. Using culture techniques, ranges of 12.8% to 86.6% were reported in different populations.<sup>7,8,10,17,33-35</sup> The use of PCR for the identification of *P. gingivalis* showed ranges of 28% to 97.4%.<sup>18,28,36-38</sup> In AgP, the frequency of detection of *P. gingivalis* varied between 62% and 100% in different populations.<sup>39-42</sup> This microorganism was the most frequently found in patients with CP (68.2%) and AgP (74.6%) in the currently studied population. This is similar to the frequencies reported in other South American studies targeting Chileans<sup>43,44</sup> and Brazilians.<sup>45</sup> *P. gingivalis* did not show large differences among regions we studied or with respect to other variables assessed. *P. gingivalis* showed an association with mean PD, similar to the findings reported by other investigators.<sup>7,12,46</sup>

the CP group (OR, 2.17; 95% CI, 1.12 to 4.19) (data not shown). Moreover, individuals who had deeper pockets also were significantly more likely to have *A. actinomycetemcomitans* (OR, 6.50; 95% CI, 1.86 to 22.61) (Table 4). *P. gingivalis* was associated with the presence of periodontitis (CP: OR, 10.16; 95% CI, 3.39 to 30.50; AgP: OR, 9.45; 95% CI, 3.15 to 28.37). PD had a weak association with *P. gingivalis* (for pockets of moderate and severe depth) compared to shallow pockets. Other variables did not show any association (Table 4).

Individuals from the Eastern region were more likely to have *T. forsythensis* (OR, 2.18; 95% CI, 0.96 to 4.95). The West Pacific region had a lower frequency of *T. forsythensis* (OR, 0.37; 95% CI, 0.20 to 0.71). There was no association observed between *T. forsythensis* and PD (Table 4).

*C. rectus* was more prevalent in CP (OR, 6.13; 95% CI, 2.21 to 17.00) and AgP (OR, 5.50; 95% CI, 1.95 to 15.51), and its frequency was lower in the Central (OR, 0.35; 95% CI, 0.20 to 0.62) and West Pacific regions (OR, 0.41; 95% CI, 0.22 to 0.74). The same was

The isolation range of *T. forsythensis* in patients with CP varied between 40% and 42% using culture techniques;<sup>8,9</sup> the prevalence increased to 73% to 96% when PCR and DNA probes were used.<sup>18,47</sup> The frequency for this Colombian population was slightly lower than frequencies reported in other studies that used PCR. However, the East region showed a high

**Table 3.**  
**Bivariate Analysis of Demographic and Clinical Factors**

Variable	Aa	Pg	Tf	Ent Rod	Cr	Ec	Pn	Pi
Socioeconomic status	0.035 <sup>†</sup>	0.077	0.183	0.36	0.51	0.42	0.5	0.28
Type of practice	0.447	0.128	0.01 <sup>†</sup>	0.35	0.49	0.08	0.86	0.7
Region	0.004 <sup>†</sup>	0.309	0.0002*	<0.0001*	<0.0001*	<0.0001*	0.03 <sup>†</sup>	0.17
Diagnosis	<0.0001*	<0.0001*	<0.0001*	0.7	<0.0001*	<0.0001*	0.87	<0.0001*
Gender	0.081	0.312	0.347	0.41	0.97	0.05*	0.49	0.77
Age	0.385	0.002 <sup>†</sup>	<0.0001*	0.26	0.001 <sup>†</sup>	0.06	0.46	0.01
Race	0.248	0.1	0.741	0.84	0.49	0.11	0.1	0.02
Smoker	0.518	0.109	0.103	0.74	0.75	0.1	0.11	0.006 <sup>†</sup>
PD	<0.0001*	<0.0001*	<0.0001*	0.94	<0.0001*	<0.0001*	0.72	0.008 <sup>†</sup>
PD sites sampled	0.001 <sup>†</sup>	<0.0001*	<0.0001*	0.29	<0.0001*	<0.0001*	0.56	<0.0001*
CAL	0.0006 <sup>†</sup>	<0.0001*	<0.0001*	0.13	<0.0001*	<0.0001*	0.93	<0.0001*

Aa = *A. actinomycetemcomitans*; Pg = *P. gingivalis*; Tf = *T. forsythensis*; Ent Rod = enteric rods; Cr = *C. rectus*; Ec = *E. corrodens*; Pi = *P. intermedia*; Pn = *P. nigrescens*.

All variables are categorized based on levels used for logistic regression models. *P* values derived from the  $\chi^2$ /Fisher exact test.

\* *P* < 0.0001.

<sup>†</sup> *P* < 0.05.

frequency of this microorganism compared to other regions. This microorganism was highly variable among regions and did not show any association with PD. Future studies should be conducted to establish more precisely the microorganism's behavior in Colombian patients with periodontitis.

*C. rectus* showed a high frequency in the population with periodontitis and among controls. Lately, the importance of chronic infections associated with *C. rectus* has been of interest. Recently, Buduneli et al.<sup>48</sup> reported that *C. rectus* may have a role in increasing the risk for preterm low birth weight. Yeo et al.<sup>49</sup> found that remote subcutaneous maternal *C. rectus* infection increased fetal growth restriction in a mouse model. Offenbacher et al.<sup>50</sup> also found that maternal *C. rectus* infection induced placental inflammation as well as concomitant increases in fetal brain interferon- $\gamma$  in a mouse model.

In the present study, *A. actinomycetemcomitans* was observed two times more frequently in AgP than in CP. The levels of *A. actinomycetemcomitans* reported in periodontitis vary among populations. In AgP, *A. actinomycetemcomitans* varied between 3% and 53% among Europeans and Americans,<sup>40-42</sup> Japanese,<sup>39,51</sup> and Chileans.<sup>43,44</sup> Isolates of *A. actinomycetemcomitans* in CP varied between 8% and 57% in Americans and Europeans<sup>7,28,37,38,52-54</sup> and reached 28.5% to 40% in African countries.<sup>8,10,33</sup> The highest frequencies were reported in Chinese and Koreans, with a range between 63% and

83%.<sup>18,34,55</sup> This study demonstrated that the presence of *A. actinomycetemcomitans* varied between 16.5% for CP and 30.1% for AgP. These values are within the range of North American, European, and other South American populations,<sup>44</sup> but are lower than among Asians and Africans.

Sociodemographic variables did not influence the presence of *A. actinomycetemcomitans*. A significant association was observed between this microorganism, AgP, and PD, whereas a weaker association was observed with CP. A systematic review conducted by Mombelli et al.<sup>16</sup> showed that the presence or absence of *A. actinomycetemcomitans* did not discriminate between patients with AgP and CP. *A. actinomycetemcomitans* has shown a low response to scaling and root planing.<sup>56,57</sup> Several antimicrobial protocols administered with periodontal therapy have been implemented for the elimination of the periodontal pockets associated with *A. actinomycetemcomitans*;<sup>58-62</sup> therefore, it was important to study its presence in this population.

A great percentage of the population showed the presence of enteric rods in subgingival plaque, including the population without periodontitis. Similar frequencies were reported among Brazilians.<sup>21,46</sup> High levels of resistance to antimicrobials used in periodontal treatment have been reported for enteric rods.<sup>21,63,64</sup> Further studies are required in order to clarify the effect of enteric rods on clinical parameters and response to periodontal treatment.

Table 4.

## Logistic Regression Models for Evaluation of the Effect of Various Factors on the Presence of Bacteria

Microorganisms	Effect	Aa OR 95% CI	Pg OR 95% CI	Tf OR 95% CI	Cr OR 95% CI	Ec OR 95% CI
Independent variables						
Age (years)						
0 = ≤30	1 versus 0	0.97	0.60	1.02	1.03	1.08
1 = >30		0.51-1.88	0.31-1.09	0.55-1.89	0.60-1.76	0.58-2.00
Socioeconomic status						
1 = low	2 versus 1	1.20	1.37	0.92	1.09	1.10
2 = medium		0.73-1.97	0.87-2.18	0.59-1.43	0.71-1.66	0.70-1.75
3 = high	3 versus 1	0.40	1.20	0.62	0.73	0.71
		0.14-1.15	0.57-2.51	0.29-1.31	0.37-1.45	0.33-1.52
Region						
1 = Bogotá	2 versus 1	1.43	1.40	2.18‡	0.85	1.16
2 = East		0.66-3.10	0.65-3.04	0.96-4.95	0.43-1.68	0.59-2.26
3 = West Pacific	3 versus 1	1.59	0.86	0.37†	0.41†	0.24†
		0.77-3.26	0.45-1.68	0.20-0.71	0.22-0.74	0.11-0.49
4 = North Atlantic	4 versus 1	1.76	0.89	0.58‡	1.36	1.75
		0.77-4.05	0.39-2.03	0.27-1.23	0.61-3.02	0.84-3.63
5 = Central	5 versus 1	0.80	0.60	0.47*	0.35†	0.35†
		0.38-1.71	0.33-1.11	0.26-0.84	0.20-0.62	0.19-0.66
Diagnosis						
0 = healthy	1 versus 0	2.95	10.16*	65.71*	6.13†	4.35†
1 = chronic		0.71-12.30	3.39-30.50	12.64-341.50	2.21-17.00	1.21-15.65
2 = aggressive	2 versus 0	6.40†	9.45*	59.434*	5.50†	4.68†
		1.77-11.6	3.15-28.37	11.28-31.33	1.95-15.51	1.27-17.22
PD						
0 = ≤3 mm	1 versus 0	1.96‡	1.73‡	1.26	0.74	1.60
1 = >3 to <5 mm		0.90-4.30	0.95-3.14	0.71-2.24	0.41-1.32	0.84-3.05
2 = ≥5 mm	2 versus 0	6.50†	2.81‡	1.19	1.36	2.14
		1.86-22.61	0.98-8.10	0.44-3.22	0.49-3.78	0.76-6.02
CAL						
0 = ≤2 mm	1 versus 0	1.50	0.97	0.94	2.08	1.78
		0.40-5.58	0.35-2.68	0.19-4.63	0.86-5.04	0.51-6.21
1 = >2 to <5 mm	2 versus 0	0.74	1.83	0.69	1.87	1.23
		0.19-2.95	0.63-5.31	0.15-3.21	0.69-5.06	0.34-4.47
2 = ≥5 mm	3 versus 0	0.25	1.05	0.75	1.65	1.32
		0.52-1.23	0.31-3.50	0.15-3.76	0.54-5.10	0.33-5.32

Aa = *A. actinomycetemcomitans*; Pg = *P. gingivalis*; Tf = *T. forsythensis*; Cr = *C. rectus*; Ec = *E. corrodens*.

P values derived from the  $\chi^2$ /Fisher exact test.

\*  $P < 0.0001$ .

†  $P < 0.05$ .

‡  $P < 0.10$ .

The microbial component in patients with chronic and aggressive periodontitis in this Colombian population was not influenced by socioeconomic status, age, gender, or race. Sirinian et al.<sup>25</sup> found differences

among whites, Hispanics, and Asian-Americans; length of time the parents had lived in the United States; education level of the mother; length of time since last dental visit; and gender. In another study,

Alpagot et al.<sup>24</sup> reported differences among African-Americans, Native Americans, and Asians regarding age, race, and smoking status.

In Colombia, the subgingival flora were not associated with the geographic region; however, the microbiota may vary by geographic regions. This finding indicated that existing regional factors, in addition to the ones already studied, may have an effect on the composition of the subgingival microflora. Lifestyle factors, such as diet, frequency of dental visits, access to health services, consumption and self-medication of antimicrobials, and water sanitation, should be studied to establish their influence on the differences observed.

## CONCLUSIONS

The microbial component in patients with periodontitis in Colombia showed high levels of *P. gingivalis*, *T. forsythensis*, and *E. corrodens*. *A. actinomycetemcomitans* was lower in the population with periodontitis, and it was associated with the aggressive form. The geographic region did not influence the microbiota; however, the microbiota may vary by geographic regions. A great proportion of individuals with and without periodontitis or with varying degrees of inflammation had enteric rods in the subgingival plaque.

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Correspondence: Dr. Gloria Lafaurie, Transversal 9 A Bis No. 133-55, Universidad el Bosque, Facultad de Odontología, Bogotá, Colombia. Fax: 57-1-635-3713; e-mail: investigaciones.odontologia@unbosque.edu.co.

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