Original Paper

Clinical and Demographic Profiling of Periodontal Diseases: A Retrospective Analysis Using the 2018 Periodontal Classification Algorithm

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ABSTRACT: The research presented in this retrospective study aimed to investigate the prevalence of periodontal diseases within a population and explore potential demographic and clinical variations among patients diagnosed with periodontitis. The study involved the analysis of 104 patient records from the Periodontology Clinic at the University of Medicine and Pharmacy in Craiova, collected between 2018 and 2019. Utilizing the 2018 classification algorithm for periodontal diseases, patients were categorized into three groups: a control group without periodontal issues (Group H), a gingivitis group (Group G), and a periodontitis group (Group P). The collected data encompassed demographic information, oral hygiene indicators, and clinical parameters. Statistical analysis and graphical representation revealed notable trends, such as the higher prevalence of periodontitis (51%) compared to gingivitis (14%), with 35% of participants showing no signs of periodontal involvement. Detailed group analyses highlighted specific patterns, including a substantial male predominance among patients without periodontal issues and varying distributions of periodontal stages based on gender. Additionally, the study explored age-related variations, revealing an increasing average age from the control group (33.04 years) to the gingivitis group (34.86 years) and a significant rise in the periodontitis group (45.49 years). The findings underscore the importance of early detection and intervention in periodontal diseases and provide valuable insights for clinicians in tailoring individualized diagnostic and treatment approaches.

KEYWORDS: *Periodontal diseases, 2018 periodontal classification algorithm, prevalence, demographic variations, clinical indicators, gingivitis, periodontitis, oral hygiene, individualized treatment, retrospective study.*

Introduction

In 2018, through the collaborative efforts of the European Federation of Periodontology and the American Academy of Periodontology, a new classification system for periodontal and peri-implant diseases was introduced [1].

The purpose of the new classification system was to update the diagnostic principles of periodontal conditions, drawing upon the scientific research findings accumulated over a span of 20 years since the implementation of the Armitage classification system in 1999 [1].

Consequently, the novel classification system is grounded in the essential principles of evidence-based medicine, aiming to standardize the diagnostic criteria for periodontal diseases [2].

The innovative aspect of the classification system lies in the introduction of a diagnostic algorithm based on both clinical and radiological examination of the patient [2].

By following this algorithm, a diagnosis of periodontal disease is obtained, encompassing not only the type of condition but also precise information regarding its severity and rate of progression [3].

This is achieved through the utilization of a Staging system (ranging from I to IV) for severity and a Grading system (ranging from A to C) for the rate of disease progression [2].

The new classification addressed unresolved issues of the previous classification by distinguishing between the presence of gingival inflammation in one or more areas and the identification of a case of gingivitis [4].

Bleeding on probing (BOP) was set as the main clinical parameter that would indicate the presence of gingival inflammation [5].

Furthermore, periodontal health and gingival inflammation were characterized after the successful completion of treatment for a patient with periodontitis.

The experts reached a consensus that two periodontal parameters, BOP and periodontal pocket depth (PD), should be used for case definitions, including gingival health or inflammation, either in new cases or post completion of periodontal treatment [1,6].

It is widely accepted that while patients with gingivitis can potentially regain a state of oral

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health, those diagnosed with periodontitis continue to require lifelong management, even post successful treatment, necessitating consistent supportive care to reduce the risk of disease relapse [6].

The broad spectrum of plaque-induced and non-plaque-induced gingival diseases has also been reorganized based on primary aetiology [5].

Based on contemporary insights into pathophysiology, the recent classification generates three distinct presentations of periodontitis: necrotizing periodontitis, periodontitis occurring as a manifestation of systemic disease, and variants of the condition formerly characterized separately as "chronic" or "aggressive," which are now conjoined into a unified category termed "periodontitis" [7,8].

A revision of the periodontitis classification has resulted in a classification system based on a multidimensional staging and grading framework that can be adapted over time as new information emerges [2,9].

Staging is largely contingent on the severity of the disease at the time of presentation, as well as the complexity of disease management, whereas grading in periodontitis refers to the assessment of the biological phenotype and is based on three parameters: the rate of periodontitis progression, recognized risk factors for progression, and the individual risk of systemic health impact [2,3,10].

The staging process encompasses four distinct categories (stages 1 through 4), which are determined through the assessment of various parameters, including clinical attachment loss (CAL), extent and proportion of bone loss, probing depth, the prevalence and severity of angular bony defects, involvement of furcation, tooth mobility, and the incidence of tooth loss attributable to periodontitis [2,11].

The grading framework encompasses three tiers (Grade A-slow progression, Grade B-moderate progression, Grade C-fast progression), incorporating factors influencing the advancement of periodontitis, alongside considerations of the patient's general health status and additional exposures such as smoking or the degree of metabolic regulation in instances of diabetes [1,12].

Consequently, grading enables clinicians to synthesize the diverse factors pertinent to each patient, thereby facilitating comprehensive case management [2,13].

In this paper, the retrospective statistical study of demographic and clinical data extracted from the periodontal charts had the objective to verify the working hypothesis regarding the existence of demographic and clinical peculiarities within the group of patients analysed, based on the utilization of the periodontal diagnostic system proposed by the 2018 classification of periodontal conditions.

Materials and Methods

Study Design

The retrospective statistical study was conducted by analysing a total of 104 observation records of patients who addressed themselves for investigation and specialized treatment at the Periodontology Clinic of the University of Medicine and Pharmacy in Craiova, during the period 2018-2019, after approval from the Ethics Committee of the University of Medicine and Pharmacy of Craiova (no 127/09.12.2019).

Data Selection

During the patient examinations, the records documented patient identification data, medical history, clinical data regarding their dental and periodontal status (dental and periodontal charting conducted electronically, https://www.periodontalchart-online.com/ro/), and panoramic radiographs were attached.

Based on these data, a retrospective periodontal diagnosis was established using the algorithm proposed by the 2018 classification of periodontal conditions, incorporating the following parameters: Patient's age; Bleeding on probing index (BOP); Average level of periodontal pocket depth (PD); Average level of gingival attachment loss (CAL).

Group formation

According to the new 2018 classification of periodontal conditions, patients were categorized into study groups as follows:

- Group H: control group, patients without periodontal involvement;
- Group G: gingivitis group, patients diagnosed with different forms of gingivitis;
- Group P: periodontitis group, patients diagnosed with different forms of periodontitis with one of four stages (I-IV) [1].

Data extraction

After establishing the working groups, the following data were extracted from the observation records for each of them:

- Demographic Data: a. Gender; b. Age; c. Place of origin.
- Oral Hygiene Data: a. Self-perceived level of oral hygiene (Good-Average-Poor); b.

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O'Leary plaque index value (ratio between dental surfaces with dental plaque to total number of examined surfaces, multiplied by 100)

- Clinical Data: a. Number of missing teeth; b. Bleeding on probing index (ratio between number of probing sites with gingival bleeding to total number of probing sites, multiplied by 100); c. Mean depth of periodontal pockets; d. Level of gingival clinical attachment.

Statistical Analysis

Data collected were centralized in a database using the Microsoft Excel Data Analysis program (Microsoft, California, USA).

The following key indicators were calculated and graphically represented for each study group, with *t*-test performed for statistical significance between groups for the following parameters (a two-sided *p*-value smaller than 0.05 was considered to be statistically significant):

- Distribution of patients in groups and subgroups in relation to the total number of observation records analysed (prevalence of periodontal conditions in the study sample);
- Average age of patients;
- Number and proportion of patients by gender;
- Number and proportion of patients by place of origin;
- Number and proportion of patients by self-perceived level of oral hygiene;
- Average value of O'Leary plaque index (PI);
- Average number of missing teeth;
- Average value of bleeding on probing index (BOP);
- Average depth of periodontal pockets (PD);
- Average level of gingival clinical attachment level (CAL).

The obtained data were presented in tables to effectively illustrate the differences between the analysed study groups.

Results

The assessments reveal that approximately half of the participants received diagnostic of periodontitis (51%), with patients diagnosed with gingivitis representing a much smaller percentage, at 14%.

Among the participating patients, 35% did not show any form of periodontal involvement (Table 1).

The average age recorded for patients in Group H is 33.04 years, for those in Group G it is 34.86 years, while in the case of Group P, there is an increase of approximately 10 years in the average age, reaching 45.49 years.

Table 1. Prevalence of periodontal conditions in the cohort (%) and average age (years).

Group	Number	Prevalence	Age
P	53	51%	45.49 ± 14.11
G	15	14%	34.86 ± 14.29
H	36	35%	33.02 ± 14.01
Total	104	100%	

Among the 36 patients without periodontal involvement examined, it is observed that the number of male patients is twice that of female patients.

Of the 15 patients diagnosed with different forms of gingivitis, the proportion between females and males is approximately equal.

The number of male patients exceeds the number of female patients by 4% (Table 2).

In the case of the 53 patients diagnosed with different forms of periodontitis, the number of female patients is roughly equal to the number of male patients, exceeding it by only 2% (Table 2).

Patients in the control group predominantly come from an urban environment, with only 9% of them belonging to a rural environment.

Patients in Group G are mostly representatives of the urban environment, although in a smaller percentage (73%) compared to patients in Group H (92%).

Among the 53 patients in Group P, only 7 have a rural background. Patients from urban areas are the majority, constituting 87% (Table 2).

Table 2. Demographic characteristics of study and control groups.

Group	Male	Female	Urban	Rural
P	49%	51%	87%	13%
G	53%	47%	73%	27%
H	67%	33%	92%	8%

Following the self-evaluation of the level of oral hygiene, the majority of patients in Group H estimated that they have an average hygiene level (56%), a significant portion estimated good hygiene (30%), and only 14% considered their hygiene to be inadequate.

In Group G, an average level of hygiene was estimated for approximately half of the patients (47%), only 20% perceived good hygiene, and a notable percentage of 33% reported an appropriate hygiene level.

As for Group P, there is an almost equal distribution between inadequate hygiene (42%) and average hygiene (41%), with inadequate hygiene exceeding average by 1%.

Only a small percentage of these patients have good hygiene (17%) (Table 3).

Regarding the objective evaluation of the level of oral hygiene using the O'Leary plaque index, there is a progressive increase, starting with patients in Group H (12.17%), followed by patients in Group G (14%), and reaching the highest value (26.28%) observed in patients in Group P (Table 3).

Table 3. Oral hygiene status of patients, self-reported and objective assessment (PI=plaque index).

	Self-reported		
Group	**Good**	**Average**	**Poor**
P	17%	41%	42%
G	20%	47%	33%
H	30%	56%	14%
	PI		
P	26.28% ± 0.28%		
G	14% ± 0.13%		
H	12.17% ± 0.1%		

The majority of surveyed patients exhibit tooth loss, with Group H having an average of 3.41 missing teeth, Group G showing an increasing average of 4.73 missing teeth, and Group P having a significantly higher average number of missing teeth, at 7.64. ($p<0.05$).

In Group H, the bleeding index shows low values (4%). Groups G and P have much higher values (14% and 17%, respectively) for the bleeding index, the differences to the H group being statistically significant ($p<0.05$).

Patients in Group H have the smallest average probing depth, which increases as periodontal disease advances in Group G (1.45 mm) and Group P (2.10 mm) (all differences being statistically significant).

Patients in Group P have the highest average value for clinical attachment loss, at -2.53 mm ($p<0.05$), followed by -1.48 mm in Group G, and -1.35 mm in Group H. (Table 4)

Table 4. Average values for clinical assessment parameters' and statistical significance for inter-group comparison.

Para-meter	**P**	**G**	**H**	***p - value* P vs. G**	***p - value* P vs. H**	***p - value* G vs. H**
Absent teeth (n)	7.64 ± 5.5	4.73 ± 3.7	3.41 ± 3.1	0.02	<0.001	0.25
BOP (%)	17 ± 0.1	14 ± 0.2	4 ± 0.2	0.2	<0.002	<0.003
PD (mm)	2.1 ± 0.7	1.45 ± 0.3	1.31 ± 0.2	<0.001	<0.003	<0.001
CAL (%)	-2.53 ± 1.1	-1.48 ± 0.4	-1.35 ± 0.3	<0.004	<0.003	0.34

(BOP – bleeding on probing index; PD – periodontal pocket depth; CAL – gingival clinical attachment level)

Using the clinical information, the patients of P group were integrated into the four stages of periodontitis, the most prevalent being Stage I and Stage IV type periodontitis (Table 5).

Table 5. Prevalence of different stages of periodontitis according to 2018 Classification.

Group	**Stage I**	**Stage II**	**Stage III**	**Stage IV**
P	42%	15%	15%	28%
Total	53 (n)			

Discussion

The results obtained through this retrospective study revealed interesting aspects regarding the demographic and clinical characteristics of patients diagnosed with periodontal involvement, based on the diagnostic algorithm of the 2018 classification.

A good compliance between clinical data and the staging of periodontitis was observed, suggesting that categorizing a patient into a disease stage accurately reflects the reality of the clinical symptoms they present.

Other similar studies were also analysed for comparison and validation of the obtained results.

The prevalence of periodontal involvement in the analysed sample was high, with 65% of patients presenting some form of periodontal disease, of which 51% had periodontitis and 14% had gingivitis.

Thus, the prevalence of periodontitis in the analysed population remains significant, with the majority of patients suffering from a deep-level involvement of the periodontium.

Among these, most cases of periodontitis were represented by Stage I (42% of all cases of periodontitis), followed by those in Stage IV (28%).

This emphasizes the importance of seeking medical attention at the early signs of illness.

A study conducted in the metropolitan areas of Lisbon assessed the level of awareness in the local population to periodontal conditions [14].

The results of this cross-sectional study, which included 1064 participants (mainly female, 58%, with an average age of 60.9 years), highlighted that the prevalence of periodontitis increased with age.

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Additionally, the majority of the population reported no knowledge about the cause or manifestations of periodontal disease.

Regarding their oral health behaviours, approximately one third of the participants reported brushing their teeth once or less per day.

Additionally, it was found that 70.2% of subjects diagnosed with severe periodontitis had never engaged in interproximal cleaning, a crucial practice for eliminating interdental biofilm deposits, which are recognized as a primary etiological factor in periodontal disease [14].

In our study, participants also predominantly came from an urban environment (only 14 out of 104 participants are from a rural background), with a nearly equal number of men and women (58 men and 46 women).

The average age of participants without periodontal conditions is 33.02 years, 34.86 for patients with gingivitis, and 45.49 years for patients with various stages of periodontitis.

Regarding the clinical periodontal assessment of the Portughese study, it highlighted that the mean PD and the number of sites with PD ≥4 mm and ≥6 mm were constant in all age patient categories [14].

Conversely, a significantly moderate correlation was identified for the average clinical attachment level (CAL) and the number of sites with CAL ≥4 mm and ≥6 mm, which were inhomogeneous across the age groups, displaying an increasing tendency with the age parameter [14,15].

However, our study results show that the mean probing depth value is lower, but still increases with the advancement of periodontal disease from 1.31 mm in healthy patients to 2.77 mm in those with Stage IV periodontitis.

The number of missing teeth is also correlated with the average CAL in all age groups.

This suggests that there exists a positive correlation between the number of missing teeth and the average CAL; however, this association is less pronounced for PD [14].

Similarly, in our study, the majority of the surveyed patients exhibit edentulism, with Group H having an average of 3.41 missing teeth, Group G showing an increasing average of 4.73, and Group P having a considerably higher average of 7.64 missing teeth (with patients in stage IV presenting an average of 10.80 missing teeth).

The values of the BOP parameter were similar to those of our study, being evenly distributed in the population for all age categories and increasing incrementally with the progression of periodontal disease, from healthy controls (4%) to gingivitis (14%) and to periodontitis (17%).

In Norway, a cross-sectional study assessing the prevalence of periodontitis according to the 2018 classification was conducted.

The examination involved 4863 participants, with 2174 being men.

The prevalence of periodontitis demonstrated an escalation post the age of 40, with severe manifestations predominantly occurring after individuals reached the age of 60 [16].

From the studied population, 26.2% did not exhibit radiographic bone loss (RBL).

Among these, 13.5% participants were not affected by gingivitis (due to BOP<10%), while other 12.3% were diagnosed with gingivitis (either localized or generalized forms).

Among the participants, 0.5% lacked both radiographic evidence of bone loss and bleeding on probing (BOP) data [16].

Within the "no gingivitis" subgroup, 2.5% exhibited at least one site with probing depth (PD) exceeding 3 mm, resulting in 10.9% of participants meeting the criteria for periodontal health as defined in the study.

Periodontitis was observed in 3573 participants (72.4%) [16].

Another cross-sectional study on a randomized population sample from northern

Norway focused on the assessment of factors that may increase the susceptibility towards periodontal conditions [17].

The population of the study mainly consisted of middle-aged women (51%, 47.3 years average age), living in urban settlements [17].

Regarding oral hygiene, the majority reported brushing their teeth ≥2 times a day. The average number of present teeth was 25 [17].

Although women exhibited greater participation, the prevalence of periodontitis was notably higher among men, accounting for 56.7% of cases.

Moreover, the prevalence of periodontitis rose with age, peaking in the oldest age cohort, where it was approximately five times higher than in the youngest group of participants [17].

Furthermore, a comparison of periodontitis prevalence between urban and rural locales revealed a higher incidence in suburban and rural communities than in urban areas.

Notably, the prevalence of severe periodontitis was most pronounced within the age group ranging from 65 to 79 years [17].

The assessment of clinical periodontal parameters revealed a high prevalence of PD ≥4 mm across all age groups. Additionally, the distribution of sites with PD ≥4 mm was found to be uneven throughout the population across all age categories [17].

On the other hand, BOP (30% average value) showed a different behaviour, as it remained constant across all age groups. BOP exhibited an upward trend corresponding to the severity of periodontitis.

Specifically, the average BOP prevalence was 25.4% among individuals without periodontitis, 33.2% among those with non-severe periodontitis, and 41.7% among individuals with severe periodontitis.

Similarly, the PI demonstrated a parallel pattern to BOP and the outcomes of our study, with an average of 44.2% and increasing prevalence observed with both the severity of periodontitis and advancing age [17].

The results of this Norwegian study are considerable, as they depict that half of the adults in the targeted population had periodontitis, in various degrees of severity [17].

The chronic nature of periodontitis is suggested by the incremental worsening of periodontal parameters with age, leading to consequently aggravated clinical outcomes [17].

In Colombia, the fourth edition of the National Oral Health Study was conducted to provide a comprehensive overview of the oral health issues impacting the local population [18].

A total of 9,255 subjects were examined, with an average number of teeth of 21.7 [18].

When using the 2018 classification criteria, the overall prevalence of periodontitis cases was 61.5% (most of which were moderate cases 43.6%).

The percentage of the population without periodontitis steadily decreased from 79.0% at the age of 18 to 11.9% in the age range of 65-79 years.

The severity of periodontitis increase proportionality with age, the highest prevalence of severe cases being in the above 44 years age group (20%).

Particularly, the incidence of severe periodontitis cases was nearly twofold higher among men (13.9%) in contrast to women (7.5%).

Periodontitis' prevalence was also higher in individuals originating from rural areas [18].

From a clinical standpoint, the average PD was 4.43 mm. Individuals aged above 20 exhibited at least one PD>4mm in 30% of the cases.

However, deep periodontal pockets (PD>6mm) were less prevalent.

The highest prevalence of PD ≥6 mm was for the age range of 45-64 years, with an incidence of 9.8% [18].

Regarding the demographic elements, similar characteristics were shown for PD>6mm as for the prevalence of periodontitis (twice as prevalent in men from rural areas) [18].

The other clinical periodontal parameter used during the evaluation, CAL (mean value=1.47mm) expressed a similar behaviour to PD.

The prevalence and severity of periodontal conditions demonstrated an escalation with advancing age.

For instance, among individuals aged 18 years, 16.9% exhibited clinical attachment loss (CAL) ≥3mm.

In contrast, in the age group of 45-64 years, a substantial proportion of subjects (93.5%) had at least one site with CAL ≥3 mm, with 60.6% manifesting a site with CAL ≥5 mm.

Men were significantly more affected by increased CAL than women.

Future research in periodontal health should focus on refining machine learning models for disease classification, incorporating age-related variations and factors influencing periodontal health to enhance diagnostic accuracy [19].

Longitudinal studies are required to evaluate the progression of periodontal diseases over time, particularly considering the observed age-related trends in disease prevalence in both Norway and Colombia.

Understanding the evolving nature of these conditions with age is critical for the development of effective preventive and therapeutic interventions [20].

Additionally, investigations into the factors influencing periodontal health, as emphasized in the cross-sectional studies, should be expanded to identify and address specific determinants contributing to the prevalence and severity of periodontal diseases.

Conclusions

The prevalence of periodontal diseases in the analysed population is high, and among patients with periodontitis, there may be certain

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demographic and clinical peculiarities incorporated into the algorithm of the new classification system for periodontal diseases, improving the prospects for individualized diagnosis and treatment available to practitioners.

Conflict of interests

None to declare.

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