Perception of Oral Health-related Quality of Life Before the First Step and After the Second Step of Periodontal Therapy *

Percepción de la calidad de vida relacionada con la salud oral antes del primer paso y después del segundo paso de la terapia periodontal

Percepção da qualidade de vida relacionada à saúde bucal antes da primeira etapa e após a segunda etapa da terapia periodontal

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ABSTRACT

Background: Periodontal research has focused on clinical outcomes of periodontitis and in a lesser extent on patient-reported outcomes. **Objective:** The objectives of this study were to 1) determine oral health-related quality of life (OHRQoL) before the first step and after the second step of periodontitis therapy and 2) compare sociodemographic and clinical characteristics with changes in OHRQoL. **Methods:** Patients with periodontitis that had never been treated with subgingival plaque instrumentation were recruited. Clinical parameters were recorded. A questionnaire was applied to collect sociodemographic data, smoking status, and pain. The Oral Health Impact Profile-14 (OHIP-14) was used to evaluate OHRQoL before the first step and after the second step of periodontitis therapy. **Results:** Fifty-one participants completed the study, mean age 46.88 years ± 11.16. OHIP-14 total score decreased from 16.98 ± 11.48 to 8.41 ± 9.06 after treatment. Improvements in physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap accounted for the changes. The most frequent periodontal staging was stage III. As for grading, Grade A was diagnosed in 16 (31.37 %) participants, Grade B in 16 (31.37 %), and Grade C in 17 (33.33 %). Mean plaque index was 61.4 % ± 17.6 before the first step of periodontitis therapy and 22.8 % ± 10.6 after. Pain in the last month decreased after periodontal care. No differences in OHRQoL changes were detected when comparing age categories, gender, and educational level. Better scores were reported from non-smokers, before and after therapy (p = 0.003). **Conclusion:** Periodontal therapy had a positive impact on self-perceived quality of life of patients.
Keywords: delivery of health care; dental care; dentistry; indicators of quality of life; patient-reported outcome measures; perception; periodontitis; quality of life

RESUMEN

Antecedentes: La investigación en enfermedad periodontal se ha centrado en resultados clínicos y, en menor medida, en resultados reportados por el paciente. **Objetivo:** Los objetivos de este estudio fueron 1) determinar la calidad de vida relacionada con la salud oral (CVRSO) antes del primer paso y después del segundo paso del tratamiento periodontal y 2) comparar características sociodemográficas y clínicas con cambios en CVRSO. **Métodos:** Se reclutaron pacientes con periodontitis que nunca habían sido tratados con instrumentación subgingival. Se registraron parámetros clínicos. Se aplicó un cuestionario para recoger datos sociodemográficos, sobre tabaquismo y dolor. Se utilizó el Perfil de Impacto en la Salud Oral-14 (OHIP-14) para evaluar la CVRSO antes del primer paso y después del segundo paso del tratamiento periodontal. **Resultados:** Cincuenta y un participantes completaron el estudio, promedio de edad 46,88 años ± 11,16. La puntuación total del OHIP-14 disminuyó de 16,98 ± 11,48 a 8,41 ± 9,06. Mejoró el dolor físico, malestar psicológico, discapacidad física, discapacidad psicológica, discapacidad social y discapacidad. El estadio más frecuente fue el III. En cuanto al grado, 16 (31.37 %) participantes fueron diagnosticados grado A, grado B 16 (31.37 %), y grado C 17 (33.33 %). El índice de placa fue 61,4 % ± 17,6 antes del primer paso y 22,8 % ± 10,6 después. El dolor en el último mes disminuyó después del tratamiento. No se detectaron diferencias en CVRSO al comparar edad, género y nivel educativo. Los no fumadores reportaron mejores puntajes (p = 0,003). **Conclusión:** El tratamiento periodontal tiene un impacto positivo en la autopercepción de calidad de vida de los pacientes.

Palabras clave: atención a la salud; atención odontológica; calidad de vida; indicadores de calidad de vida; medición de resultados informados por el paciente; odontología; percepción; periodontitis

RESUMO

Antecedentes: A pesquisa em doença periodontal concentrou-se nos resultados clínicos e, em menor grau, nos resultados relatados pelos pacientes. **Objetivo**: Os objetivos deste estudo foram 1) determinar a qualidade de vida relacionada à saúde bucal (QVR) antes da primeira etapa e após a segunda etapa do tratamento periodontal e 2) comparar características sociodemográficas e clínicas com alterações na QVRSB. **Métodos:** Foram recrutados pacientes com periodontite que nunca haviam sido tratados com instrumentação subgengival. Os parâmetros clínicos foram registrados. Foi aplicado um questionário para coleta de dados sociodemográficos, tabagismo e dor. O Oral Health Impact Profile-14 (OHIP-14) foi utilizado para avaliar a QVRS antes da primeira etapa e após a segunda etapa do tratamento periodontal. **Resultados:** Cinquenta e um participantes completaram o estudo, com idade média de 46,88 anos ± 11,16. A pontuação total do OHIP-14 diminuiu de 16,98 ± 11,48 para 8,41 ± 9,06. Melhoria da dor física, desconforto psicológico, incapacidade física, deficiência psicológica, incapacidade social e incapacidade. O estágio mais frequente foi o III. Em relação à série, 16 (31,37%) participantes foram diagnosticados com grau A, grau B 16 (31,37 %) e grau C 17 (33,33 %). O índice de placa foi de 61,4 % ± 17,6 antes da primeira etapa e 22,8 % ± 10,6 depois. A dor no último mês diminuiu após o tratamento. Não foram detectadas diferenças na QVRS ao comparar idade, sexo e escolaridade. Os não fumantes relataram melhores escores (p = 0,003). **Conclusão:** O tratamento periodontal tem impacto positivo na autopercepção de qualidade de vida dos pacientes.
Palavras-chave: cuidados de saúde; cuidado dental; indicadores de qualidade de vida; medição dos resultados relatados pelos pacientes; odontologia; percepção; periodontite; qualidade de vida

INTRODUCTION

Periodontal disease, which comprises gingivitis and periodontitis is an infectious disease with inflammatory characteristics, which affects the surrounding and supporting tissues of teeth (i.e., the periodontium) (1). Gingivitis is characterized by gingival bleeding, swollen gums, and sometimes pain, and if left untreated, may progress to periodontitis which involves loss of periodontal attachment and supporting bone that may lead to tooth loss (2). Even though it is a preventable and treatable disease, more than half of the adult population is affected by periodontitis (3). Therefore, it is considered a public health problem. Some of the clinical characteristics of patients with periodontal disease are periodontal pockets and loss of attachment of periodontal tissues. In more advanced stages, the patient may present dental mobility and tooth loss. Signs and symptoms of both gingivitis and periodontitis can compromise the ability of an individual to eat, speak, socialize, and perform various daily activities, adversely affecting quality of life (4-6). Moreover, periodontal disease has been independently associated with cardiovascular disease, diabetes, chronic obstructive pulmonary disease, and obstructive apnea (7), morbidities that affect people's well-being.

In 2017, a new classification system was developed for periodontal and peri-implant diseases and conditions, according to current evidence (8). This consensus provides diagnostic criteria based on a multidimensional staging and grading system. Staging classifies the severity and extent of a patient's disease based on the measurable amount of tissue destroyed or damaged by periodontitis. Furthermore, staging evaluates specific factors that may be attributed to the complexity of long-term case management. The initial stage should be determined using clinical attachment loss. If clinical attachment loss is not available, radiographic bone loss should be used. Additionally, tooth loss due to periodontitis can modify the definition of the stage. One or more complex factors can change the scenario to a higher level (9). Whereas grading indicates the progression rate of periodontitis, the ability to respond to periodontal therapy, and the potential impact on systemic health (9).

After the 2017 Classification of Periodontal and Peri-impact Diseases and Conditions was incorporated, evidenced-based clinical practice guidelines for the treatment of Stage I-III, and Stage IV

periodontitis were developed (10,11). Leading experts under the auspices of the European Federation of Periodontology (EFP), formulated specific recommendations using a pre-established stepwise approach to therapy, depending on periodontal disease stage, including different interventions (10). In addition, these guidelines introduced new terms. To illustrate, the first step of periodontitis therapy is the phase of therapy aimed at guiding and motivating patients to change behavioral practices to undertake successful removal of supragingival dental biofilm and control risk factors associated with periodontitis. The second step, or cause-related therapy, seeks the reduction/elimination of subgingival biofilm and calculus, and in some cases root surface cementum. In this consensus, experts agreed to use the term subgingival instrumentation to refer to all non-surgical periodontal procedures, performed manually, or with the aid of power-driven instruments (10, 12). The third step of periodontal treatment is aimed at treating non-responding areas of the dentition to the second step. For example, if there are still pockets of ≥4 mm with bleeding on probing or the presence of periodontal pockets of ≥6 mm. This step may include repeated subgingival instrumentation in which adjunctive therapies may or may not be included, access flap periodontal surgery and regenerative periodontal surgery. Finally, the fourth step aims to maintain periodontal stability by combining preventive and therapeutic measures through supportive periodontal care (10,11).

Historically, clinical research on periodontal disease has been relied on clinical outcomes, focused primarily on improvements in gingival inflammation, gains in attachment levels, and efficacy of methods (13). Several factors can negatively affect periodontal treatment. Risk factors such as cigarette smoking or chronic diseases, (i.e., metabolic control of diabetes) are recognized to change periodontal response to therapy (9). Nonetheless, these clinical outcomes do not reflect patients' experience of dental treatment. For this reason, patients' opinions and satisfactions are being incorporated to healthcare research (14-16).

It is well known; oral health is an integral part of systemic health and an important factor that influences an individual's quality of life. Oral health-related quality of life (OHRQoL) reflects a persons' self-perception of how oral diseases and conditions impacts their overall day to day life (17,18). OHRQoL captures consequences of good or poor oral health, and aids clinicians and public health actors in identifying patients' concerns, expectations and satisfaction with dental care received (19). The use of this multidimensional construct along with clinical assessments, reflects a change in the conventional approach of treating patients in the dental clinic. OHRQoL indicators determine not only health status, but its impact in emotional, social, and phycological aspects (20,21).

In the dental field, one of the most used indicators of OHRQoL is the self-administered questionnaire, Oral Health Impact Profile (OHIP-49) and its shortened version, OHIP-14. Both versions provide insights into how oral health problems influence an individual's life. The OHIP-14 has been validated and translated into many languages, including Spanish, allowing its scores to be compared among different populations. It is possible to relate OHIP-14 scores to clinical parameters or sociodemographic characteristics. Durham *et al.* used the OHIP-49 questionnaire and reported that individuals suffering from chronic periodontitis have significantly lower OHRQoL compared to periodontally healthy individuals (22). Paśnik-Chwalik and Konopka reported in a recent systematic review and meta-analysis, significant influence of periodontitis on the deterioration of OHIP-14 values, and this relationship was shown to be proportional to the degree of advancement and extent of periodontal tissue damage (23). Recently, different authors have reported that patients with increased severity of periodontitis exhibit impairments of overall OHRQoL (24-27).

Several studies have intended to establish that periodontal therapy has a positive impact in OHRQoL (28-30). Two robust reviews concluded that non-surgical procedures may have the potential to improve compliance with maintenance, positive attitudes, and oral hygiene by the patient (31,32). In this line, a

third systematic review concluded that non-surgical treatment greatly improved OHRQoL within a short time, remaining stable after three months of therapy (33). However, these reviews included only a few studies from Brazil that met the inclusion criteria. Thus, there is lack of assessment on how periodontal treatment impacts OHRQoL in Costa Rica, and other Latin American countries. Therefore, the objectives of this study were to 1) determine OHRQoL before the first step and after the second step of periodontitis therapy and 2) compare sociodemographic and clinical characteristics with changes in OHRQoL. Specifically, to answer if OHRQoL improved after therapy and if there were associations between sociodemographic and clinical characteristics of the studied population and enhancement in OHRQoL.

The rationale of this investigation lies in raising awareness of the importance of periodontal care and recognizing that restoring the health of the tooth-supporting tissues has an impact on the well-being and life of our patients. Furthermore, studies evaluating the periodontal state of Costa Ricans are scarce with no studies regarding OHRQoL, before and after periodontal therapy. Assessing indicators of quality of life in relation to oral health would help improve the quality of care and enhance a shared decision-making process in the clinical setting.

MATERIALS AND METHODS

Population of Study

The present observational study has a before-after (pre-post) design. It was conducted between the months of February to September 2022 at the Clinic of Periodontics of the Faculty of Dentistry of the University of Costa Rica. Patients with periodontitis who had never had subgingival plaque instrumentation, were recruited to determine if participants perceived a change in OHRQoL before the first step of periodontitis therapy and one month after the second step of therapy. A written informed consent for participation was obtained from all individuals prior to the initiation of the study. The Scientific Ethics Committee of the University of Costa Rica (CEC- 341- 2021) approved the present study.

The sample size to ensure adequate power for this study was based on a previous publication (34), considering the mean for group before and after treatment as 41.08 and 27.68 and standard deviation as 6.80 and 6.93, respectively, with a true difference of 1. Based on the above values and using a formula to estimate the sample size of two means, for α = 0.05 and a power of 80 %, a total sample of 50 participants was calculated.

To be eligible to participate subjects had to be over 18 years old, diagnosed with gingivitis or periodontitis with at least twenty teeth, with no cognitive impairments, and able to complete the questionnaire independently. Exclusion criteria included: use of illicit drugs, malignant diseases, taking sedatives, anxiolytics, or analgesics, pregnancy, or lactation, an acute dental or periodontal condition, and patients who had in the past subgingival plaque instrumentation.

Data Collection and Questionnaire

The following information was obtained from the electronic dental health record, before the first step of periodontitis therapy: periodontal diagnosis and the plaque index (PI) according to the Modified O'Leary Index. As well, at the initial visit of the participant, before initiation of the first step of treatment, participants were asked to complete a survey that consisted of: 1) demographic data: age, gender, and educational level (completion of elementary school, completion of high school, university studies, or other), 2) past and current smoking status (current smokers were asked the number of cigarettes

consumed per day), 3) current dental pain and dental pain in the last month, and 4) OHIP-14 questions. After completion of the second step of periodontitis treatment, participants were asked to complete a survey about 1) dental pain and 2) OHIP-14 questions.

Participants rated their average intensity of dental pain on a scale of 0 to 10, using a numeric rating scale (NRS), where 0 represented "no pain", 5 moderate pain, and 10 represented "the worst pain possible". The subject was asked to indicate current pain and the maximal pain in the last month on the NRS.

Oral Health Impact Profile 14 (OHIP-14)

The OHIP-14 Spanish version questionnaire was used (35,36). OHIP-14 consists of 14 questions that measures seven conceptual domains of quality of life: functional limitation (such as difficulty in chewing, trouble in pronouncing words), physical pain (pain in mouth and discomfort in eating foods), psychological distress or self-awareness (discomfort or feeling self-conscious and tense), physical disability (interrupted meals and unsatisfactory diet), psychological disability (difficulty in relaxing or embarrassment), social disability (irritable with other people, difficulty performing usual jobs) and disability or handicap (not being able to function or work productively because of oral health diseases or conditions). Respondents self-completed questions on a 5-point Likert scale. Options for which a score was assigned were 0 = never, 1 = almost never, 2 = occasionally, 3 = frequently, 4 = always. Each domain is made up of two questions and a value ranging from 0 to 8 is obtained per dimension. The total score of the OHIP-14 was obtained by adding the values of the seven domains. Scores were calculated between 0-56 (37). Lower scores indicated a positive self-perception and high scores a negative self-perception. For each of the questions that were asked in the OHIP-14, participants were asked the frequency of the impact in the last six months.

Statistical Analysis

R studio software version 4.0.3. was used for data analysis. Continuous variables are presented as means and standard deviations, and categorical variables are presented as frequencies and percentages. Normality was determined using a Quantile Plot and Shapiro-Wilk test.

To measure the internal consistency of the OHIP-14, the Cronbach's Alpha coefficient was used. The change in OHIP-14 after the second step of periodontal therapy was determined by subtracting the OHIP-14 scores at follow-up from baseline. To analyze the hypothesis that there were differences before and after the treatment for the quantitative variables, the Wilcoxon rank test was used. For binary variables, a sign test was used. Significance level was set at 5 % (0.05). Cohen's D test was used to measure effect size. The effect size was calculated by dividing the mean change score by the standard deviation of the baseline score. An effect size of < 0.2 indicated a small but clinically significant magnitude of change, 0.3–0.7 a moderate change, and > 0.7 a large change (38).

The F-test was used to compare variance between sociodemographic variables and changes in OHRQoL before and after treatment. Significance was established at a level of 5 % (0.05).

RESULTS

Sociodemographic Characteristics

This study comprised fifty-one adults, 19 (37.3 %) men and 32 (62.7 %) women. Mean age of the participants was 46.88 ± 11.16 years. Seven participants, 13.7%, were classified as having a young age, forty-one participants, 80.4 %, were middle-aged at the time of the survey, and three individuals, 5.9 %

of the studied population, were elderly. Concerning completion of educational level, 12 people completed primary studies (23.5 %), 19 completed high school (37.3 %), 18 university studies (35.3 %), and 2 (3.9 %) referred having completed another degree (3.9 %), for example technical studies (Table 1).

Smoking Status

Only 5 people (9.8 %) revealed being current smokers, and 46 individuals (90.2 %) referred being non-smokers. Of non-smokers, 4 persons (7.8 %) were former smokers. Current smokers reported smoking an average of 10.2 ± 8.96 cigarettes per day (Table 1).

Dental Pain

Reported current pain before the first step of periodontitis therapy was 1.73 ± 2.81, and after the second step of therapy, 1.29 ± 2.64 (p= 0.388). About the maximal dental pain in the last month, patients indicated pain reduced from 3.41 ± 3.01 to 1.61 ± 2.86 (p= 0.002) after one month of concluding the second step of therapy (Table 1).

TABLE 1
Sociodemographic variables, smoking status, and pain scores of the studied population

Parameter	**Variable**	**n(%)**		
Gender	Male	19 (37.3)		
	Female	32 (62.7)		
Age (years)	18-34 (young)	7 (13.7)		
	35-64(middle-aged)	41 (80.4)		
	≥65 (elderly)	3 (5.9)		
	Mean ± SD	46.88 ± 11.16		
Level of education completed	Primary	12 (23.5)		
	High-school	19 (37.3)		
	University	18 (35.3)		
	Other	2 (3.9)		
Smoking status	Yes	5 (9.8)		
	No	46 (90.2)		
Former smoker	Yes	4(7.8)		
	No	47(92.2)		
Parameter	**Variable**	**Mean**	**Standard Deviation**	***P* value****
*Number of cigarettes per day		10.2	8.96	
Current dental pain	Before	1.73	2.81	0.388
	After	1.29	2.64	
Dental pain in the last month	Before	3.41	3.01	**0.002**
	After	1.61	2.86	

n: number
%: percentage
SD, standard deviation
*The variable "number of cigarettes per day" only considered current smokers.
**Sign test
P value in bold denotes statistical significance ($P < 0.05$)

Periodontal Diagnosis

Periodontal diagnosis by gender is shown in Tables 2 and 3. In relation to staging, most of the participants were diagnosed with stage III, 31(60.8 %) patients, with stage II, 13 (25.5 %) patients, with stage I, 1 (2.0 %) patient and 2 (3.9 %) participants were diagnosed with gingivitis. Regarding grading, Grade A was diagnosed in 16 (31.37 %) participants, Grade B as well in 16 (31.37 %) individuals, and Grade C in 17 (33.33 %) people. Mean PI before step one of periodontitis therapy was 61.4 % ± 17.6 and 22.8 % ± 10.6 after completion of the second step of periodontal therapy (data not shown on the tables presented).

TABLE 2
Periodontal diagnosis of the studied population by gender (including staging and grading)

Diagnosis	**n (%)**	**Gender**	
		Male n (%)	**Female n (%)**
Gingivitis	2(3.9)	1(5.3)	1(3.1)
*Stage I Grade A	2(3.9)	0(0.0)	2(6.2)
*Stage II Grade A	5(9.8)	2(10.5)	3(9.4)
*Stage II Grade B	1(2.0)	1(5.3)	0(0.0)
*Stage III Grade B	11(21.6)	4(21.1)	7(21.9)
*Stage III Grade C	14(27.5)	5(26.3)	9(28.1)
**Stage II Grade A	1(2.0)	1(5.3)	0(0.0)
**Stage II Grade B	1(2.0)	0(0.0)	1(3.1)
**Stage III Grade A	3(5.9)	0(0.0)	3(9.4)
**Stage III Grade B	1(2.0)	0(0.0)	1(3.1)
**Stage III Grado C	1(2.0)	1(5.3)	0(0.0)
**Stage IV Grade A	5(9.8)	3(15.8)	2(6.2)
**Stage IV Grade B	2(3.9)	0(0.0)	2(6.2)
**Stage IV Grade C	2(3.9)	1(5.3)	1(3.1)

n: number
%: percentage
Gingivitis: Dental plaque biofilm-induced gingivitis
*Localized (clinical attachment loss/bone loss affects less than 30% of the teeth)
**Generalized (clinical attachment loss/bone loss affects more than 30% of the teeth)

TABLE 3
Periodontal diagnosis by gender

Diagnosis	**n (%)**	**Gender**	
		Male n (%)	**Female n (%)**
Gingivitis	2(3.9)	1(2.0)	1(2.0)
Stage I	1(2.0)	0(0.0)	1(2.0)
Stage II	13(25.5)	6(11.8)	7(13.7)
Stage III	31(60.8)	12(23.5)	19(37.3)
Stage IV	4(7.8)	0(0.0)	4(7.8)

n: number
%: percentage
Gingivitis: Dental plaque biofilm-induced gingivitis

OHRQoL Scores

The reliability coefficient, Cronbach's alpha, of the OHIP-14 was 0.90 before the first step of periodontitis therapy and 0.89 after the second step of therapy, suggesting that the items have a relatively high internal consistency, above the recommended 0.7 threshold. Mean OHIP-14 global score and domain scores are presented in Table 4. OHIP-14 global score was lower post-treatment ($p< 0.001$; $d= 0.83$). All OHIP-14 domain scores, excluding functional limitation, were improved post-treatment: physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap (all $Ps< 0.008$; $d = 0.51$, 1.02, 0.44, 0.91, 0.40, and 0.62 respectively).

TABLE 4
Mean OHIP-14 global and domain scores before the first step and after second step of periodontitis therapy

OHIP-14	Periodontal therapy	Mean	SD	Effect size*	*P* value**
OHIP-14 Global score	Before After	16.98 8.41	11.48 9.06	**0.83**	**<0.001**
Functional limitation (OHIP-1 + 2)	Before After	1.16 0.82	1.64 1.37		0.098
Physical pain (OHIP-3 + 4)	Before After	3.16 1.98	2.25 2.37	**0.51**	**0.001**
Psychological discomfort (OHIP-5 + 6)	Before After	4.69 2.16	2.59 2.38	**1.02**	**<0.001**
Physical disability (OHIP-7 + 8)	Before After	2.04 1.12	2.24 1.94	**0.44**	**0.002**
Psychological disability (OHIP-9 + 10)	Before After	3.18 1.33	2.27 1.75	**0.91**	**<0.001**
Social disability (OHIP-11 + 12)	Before After	0.88 0.35	1.60 0.96	**0.40**	**0.008**
Handicap (OHIP-13 + 14)	Before After	1.88 0.65	2.52 1.21	**0.62**	**<0.001**

OHIP-14, Oral Health Impact Profile-14
SD, standard deviation
* An effect size of < 0.2 indicates a small but clinically significant magnitude of change, 0.3–0.7 a moderate change, and > 0.7 a large change.
**Wilcoxon test. *P* values in bold denote statistical significance ($P < 0.05$)

Table 5 and Table 6 show changes in OHRQoL before the first step and after the second step of periodontitis therapy according to sociodemographic variables of the studied population. There were no differences in reported changes when comparing age categories ($p= 0.288$), gender ($p= 0.306$), and educational level ($p= 0.851$). Differences were detected for smoking status. Higher scores were reported from smokers, before and after therapy, for total and domain scores ($p= 0.003$).

TABLE 5

Sociodemographic variables of the studied population and changes in OHIP-14 domain scores and total score before the first step and after the second step of periodontitis therapy

Periodontitis therapy	Functional limitation (OHIP-1 + 2)		Physical pain (OHIP-3 + 4)		Psychological discomfort (OHIP-5 + 6)		Physical disability (OHIP-7 + 8)	
	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)
Age (years)								
18-34 (young)	1.4 (1.6)	0.9 (1.6)	3.1 (1.1)	1.9 (1.8)	3.9 (2.1)	3.0 (2.8)	1.4 (1.4)	0.7 (1.0)
35-64 (middle-aged)	1.0 (1.6)	0.9 (1.4)	3.1 (2.5)	2.0 (2.5)	4.8 (2.6)	2.1 (2.4)	2.2 (2.4)	1.1 (2.1)
≥65 (elderly)	2.0 (2.0)	0.0 (0.0)	3.3 (1.2)	2.0 (2.0)	4.7 (4.2)	0.7 (1.2)	1.0 (1.7)	1.7 (2.1)
Gender								
Male	1.1 (1.4)	0.9 (1.4)	2.7 (2.2)	2.0 (2.4)	3.9 (2.8)	2.3 (2.7)	1.5 (2.0)	0.6 (1.2)
Female	1.2 (1.8)	0.8 (1.3)	3.4 (2.3)	2.0 (2.4)	5.2 (2.4)	2.1 (2.2)	2.3 (2.4)	1.4 (2.2)
Educational level								
Primary	1.9 (2.4)	1.4 (1.8)	2.9 (2.4)	2.2 (2.1)	5.4 (2.8)	2.7 (2.9)	3.3 (2.7)	1.9 (2.3)
Secondary	0.9 (1.4)	0.7 (1.2)	3.6 (2.5)	2.5 (2.6)	4.7 (2.8)	2.3 (1.7)	2.2 (2.2)	1.4 (2.2)
University	0.9 (1.2)	0.7 (1.2)	2.9 (2.0)	1.5 (2.3)	4.2 (2.2)	1.9 (2.7)	1.1 (1.5)	0.4 (1.1)
Other	0.5 (0.7)	0.0 (0.0)	2.5 (2.1)	0.0 (0.0)	5.0 (4.2)	0.0 (0.0)	1.0 (1.4)	0.0 (0.0)
Smoking status								
Yes	1.8 (2.5)	1.8 (1.8)	5.2 (1.8)	4.2 (2.9)	6.0 (2.0)	5.6 (2.2)	2.6 (3.0)	3.4 (3.1)
No	1.1 (1.5)	0.7 (1.3)	2.9 (2.2)	1.7 (2.2)	4.5 (2.6)	1.8 (2.1)	2.0 (2.2)	0.9 (1.6)

OHIP-14, Oral Health Impact Profile-14. SD, standard deviation

TABLE 6

Sociodemographic variables of the studied population and changes in OHIP-14 domain scores and total score before the first step and after the second step of periodontitis therapy

Periodontitis therapy	Psychological disability (OHIP-9 + 10)		Social disability (OHIP-11 + 12)		Handicap (OHIP-13 + 14)		OHIP-14 Global score		P*
	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)	Before Mean (SD)	After Mean (SD)	
Age (years)									
18-34 (young)	2.3 (1.9)	1.6 (1.4)	1.1 (1.5)	1.1 (1.5)	1.0 (1.3)	1.1 (1.1)	14.3 (7.5)	10.3 (8.0)	0.288
35-64 (middle-aged)	3.4 (2.3)	1.4 (1.8)	0.9 (1.7)	0.2 (0.8)	1.9 (2.6)	0.6 (1.3)	17.4 (12.0)	8.4 (9.5)	
≥65 (elderly)	2.3 (2.5)	0.0 (0.0)	0.3 (0.6)	0.0 (0.0)	4.0 (3.5)	0.3 (0.6)	17.7 (14.0)	4.7 (4.2)	
Gender									
Male	2.7 (2.2)	1.1 (1.6)	0.9 (1.8)	0.3 (0.9)	1.6 (2.2)	0.5 (0.9)	14.5 (11.5)	7.6 (8.0)	0.306
Female	3.5 (2.3)	1.5 (1.8)	0.9 (1.5)	0.4 (1.0)	2.0 (2.7)	0.7 (1.4)	18.5 (11.4)	8.9 (9.7)	
Educational level									
Primary	4.3 (2.1)	2.0 (2.3)	1.7 (2.3)	1.2 (1.7)	3.2 (3.2)	1.2 (2.0)	22.8 (14.7)	12.8(12.0)	0.851
Secondary	3.2 (2.5)	1.7 (1.6)	1.0 (1.6)	0.2 (0.4)	2.1 (2.4)	0.7 (0.9)	17.7 (11.0)	9.4 (7.4)	
University	2.5 (1.9)	0.6 (1.3)	0.2 (0.6)	0.0 (0.0)	1.0 (2.0)	0.2 (0.6)	12.9 (8.3)	5.4 (7.6)	
Other	2.0 (1.4)	0.0 (0.0)	1.0 (1.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	12.0 (9.9)	0.0 (0.0)	
Smoking status									
Yes	4.0 (1.9)	3.0 (1.4)	1.2 (1.3)	1.0 (1.4)	3.4 (3.8)	1.6 (1.7)	24.2 (14.0)	20.6 (8.9)	**0.003**
No	3.1 (2.3)	1.2 (1.7)	0.8 (1.6)	0.3 (0.9)	1.7 (2.3)	0.5 (1.1)	16.2 (11.1)	7.1 (8.1)	

OHIP-14, Oral Health Impact Profile-14. SD, standard deviation. *F-test, a *P* value ≤ 0.05 denotes statistical significance

Table 7 indicates changes in OHIP-14 total and domain scores according to the diagnosis of the studied population. It can be appreciated that Stage III had a significant change in all OHRQoL values, however, this data must be interpreted with caution, since 31 (60.8 %) patients were classified as having this stage.

TABLE 7
Diagnosis of the studied population and changes in OHIP-14 domain and global score

Domain		**Diagnosis**				
		Gingivitis Mean (SD)	**Stage I Mean (SD)**	**Stage II Mean (SD)**	**Stage III Mean (SD)**	**Stage IV Mean (SD)**
Functional Limitation	Before	0.0 (0.0)	1.0 (NA)	1.5 (1.9)	1.0 (1.5)	2.2 (2.1)
(OHIP-1 + 2)	After	0.0 (0.0)	0.0 (NA)	1.2 (1.5)	0.7 (1.3)	1.5 (1.9)
Physical pain	Before	1.5 (2.1)	1.0 (NA)	2.9 (1.3)	3.2 (2.5)	5.0 (2.6)
(OHIP-3 + 4)	After	0.0 (0.0)	0.0 (NA)	1.5 (1.8)	2.2 (2.5)	3.5 (3.4)
Psychological discomfort	Before	4.0 (0.0)	2.0 (NA)	4.2 (2.5)	4.9 (2.8)	6.0 (0.0)
(OHIP-5 + 6)	After	0.0 (0.0)	0.0 (NA)	2.8 (2.7)	2.2 (2.3)	1.5 (1.9)
Physical disability	Before	0.0 (0.0)	0.0 (NA)	2.0 (2.2)	2.2 (2.4)	2.8 (1.0)
(OHIP-7 + 8)	After	0.0 (0.0)	0.0 (NA)	1.5 (2.1)	0.7 (1.4)	4.0 (3.3)
Psychological disability	Before	4.0 (1.4)	1.0 (NA)	2.9 (2.6)	3.1 (2.3)	4.8 (1.3)
(OHIP-9 + 10)	After	0.0 (0.0)	0.0 (NA)	1.8 (2.1)	1.4 (1.7)	0.5 (1.0)
Social disability	Before	0.0 (0.0)	0.0 (NA)	0.8 (1.2)	0.9 (1.8)	1.5 (1.3)
(OHIP-11 + 12)	After	0.0 (0.0)	0.0 (NA)	0.7 (1.3)	0.3 (0.9)	0.0 (0.0)
Handicap	Before	0.0 (0.0)	0.0 (NA)	1.8 (2.6)	1.8 (2.5)	4.0 (2.3)
(OHIP-13 + 14)	After	0.0 (0.0)	0.0 (NA)	1.2 (1.7)	0.5 (1.0)	0.5 (1.0)
OHIP-14	Before	9.5 (3.5)	5.0 (NA)	16.0 (11.1)	17.1 (12.1)	26.2 (5.1)
Global score	After	0.0 (0.0)	0.0 (NA)	10.7 (11.0)	7.9 (8.1)	11.5 (11.2)
P value*		0.500	1.000	0.100	**<0.001**	0.198

OHIP-14, Oral Health Impact Profile-14
Gingivitis: Dental plaque biofilm-induced gingivitis
SD, standard deviation
NA: Standard deviation could not be determined since there is no variance in the studied population
* Wilcoxon test. *P* values in bold denote statistical significance ($P < 0.05$)

DISCUSSION

The outcomes of periodontal disease and treatment are generally reported in terms of clinical parameters such as bleeding on probing, probing depth, clinical attachment level, plaque index, or bone level. Current research highlights the importance of considering patient's subjective perception of their oral health, since periodontal disease may compromise functional aspects of the stomatognathic system such as mastication, swallowing, speak, smile esthetics, and consequently self-esteem (39). We observed a decreasing trend in the mean OHIP-14 total score from 16.98 ± 11.48 at baseline to 8.41 ± 9.06 after non-surgical treatment towards the end of the study. Enhanced improvements in subdomains of physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap accounted for the changes. These results are in accordance with previous findings reporting proper periodontal treatment and maintenance yielded significant improvement in patients' perceived quality of life (29, 30, 40-43).

Concerning sociodemographic data, most of the participants that concluded the study were women. We did not find associations between gender and OHIP-14 scores before and after treatment as opposed

to other authors that have showed that women perceived oral health as having a greater impact on quality of life when compared to men (40,44). Nonetheless, the association with gender in non-conclusive. For instance, Graetz *et al.*, found no statistically significant association between gender and OHIP-14 in a study reporting OHRQoL impacts after 27 years of periodontal care (43).

We assessed education level since higher educational attainment is associated with a lower risk of periodontitis (46,47), and better OHIP-14 scores (48). In our study, most of the studied population had a lower educational level. However, we did not find associations between educational level and changes in OHIP-14 scores. Participants from all educational levels benefited from periodontal care.

We found an association with better positive self- perceptions of OHRQoL before and after periodontal therapy in non-smokers compared to smokers. This is in accordance with other reports that have stated that smokers report poorer OHRQoL (49-51). Most of the participants reported being non-smokers. Costa Rica has a General Law on Tobacco Control and its Harmful Effects on Health. This law regulates smoking and vaping in public areas. These activities are not allowed in shared areas, and fines exist for offenders. What is more, with massive antismoking campaigns in Costa Rica, the prevalence and consumption of tobacco cigarettes has decreased over the last years (52).

Gingivitis and periodontitis are usually painless, but it some cases may cause mild, episodic pain due to acute infectious such as gingival and periodontal abscesses (53). An exclusion criterion of this study was having acute dental or periodontal conditions. This may be a reason participants did not have a statistical change pre and post treatment when asked about current pain. It is worth mentioning that when the second questionnaire was applied, some patients reported experiencing a slight discomfort around their teeth and tooth sensitivity for several days after subgingival plaque scaling. Therefore, statistically significant reductions in the variable pain in the last month might been related to tooth sensitivity and not periodontitis.

The clinical magnitude of treatment provided is reflected by effect sizes (54). By way of explanation, a meaningful change in the reported outcome measure that would be clinically relevant (55). The effect size in OHRQoL global score in the current study was large, $d = 0.83$, the same as the one reported in a study by Saito *et al.*, $d = 0.8$, (24) which brings more evidence that periodontal health is an important aspect in OHRQoL. We also found a large effect in psychological discomfort described as “having felt tense, being self-conscious”. Psychological discomfort is manifested as being unhappy with the appearance of teeth.

Also, a large effect size was detected in the domain psychological disability described as “having to interrupt meals, diet has been unsatisfactory”. Several investigations have reported these domains to be the most affected at baseline in patients with periodontitis (25-27,56,57). Similarly, after non-surgical periodontal therapy, the scores for these domains improved significantly (28, 40,57). This indicates that the most important periodontal-related problems perceived by patients are embarrassment, stress, and difficulty relaxing (22). Periodontal disease may even affect interpersonal relations or enjoying everyday activities.

In our study, functional limitation had a small effect after non-surgical periodontal therapy. This may be related to the fact that inclusion criteria specified that patients enrolled in this study had to have at least 20 teeth. The domain functional limitation translates to loss of teeth functionality, difficulty to chew, and severe tooth loss that may be caused by periodontitis. A recent study by Moya-Villaescusa *et al.* in a Spanish clinical setting, found that before and after periodontal treatment, “functional limitation” occupied the third place, as the most affected dimensions of OHIP-14 (58). These authors express functional limitations may lead to poor chewing and consequently digestive discomfort if the patient does not recur to prosthetic rehabilitation (58).

The patients included in this study were treated following the recommendations of the European Federation of Periodontology (EFP) S3 treatment guide: patient motivation, oral hygiene instructions, supragingival plaque removal and subgingival plaque instrumentation (steps 1 and 2 of the guideline) (10). Nonetheless, our study has several limitations that need to be discussed. The data obtained in this study represents a small sample of the population of patients treated at the Faculty of Dentistry of the University of Costa Rica. Applying the questionnaire to a larger sample of patients could result in more meaningful results. It would be interesting to conduct a similar investigation in the different dental clinics of our school, to evaluate OHRQOL before and after different treatment necessities and modalities. Additionally, we applied the second questionnaire in a short follow-up period of the patients, which was only one month after finalizing the second step of periodontal therapy. Every so often, the healing time of supporting tissues of teeth take periods of 6 to 8 weeks. This is the time when noticeable changes are detected when measuring clinical outcomes in advanced stages of periodontitis.

This study adds pertinent data to the limited literature examining the effect of periodontal treatment on OHRQoL in Latin American countries. It is well known that periodontal treatment has a positive effect on patient's periodontal state, yet there are few studies in our region, showing improvements in OHRQoL after the different sequences of periodontal therapy. The results of our investigation demonstrated substantial differences between pre- and post- periodontal treatment measures on OHRQoL. No differences in OHRQoL changes were detected when comparing sociodemographic characteristics: age categories, gender, and educational level. Of relevance, better scores were reported from non-smokers, before and after therapy. A strength of this study includes a pre-post interventional study design of temporality that suggests that periodontal patients' OHRQoL is impacted after the second step of therapy. Also, we used standardized and internationally validated questionnaires, the OHIP-14 and the NRS. Another strength and novelty are we assessed periodontal diagnosis according to the current classification of periodontal disease. The present investigation addressed confounding factors such as demographics, smoking habits, and pain scores.

CONCLUSIONS

A better understanding of the sequels of periodontitis and the effects of periodontal care are of pivotal importance to be cognizant of patient's perceptions of the impact of oral health on their lives. Periodontal therapy should address patient's needs, concerns, and patient's perspectives in evaluating outcomes. The findings of the present study demonstrated improvements in OHRQoL in patients treated for periodontal disease, shortly after completion of the second step of therapy. Our results endorse the notion that periodontal status influences patient's social, physical, and psychological functioning.

A comprehensive periodontal evaluation jointly with a validated OHRQoL questionnaire is recommended. Clinicians should be acquainted of the influence of periodontal disease on a person's daily activities and have present that periodontitis may compromise mastication, speech, social interactions, psychological well-being, and life satisfaction. Dental professionals should draw attention on patient's physical and psychological perceptions, to personalize the treatment plan and achieve patient adherence and motivation.

RECOMMENDATIONS

Different survey tools to elucidate OHRQoL exist. Thus, for periodontal research purposes, there is a need to utilize a globally accepted specific questionnaire to elucidate OHRQoL assessment considering

signs and symptoms of periodontal disease. Future investigations in the Latin American region, should be multi centric, with a longitudinal design, which collect both clinical and patient-reported outcomes. These investigations are needed in world-wide populations to gather more information on patient's comfort, function, and positive sense of welfare after the distinct steps of periodontal therapy.

Specifically with this project, another interesting line of research would be to follow-up at 6-months and 12-months perceptions of OHIP-14 with respect to the baseline and reevaluation appointment scores.

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