Evaluation of the gingival condition and stress level of soldiers from the Brazilian Navy's Marine Corps during field training

Avaliação da condição gengival e nível de estresse de militares do Corpo de Fuzileiros Navais da Marinha do Brasil durante treinamento de campo

Evaluación de la condición gingival y nivel de estrés de soldados del Cuerpo de Infantería de Marina de la Marina de Brasil durante el entrenamiento de campo

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Abstract
The aim of this study was to evaluate the gingival condition and stress level of the military during field training. Thirty militaries were clinically evaluated at two times (1st and 10th - last day of the mission), by probing pocket depth (PPD), visible plaque index (VPI), and gingival bleeding index (GBI). After the clinical evaluation, the soldiers answered a stress questionnaire in both moments. The difference between the 1st and last day of the mission was verified by the Friedman and Wilcoxon tests and the correlation between stress x GBI and stress x VPI by the Spearman test (p<0.05). There was higher PPD (0.98mm), VPI (8.0%) and GBI (13.5%) on the last day of the mission, when compared to the first (PPD = 0.92mm; VPI= 5.2% and GBI = 10.2%), with significant statistical difference. Regarding the regions (anterior and posterior teeth), a higher VPI was observed in anterior (11.7%) than in posterior teeth (1.1%) on the first day (p=0.013); and in posterior teeth, between the first (1.1%) and last day (5.5%) (p=0.005). In the GBI, there was a difference for posterior teeth between the first (10.3%) and last day (14.9%) (p=0.004). One patient (3.3%) had initial symptoms of stress and,3 patients (10%) in the last day (p>0.05). There was no correlation between stress and gingival conditions. The military demonstrated a higher incidence of VPI and GBI at the end of the mission, especially in the posterior teeth. However, the stress was similar at the beginning and end of the mission.
Keywords: Armed forces; Gingival diseases; Stress; Health teaching.

Resumo
O objetivo deste estudo foi avaliar a condição gengival e o nível de estresse de militares durante o treinamento de campo. Trinta militares foram avaliados clinicamente em dois momentos (1º e 10º - último dia da missão), por sondagem de profundidade de bolsa (PPD), índice de placa visível (VPI) e índice de sangramento gengival (GBI). Após a avaliação clínica, os militares responderam a um questionário de estresse em ambos os momentos. A diferença entre o 1º e o último dia de missão foi verificada pelos testes de Friedman e Wilcoxon e a correlação entre estresse x GBI e estresse x VPI pelo teste de Spearman (p<0,05). Houve maior PPD (0,98mm), VPI (8,0%) e GBI (13,5%) no último dia da missão, quando comparado ao primeiro (PPD = 0,92mm; VPI= 5,2% e GBI = 10,2%) com diferença significativa. Em relação às regiões, observou-se maior VPI nos dentes anteriores (11,7%) do que nos posteriores (1,1%) no primeiro dia (p=0,013); e nos dentes posteriores, entre o primeiro (1,1%) e o último dia (5,5%) (p=0,005). No GBI, houve diferença para os dentes posteriores entre o primeiro (10,3%) e o último dia (14,9%) (p=0,004). Um paciente (3,3%) apresentou sintomas iniciais de estresse e 3 pacientes (10%) no último dia (p>0,05). Não houve

correlação entre estresse e condições gengivais. Os militares demonstraram maior incidência de VPI e GBI ao final da missão, principalmente nos dentes posteriores. No entanto, o estresse foi semelhante no início e no final da missão.
Palavras-chave: Forças armadas; Doenças gengivais; Estresse; Ensino em saúde.

Resumen
El objetivo de este estudio fue evaluar la condición gingival y el nivel de estrés del personal militar durante el entrenamiento de campo. Treinta soldados fueron evaluados clínicamente en dos momentos (1º y 10º - último día de la misión), por profundidad de sondaje (PPD), índice de placa visible (VPI) e índice de sangrado gingival (GBI). Después de la evaluación clínica, los militares respondieron a un cuestionario de estrés en ambos momentos. La diferencia entre el 1° y el último día de la misión fue verificada por las pruebas de Friedman y Wilcoxon y la correlación entre estrés x GBI y estrés x IPV por la prueba de Spearman (p<0,05). Hubo mayor PPD (0.98mm), VPI (8.0%) y GBI (13.5%) en el último día de la misión, en comparación con el primero (PPD = 0.92mm; VPI= 5.2% y GBI = 10.2%) con una diferencia significativa En cuanto a las regiones, se observó mayor IPV en dientes anteriores (11,7%) que en dientes posteriores (1,1%) el primer día (p=0,013); y en dientes posteriores, entre el primer (1,1%) y el último día (5,5%) (p=0,005). En GBI hubo diferencia para los dientes posteriores entre el primer (10,3%) y el último día (14,9%) (p=0,004). Un paciente (3,3%) presentó síntomas iniciales de estrés y 3 pacientes (10%) el último día (p>0,05). No hubo correlación entre el estrés y las condiciones gingivales. Los militares mostraron una mayor incidencia de IPV y GBI al final de la misión, especialmente en los dientes posteriores. Sin embargo, el estrés fue similar al principio y al final de la misión.
Palabras clave: Fuerzas armadas; Enfermedades de las encías; Estrés; Enseñanza en la salud.

1. Introduction

The Brazilian Navy's Marine Corps periodically conducts intensive training that simulates the conditions seen in combat and natural disasters. Training programs can involve major challenges for the military, such as long-term physical activity, exposure to psychological stress, changes in the biological cycle, sleep deprivation, negative energy balance, in addition to exposure to extreme heat or cold temperatures (Brenner et al., 2000, Yamashita et al., 2017). These challenges can impact the health condition and lead to a deficiency in immunity, compromising the physical and mental performance of the military and even causing an increase in susceptibility to infectious diseases (Glaser 2005, Gomes-Merino et al., 2003, 2005, Hughes et al., 2016, Lundeland et al., 2012, Stone & Bovbjerg 1994). In addition, the operating environment can also make daily oral hygiene difficult (Hashiba et al., 2015).

It is noteworthy that, in field training, changes in behavior such as meals at irregular times, increased frequency of snacks, decreased frequency of tooth brushing, and stress, can limit oral hygiene and influence the periodontal condition of these soldiers (Yamashita et al., 2017). The incidence of severe oral conditions, including necrotizing ulcerative gingivitis, has been reported during rescue activities. Furthermore, studies in different countries have revealed that gingival and periodontal diseases vary from 2.8% to 10% of dental emergencies during implantations and maneuvers (Dunn et al., 2004, Sandoval & Puy 2008).

In a previous study, Yamashita et al., (2017) verified the impact of field training for seven days on the oral health condition of soldiers from the Self-Defense Force of Japan and found that behavioral changes, especially the interruption of regular brushing, promoted plaque maturation and resulted in inflammatory changes in the periodontal condition of the soldiers.

Previous studies have demonstrated the impacts of stressful conditions on the immune system (Hughes et al., 2016, Stone & Bovbjerg 1994). Military training involves intense stress conditions and can promote a decrease in immunoglobulin A (Gomes-Merino et al., 2003), high levels of interleukin-6 (Gomes-Merino et al., 2005) and the presence of toll-like receptors and tumor necrosis factor-α (Lundeland et al., 2012), which indirectly influence tissue destruction as a host response.

The changes in gingival conditions, even as the stress factors during the training period, provide useful information for the development of strategies to maintain satisfactory oral health in the military environment. Considering that field

training can difficult daily oral hygiene and lead to stressful situations in the military, the aim of this study was to evaluate the gingival conditions and the stress level of the military of the Brazilian Navy in field training.

2. Methodology

This research was approved by the Research Ethics Committee (n. 3.460.211). To calculate the sample size, equation 1 was used for finite populations, obtaining a required sample of 26.

n = N Z (c / 100) 2 r (100-r) / ((N-1) E2 + Z (c / 100) 2 r (100-r))

(Equation 1)

On what:

n = sample size

N = population size (180)

Z (c / 100) = critical value for confidence level c (95%)

r = proportion to interest response (2%)

E = desired margin of error (5%)

Thus, 30 military (cables and soldiers), volunteers, male, from the Ilha das Flores Complex (São Gonçalo, Rio de Janeiro, Brazil), scheduled for a mission of the Brazilian Navy - Formosa Operation 2019 (Formosa, Goiás, Brazil), were selected from 180 militaries (N).

Only patients without systemic diseases, periodontal diseases, and non-smokers were included. Initially, a review of the individual dental records of each volunteer was carried out, the anamnesis was remade, and the clinical and radiographic data were updated. Then, the military underwent a supragingival scaling and prophylaxis, one week before the mission, to homogenize the initial sample (Yamashita et al., 2017). The procedures were carried out at the Navy's Expeditionary Medical Unit (São Gonçalo, Rio de Janeiro, Brazil), by the same professional, specialist in Periodontics.

In field training, militaries were evaluated clinically and for stress levels at two different times, on the 1st and the last day of the mission, which characterized the 10th day (Yamashita et al., 2017). The clinical analysis consisted of periodontal assessment (Ainamo & Bay, 1975) and the level of stress was assessed by a questionnaire (Lipp 2000).

Periodontal assessment

The clinical periodontal assessment was performed by one professional, a specialist in Periodontics, calibrated (kappa for PPD, VPI, and GBI were 0.85, 1.00, and 0.83, respectively). For the assessment, a clinical mirror and a Glickman and North Carolina periodontal probe (Golgran Millennium, São Caetano do Sul, SP, Brazil) were used.

Initially, relative isolation was performed, the teeth were dried with air jets and direct lighting was used. Then, the following parameters were evaluated: probing pocket depth (PPD), visible plaque index (VPI), and gingival bleeding index (GBI), respectively (Caton et al., 2018). All data were transcribed to a conventional periogram.

The assessment of PPD consisted of a gentle probing from the gingival margin to the gingival sulcus, with a periodontal probe, parallel to the long axis of the tooth, which was performed on all teeth present, in six sites: buccal (B), palatal (P) or lingual (L), mesiobuccal (MV), mesiopalatine (MP) or mesiolingual (ML), distobuccal (DV) and distopalatine (DP) or distolingual (DL).

The assessment of VPI was performed through visual inspection of all teeth, in four sites (V, L or P, M, and D),

verifying the presence or absence and distribution of the supragingival biofilm in a binomial pattern (0 - absence of visible plaque; 1 - presence of visible plaque).

The assessment of GBI, after gentle probing of the gingival sulcus, was performed in all teeth present, in four sites (V, L or P, M, and D), checking the presence or absence and distribution of bleeding in a pattern binomial (0 – absence of bleeding; 1 - presence of bleeding).

The VPI and GBI indexes were obtained by counting the number of surfaces with the presence of biofilm and bleeding, respectively, divided by the number of surfaces present in all the teeth of the patient, multiplied by 100 (Casarin et al., 2008, Carvajal et al., 2016, Haas et al., 2019, Neves et al., 2010).

Stress level assessment

After the clinical analysis, the Lipp's Stress Symptom Inventory for Adults (LSSI) was applied to measure stress. The instrument allows the diagnosis of stress, determining what stage the person is at and whether stress is more manifested through physical or psychological symptoms in individuals who experience a potentially stressful situation (Lipp 2000). Its application consists of multiple-choice responses to lists of symptoms grouped in tables relating to the different phases of stress, according to the theorization followed by the author (alert, resistance, near-exhaustion, and exhaustion). The LSSI is composed of three frames (Q) that refer to the four phases of stress, temporally divided into symptoms of the last 24 hours (Q1 – 15 symptoms of the alert phase); last week (Q2 – 15 symptoms of the resistance and near-exhaustion phase) and last month (Q3 – 23 symptoms of the exhaustion phase).

In LSSI, the positive diagnosis is given from the sum of the symptoms of each frame in the inventory, and when exceeding the threshold number in a specific phase (Q1 > 6 warning symptoms; Q2 > 3 resistance symptoms or > 9 symptoms of resistance near-exhaustion; Q3 > 8 symptoms of exhaustion), will indicate that the person has stress, the specific phase and the predominant symptomatology (Santos & Junior 2007).

The present study evaluated the presence of stress in the last 24 hours (Q1) and last week (Q2), at two different times (1st and 10th day of mission), given that the training time in the operating environment was not greater than 30 days (Barros et al., 2018, Rosseti et al., 2008).

Statistical analysis

Data were tabulated in Excel and statistical analyses were performed using IBM SPSS 22 software (IBM Corporation, Armonk-NY, United States). The Shapiro-Wilk test was performed to verify the normality of the data and the non-normality of the sample was observed, indicating the use of non-parametric tests.

The Friedman and Wilcoxon tests were used to analyze the differences between the moments (1st and 10th day of mission) and the Mann-Whitney test was used to assess differences between groups (anterior and posterior teeth). Spearman's correlation test was used to assess the relationship between stress x VPI and stress x GBI. For all analyses, a significance level of 5% (p<0.05) was considered.

3. Results

Of the 30-military included, 20 were cables (66.7%) and 10 soldiers (33.3%), with a mean age of 25.7 years (± 3.3, standard deviation, SD).

Table 1. shows the PPD, VPI, and GBI values on the 1st and last day of the mission. It was found that there was greater probing depth (0.98mm), incidence of visible plaque (8.0%) (P = 0.005) and increased bleeding (13.5%) (P = 0.006) on

the last day of the mission, when compared to the first day (PPD = 0.92mm; VPI = 5.2% and GBI = 10.2%), with a statistically significant difference.

Table 1. Values (mean ± SD) of periodontal clinical parameters evaluated on the first and last day of the mission.

	Field training	
	First day	**Last day**
PPD (mm)	0.92 (± 0.5)a	0.98 (± 0.5)b
VPI (%)	5.2 (± 9.4)a	8.0 (± 11.6)b
GBI (%)	10.2 (± 10.6)a	13.6 (± 15.0)b

Note: probing pocket depth (PPD), visible plaque index (VPI), and gingival bleeding index (GBI).
Note[1]: Different letters in the line indicate statistically significant values (Wilcoxon test, $p<0.05$)
Source: Authors.

When the region with visible plaque was evaluated, there was a significant difference in two comparisons: between anterior (11.7%) and posterior teeth (1.1%) on the first day of the mission (Mann-Whiney test, $p=0.013$); and posterior teeth, between the first (1.1%) and last day of the mission (5.5%) (Wilcoxon test, $p=0.005$).

When evaluating the region (anterior and posterior teeth) that presented gingival bleeding (GBI), a significant difference was observed for posterior teeth between the first (10.3%) and last day of the mission (14.9%) (Wilcoxon test, $p=0.004$) (Table 2).

Table 2. Mean and standard deviation (SD)for the incidence of visible plaque and gingival bleeding, in anterior and posterior teeth, on the first and last day of the mission.

		Visible plaque (PPD)		Gingival bleeding (GBI)	
		Mean	**SD**	**Mean**	**SD**
Anterior teeth	First day	11.7%Ba	21.8%	10.2% Aa	16.8%
Posterior teeth	First day	1.1% Aa	2.9%	10.3% Aa	8.9%
Anterior teeth	Last day	11.9% Aa	22.2%	11.9% Aa	21.6%
Posterior teeth	Last day	5.5% Ab	8.4%	14.9% Ab	14.5%

Note: capital letters compare anterior and posterior teeth within the same evaluation by the Mann-Whitney test ($p<0.05$).
Note[1]: lowercase letters compare the first and last day for posterior and anterior teeth by Wilcoxon test ($p<0.05$).
Source: Authors.

When stress was assessed, 1 patient (3.3%) had symptoms on the first day and, at the end of the mission, 3 patients (10%) had symptoms, with no significant difference (Friedman test, $p=0.157$) between the moments (Table 3). Of the three patients with stress at the end of the mission, one of them had a GBI greater than 10%, with 25%. The others had low GBI values (3.6% and 0.0%).

Table 3. Frequency of military who presented symptoms of stress.

	First day		Last day	
	Frequency	%	Frequency	%
Phase I - alert	0	0	0	0
Phase II – resistance and near-exhaustion	1A	3.3	3A	10
Phase III - exhaustion	0	0	0	0
Total	30	100	30	100

Note: Different letters indicate differences between first and last day by the Friedman test (p<0.05).
Source: Authors.

There was no correlation between stress X VPI and stress X GBI, assessed in both moments (Table 4). Regarding the correlation with grade (cables and soldiers), there were no significant correlations between stress, VPI and GBI in the two moments.

Table 4. Correlation of stress with visible plaque index (VPI) and and gingival bleeding index (GBI) in the two moments of the mission.

			Spearman' correlation	p-value
First day of mission	Stress	GBI	0.000	1.000
		VPI	-0.154	0.416
Last day of mission	Stress	GBI	-0.078	0.684
		VPI	-0.122	0.521

Source: Authors.

4. Discussion

Although changes in gingival conditions, as well as stress factors during the training period, provide useful information for the development of strategies to maintain satisfactory oral health (Yamashita et al., 2017), there is a lack of knowledge of such effects in the Brazilian Navy's Marine Corps. Considering the importance of adopting preventive measures against biofilm-induced gingivitis (Caton et al., 2018) and the reinforcement of regular toothbrushing in the field, the aim of this study was to evaluate the gingival conditions and the stress level of the military in field training. Thus, a clinical assessment of the gingival condition of the military and the stress assessment with a questionnaire was carried out, based on previous studies (Rosseti et al., 2008, Yamashita et al., 2017). In the present study, the visible plaque index (VPI) and the gingival bleeding index (GBI) proposed by Ainamo & Bay (1975) were used, which represent a simplification of the plaque and gingival indexes proposed by Löe (1967). These indexes were used in similar previous studies (Carvajal et al., 2016, Casarin et al., 2008, Grellmann & Zanatta 2014, Haas et al., 2019, Neves et al., 2010).

In relation to gingival condition, in the present study, higher incidences of VPI and GBI were found on the last day of the mission, like the findings of Yamashita et al., (2017) and Suman et al., (2008) who investigated the impact of military training on field for seven days of the Japan Self-Defense Force and the military involved in the Croatian War, respectively. These results confirm the theory that hostile conditions can significantly influence the severity of the periodontal condition (Bárcena-García et al., 2022, Suman et al., 2008). Although the VPI and GBI indexes were significantly higher on the last day of the mission when compared to the first, it is noteworthy that a time interval between 10 and 21 days is necessary to establish the gingivitis after removing all hygiene measures oral in healthy volunteers (Loe et al., 1965). Therefore, it can be suggested

that if the mission had a longer duration, more military could present gingival alterations, characterizing gingivitis, at the end of the mission. Therefore, brushing teeth is an important behavior to prevent periodontal diseases during the training period.

Regarding the region that showed visible plaque and gingival bleeding, there was a significant difference for posterior teeth between the first and last day of the mission, like a previous study (Sreenivasan & Prasad 2017) that evaluated the same gingival conditions, with different rates, in two different times, which reinforces the need for greater control of oral hygiene, especially in the posterior teeth, due to the difficulty of cleaning.

Regarding the levels of stress, one patient initially presented symptoms of stress and three patients on the last day of the mission without significant difference between the two moments. This result corroborates with previous studies that assessed the level of stress in an operating environment with the Brazilian military on a mission in Haiti (Barros et al., 2018) and military on a basic training in Australia (Tait et al. 2021). Moreover, Yamashita et al., (2017) evaluated the salivary activity of α -amylase as a stress marker and verified no changes in this marker after training (Yamashita et al., 2017). These facts could be justified by the fact that the training intensity was insufficient to raise the stress levels of the participants or by the military being able to adapt due to periodic training activities.

It was observed that in patients with more stress, the resistance phase (phase 2) was the one that prevailed among the military, at both times, like the results found with employees of the Federal Police of São Paulo (Rossetti et al., 2008).

In the present study, militaries from the same unit were selected and underwent supragingival scaling and prophylaxis one week before the mission, promoting a greater sample homogeneity. Moreover, this sample was selected considering that a single evaluator (periodontist) would not be able to assess a larger number of militaries in a single day. Thus, the examiner variability was eliminated.

Gingival diseases negatively affect the performance of militaries during field training[1], so it is necessary to perform, in the Brazilian Navy, preventive measures against these diseases prior to missions or even during training and to reinforce the practice of brushing during field training (Yamashita et al., 2017)., especially in the posterior teeth, as verified in the present study. As a preventive measure, the use of a mouthwash with chlorhexidine (James et al., 2017), xylitol gum (Hashiba et al., 2015) and probiotic tablet (Schlagenhauf et al., 2020) can be suggested to maintain periodontal health in situations of unsatisfactory oral hygiene.

5. Conclusion

It was observed that the military submitted to the mission in field training demonstrated a higher incidence of visible plaque and gingival bleeding at the end of the mission, especially in the posterior teeth. However, the stress was similar on the first and last day of the mission, without correlation between stress and gingival indices (VPI and GBI). Thus, it is suggested to carry out future studies evaluating preventive measures against periodontal disease before the missions.

Acknowledgments

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