

Stressful Events and Oral Health Related Quality of Life Aboard: a Longitudinal Study

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Abstract

Background: Stressful events may affect self-perceived general and oral health. While the working environment is known to expose military personnel to chronic stress, oral health reports in these populations is limited.

Methods: This longitudinal study aimed to investigate the association of oral health related quality of life (OHRQL) and stress in the military population aboard a training ship for 6 months. The participants included were 259 crew and 227 cadets. Two anonymous questionnaires, the perceived stress scale (PSS-14) and the oral health impact profile (OHIP-14), were applied at baseline and follow-up (six-month later). Socio-demographic characteristics were also obtained.

Results: Multivariate Poisson regression analysis showed that PSS-14 predicted higher OHIP-14 scores at baseline and follow-up. At follow-up, besides PSS-14 (RR: 2.03; 1.42-2.90), being part of the crew group represented an increase of 87% on the OHIP-14 scores (RR:1.87; 1.27-2.74). Older individuals were 24% less likely to present higher OHIP-14 scores (RR:0.76; 0.58-0.99) than younger ones.

Conclusion: Oral health related quality of life has worsened over time in this military population, and stress was an associated factor of that.

Trial registration: 10751419.8.0000.5256/2019.

Introduction

Occupational stress occurs when the demands of the environment go beyond the worker's coping skills, causing excessive wear on the body and interference with productivity (1). Furthermore, living under stress or stressful events may cause an individual to become vulnerable to health problems, and also to physiological, emotional, and behavioral symptoms (2).

Job stress may affect one's perception of general health, because individuals under stressful situations adopt unhealthy behaviors, like being more likely to smoke, less inclined to brush their teeth, and less likely to visit a dentist (3). It can also worsen self-perceived oral health, increasing the risk of periodontal diseases, dental caries, and oral cancer (4).

Self-perceived oral health status includes subjective measurements that reflect the individual's own assessment of oral health status and treatment needs (5, 6). Specific tools, which consider the impact of oral health conditions on quality of life, have been developed to measure how changes in oral health compromise the quality of life and the well-being of individuals (7).

Military activities have been linked to a variety of physical and physiological symptoms, such as post-traumatic stress which results in poor individual-level outcomes (8). This happens often to military personnel because their unique working environment exposes them to chronic stress and experiences of extreme violence may be anticipated under certain conditions (9).

There are no studies about the consequences of the stressful condition of military environments in the self-perceived oral health status so far. Evaluating work stress effects on quality of life aboard can help managers implement programs or strategies that help them cope with problems and avoiding the negative impact on the military's health.

This study aimed to assess the oral health related quality of life (OHRQL) and stress in military populations and to investigate the association of OHRQL and stress in this group.

Methods

Study design

This was a longitudinal prospective census-type study that assessed the oral health related quality of life and stress in a military population submitted to a training cruise over six months. Additionally, the association between OHRQL and stress was investigated.

Setting

This study was performed during the annual midshipmen training cruise (MTC) on the Brazilian training ship Brasil (U27) in 2019. MTC lasted six months, making 17 port calls in 14 countries. The crew comprised of 31 officers, 228 non-commissioned officers, sailors and civilians, and 227 cadets, known as midshipmen. Upon completion of MTC, the midshipmen receive their commission as officer and serve aboard ships and other military organizations in Brazil.

Participants

As an institutional exigence regarding oral condition, all the military personnel who participate in MTC must meet parameters of health, like satisfactory aesthetics, healthy dental articulation, healthy soft tissues, and healthy and treated teeth. Partial or total dental prosthesis are also admitted. Some conditions are considered unsatisfactory including the following: acute or chronic processes in the oral cavity, decay without treatment or with insufficient treatment, unsatisfactory restorations and prosthesis, infections, cysts, tumors, dental absences in the lip battery without aesthetic and functional rehabilitation, and impacted teeth that cause painful chewing.

Before MTC, all military staff submit to an exam of panoramic radiograph exam to identify who needs complex procedures, such as prosthesis, complex extraction and endodontics treatment. These individuals are referred to specific dentists who treats their condition and make them eligible to do MTC.

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Data collection

On a scheduled work day, the military personnel aboard were invited to attend a meeting in the auditorium, where they were given instructions and objectives of the study before it began. Irrespective of age, sex, function or personnel aboard, they were invited to participate in the survey, being assured of confidentiality of the information provided. When they agreed to enroll, the informed consent was signed. The option to refuse to participate was a clear option.

This study was approved by Marcílio Dias Navy Hospital Research Ethics Committee, in Rio de Janeiro, Brazil, protocol 10751419.8.0000.5256/2019, and followed the ethical standards established by the Declaration of Helsinki.

Demographic and social data

The demographic and social data obtained were related to sex (male; female), personnel aboard (crew; cadets), age (in years), and education (high school; higher education). The age was divided into four age ranges: 20 to 29; 30 to 39; 40 to 49; and over 50 years old.

Questionnaires

One examiner applied two anonymous questionnaires: A) perceived stress scale, and B) oral health impact profile.

A) Perceived stress scale

The perceived stress scale (PSS-14) measures someone's stress level based on stressful incidents and the ability to face them on an individual level. PSS-14 comprises of 14 questions with responses varying from 0 to 4 for each item, and ranging from never, seldom, sometimes, fairly often, and very often, respectively, based on their occurrence one month before the survey. PSS-14 scores are obtained by reversing the scores on positive items, for example 0 = 4, 1 = 3, 2 = 2, 3 = 1, and 4 = 0, and then summing across all 14 items. Items 4, 5, 6, 7, 9, 10, and 13 are the positively stated items (10, 11). The scores ranged from 0 to 56, 28 being the operational cutoff value (10, 12). Participants were labeled as "stressed" when scoring upper bound and as "non stressed" when scoring less than 28.

B) Oral health impact profile

The oral health impact profile (OHIP-14) intends to measure the physical, psychological, and social impact of oral conditions one month before the survey and are composed of 14 items that assess seven different dimensions (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap). Each item has a set of possible answers rated on a 5-point Likert scale (4 = always, 3 = frequently, 2 = sometimes, 1 = seldom, and 0 = never). OHIP-14 scores can range from 0 to 56 and are calculated by summing the ordinal values for the 14 items (13).

PSS-14 and OHIP-14 were applied at two moments: a) baseline, two days before the annual MTC got started; and b) follow-up, the last day of the mission, in July and December of 2019, respectively.

Data analysis

Descriptive statistics were performed for the demographic and social data.

After the questionnaires were completed, the means of PSS-14 and OHIP-14 at baseline and follow-up were obtained.

The personnel aboard were separated into two groups: crew and cadets, and it was verified if the mean of each questionnaire was different between these groups at baseline and follow-up.

Scores for each item of OHIP-14 were compared for the whole military population and separately for the crew and cadets group, at baseline and follow-up, to identify which of them had changed the most during MTC.

The sum of PSS-14 was categorized as "non stressed" (sum < 28) or "stressed" (sum ≥ 28). Then, it was investigated whether the categorized variables of PSS-14 were different between both groups at baseline and follow-up.

Crude and multivariable Poisson regression with robust covariance was used to test the association between personnel aboard, age range, education, and PSS-14 with OHIP-14 scores at baseline and follow-up.

Statistical differences between groups were evaluated using the Chi-Square test for categorical variables and the T-test or the Mann-Whitney U test for continuous variables with a significance level of 5%. All data processing and analyses were performed using the software SPSS version 21.0 ("Statistical Package for the Social Sciences", SPSS Inc., Chicago, USA).

Results

Out of 486 military personnel on MTC that were included in this survey, 330 were enrolled at baseline and 306 at follow-up. Although the whole population agreed to participate in the survey, there were some participants not available at the moments scheduled for data collection.

At both times, the predominant sex was male and the predominant age range was 20–29 years old. Regarding personnel aboard, 69.2% were cadets and 30.8% crew. Regarding education, 19.2% reported to have finished high school and 80.8% reported to have finished higher education. No statistical differences

were found between the baseline and follow-up. Comparing the means of the questionnaires, OHIP-14 presented greater scores at follow-up (Table 1).

The internal consistency of OHIP-14 measured by Cronbach's alpha coefficient was 0.90 and could not be improved by deletion of any individual question. Excellent internal consistency was also found for PSS-14 (0.86).

Table 1
Demographic and social data of participants at baseline and follow-up

Characteristic	Baseline	Follow-up	<i>p</i>
	(n = 330)	(n = 306)	
Sex, n (%)			
Male	309 (96.0)	286 (96.6)	
Female	13 (4.0)	10 (3.4)	0.67
Personnel aboard			
Crew	89 (28.3)	95 (33.6)	
Cadet	226 (71.7)	188 (66.4)	0.16
Age range, n (%)			
20–29 years	252 (76.8)	222 (73.7)	
30–39 years	36 (11.0)	41 (13.6)	
40–49 years	33 (10.1)	33 (11.0)	
over 50 years	7 (2.1)	5 (1.7)	0.57
Education, n (%)			
High school	57 (21.0)	35 (16.8)	
Higher education	214 (79.0)	173 (83.2)	0.25
PSS-14	18.61 ± 8.80	18.49 ± 8.51	0.99
OHIP-14	4.41 ± 5.76	5.95 ± 6.88	0.002*

p value*: significance level ≤ 0.05. Qui-square test for categorical variables and Mann-Whitney U test for continuous variables.
Data expressed as an absolute number (%).
Questionnaires` data expressed as mean ± SD. SD: standard deviation.
PSS-14 = perceived stress scale.
OHIP-14 = oral health impact profile.

At baseline, the means of PSS-14 and OHIP-14 were higher for the crew group than cadets, reaching statistical significance ($p = 0.003$, and ≤ 0.001 , respectively). At follow-up, the means for OHIP-14 were higher for the cadets group ($p = 0.03$). No differences between the groups were found for PSS-14 at follow-up. The cadets' OHIP-14 mean was higher at follow-up than at baseline ($p = 0.02$) (Table 2).

Table 2
Baseline and follow-up mean for PSS-14 and OHIP-14 according to the crew and cadets groups

	Crew		<i>p1</i>	Cadets		<i>p2</i>	<i>p3</i>	<i>p4</i>
	Baseline	Follow-up		Baseline	Follow-up			
PSS-14	21.16 ± 9.28	19.85 ± 9.19	0.43	17.62 ± 8.37	17.92 ± 8.21	0.72	0.003*	0.06
OHIP-14	6.25 ± 6.57	7.09 ± 7.53	0.51	3.56 ± 5.24	5.39 ± 6.64	0.02*	≤ 0.001*	0.03*

p value*: significance level ≤ 0.05. Mann-Whitney U test for continuous variables.
Data expressed as mean ± SD. SD: standard deviation.
p1: comparison in the crew group between baseline and follow-up.
p2: comparison in the cadets group between baseline and follow-up.
p3: comparison at baseline between crew and cadets.
p4: comparison at follow-up between crew and cadets.

Exploring each item of OHIP-14, mean scores of 7 items among the 14 were significantly higher at follow-up in the cadets group (Table 3). Otherwise, only items 2 and 11 showed differences between the baseline and follow-up in the crew group (0.18 ± 0.44 versus 0.47 ± 0.77 , $p = 0.01$, and 0.53 ± 0.84 versus 0.87 ± 1.12 , $p = 0.04$, respectively; data not showed). An additional table file shows this in more detail [see Additional file 1].

None of the items of PSS-14 showed differences between baseline and follow-up, regarding the crew and cadets groups.

Table 3
Mean scores of OHIP-14 in the cadets group

Questions	Baseline	Follow-up	<i>p</i>
1. Have you had trouble pronouncing any words?	0.17 ± 0.45	0.23 ± 0.54	0.27
2. Have you felt that your sense of taste has worsened?	0.07 ± 0.27	0.18 ± 0.52	0.019*
3. Have you had painful aching in your mouth?	0.44 ± 0.71	0.48 ± 0.73	0.69
4. Have you found it uncomfortable to eat any foods?	0.34 ± 0.69	0.43 ± 0.72	0.11
5. Have you been self-conscious?	0.55 ± 0.86	0.80 ± 1.01	0.010*
6. Have you felt tense?	0.44 ± 0.79	0.69 ± 0.94	0.005*
7. Has your diet been unsatisfactory?	0.28 ± 0.62	0.45 ± 0.74	0.006*
8. Have you had to interrupt meals?	0.09 ± 0.32	0.14 ± 0.45	0.61
9. Have you found it difficult to relax?	0.27 ± 0.67	0.39 ± 0.73	0.029*
10. Have you been a bit embarrassed?	0.15 ± 0.42	0.31 ± 0.65	0.005*
11. Have you been a bit irritable with other people?	0.27 ± 0.61	0.63 ± 0.91	≤ 0.001*
12. Have you had difficulty doing your usual jobs?	0.22 ± 0.53	0.30 ± 0.62	0.15
13. Have you felt that life in general was less satisfying?	0.15 ± 0.48	0.18 ± 0.52	0.34
14. Have you been totally unable to function?	0.12 ± 0.42	0.26 ± 0.76	0.07
p value*: significance level ≤ 0.05. Mann-Whitney U test for continuous variables.			
Data expressed as mean ± SD. SD: standard deviation.			

Regarding the PSS-14 cutoff, at baseline, 83.6% of the studied population was categorized in “non stressed” and 16.4% in “stressed”, while at follow-up, 84.1% was labeled as “non stressed” and 15.9% as “stressed” (available in supplement).

Regression

The results from crude Poisson regression analysis (Table 4) showed that the OHIP-14 scores, at baseline, were significantly associated with:

- being part of the crew group (1.8 times more than the cadets group);
- age range (participants with higher age range were 25% more likely to present higher OHIP-14 scores);
- lower level of education (1.5 times more than those with higher education); and
- PSS-14 (individuals categorized as “stressed” were 2.4 times more likely to present greater means of OHIP-14 than those categorized as “non stressed”).

At follow-up, only PSS-14 remained linked to OHIP-14.

Table 4
Crude regression analysis between personnel aboard, education, age range, and PSS-14 with OHIP-14

Variables	Baseline	Follow-up
	RR (95% CI)	RR (95% CI)
Personnel aboard		
Crew	1.76 (1.31–2.36), $p \leq 0.001^*$	1.31 (0.99–1.74), 0.06
Cadet	1	1
Education		
High school	1.54 (1.15–2.07), 0.004*	1.20 (0.84–1.71), 0.33
Higher education	1	1
Age range	1.25 (1.08–1.45), 0.003*	1.01 (0.87–1.18), 0.85
PSS-14		
Stressed	2.45 (1.80–3.34), $p \leq 0.001^*$	2.06 (1.51–2.81), $p \leq 0.001^*$
Non stressed	1	1
p value*: significance level ≤ 0.05 .		
RR: rate ratio; CI: confidence interval.		

PSS-14 was statistically associated with OHIP-14 scores at baseline, according to the multivariate Poisson regression analysis (Table 5). Individuals categorized as “stressed” were 2.39 times more likely to present an increase on the OHIP-14 scores than those categorized as “non stressed” (RR:2.39; 1.70–3.36). At follow-up, besides PSS-14 (RR: 2.03; 1.42–2.90), being part of the crew group represented an increase of 87% on the OHIP-14 scores (RR:1.87; 1.27–2.74). Older individuals were 24% less likely to present higher OHIP-14 scores (RR:0.76; 0.58–0.99) than younger ones.

Table 5
Multivariable regression analysis between personnel aboard, education, age range, and PSS-14 with OHIP-14

Variables	Baseline	Follow-up
	RR (95% CI)	RR (95% CI)
Personal aboard		
Crew	1.30 (0.81–2.06), 0.27	1.87 (1.27–2.74), 0.002*
Cadets	1	1
Education		
High school	0.85 (0.53–1.36), 0.49	0.91 (0.57–1.43), 0.68
Higher education	1	1
Age range	1.17 (0.92–1.49), 0.19	0.76 (0.58–0.99), 0.04*
PSS-14		
Stressed	2.39 (1.70–3.36), $p \leq 0.001^*$	2.03 (1.42–2.90), $p \leq 0.001^*$
Non stressed	1	1
p value*: significance level ≤ 0.05 .		
RR: rate ratio; CI: confidence interval.		

Discussion

Based on this longitudinal study which evaluated a military population with similar demographic and social characteristics, it was found that oral health related quality of life got worse over time on a training cruise.

At baseline, the mean scores of PSS-14 and OHIP-14 were higher for crew compared with the cadets group. This can be explained by the arduous work that the crew group completed to prepare the ship for MTC, six months before leaving. On the other hand, at the same time, cadets were at Naval School for classes and theory instruction, and they were not living in the ship environment. At follow-up, there were no differences between both groups regarding PSS-14. This is not in accordance with an Indian study performed in a private medical college. Medical students reported a higher level of perceived stress with a mean PSS-14 score of 2.39. A possible reason for the contradictory data found in the study, like the predominance of females (67.08%), the

mean age group of 19.7 years, and because the survey was conducted among during the first and second years of graduation (14). Similar results were found in a Pakistan study (mean scores was 30.84) (10), but this study used different tools to measure stress, which limits the comparability between them.

Using the PSS-14 cutoff, only 16.4% of the whole military population were labeled as “stressed”. Comparing mean scores and times, the results were similar at follow-up, although the crew group was more stressed than the cadets group at baseline.

Self-perceived oral health in the crew group was different compared to the cadets after the whole population was used to the routine aboard. Comparing changes in OHIP-14 for each group, the mean of the cadets group was higher statistically significant at follow-up than baseline.

Exploring each item of OHIP-14, the mean scores of both questions “Have you felt that your sense of taste has worsened?” and “Have you been a bit irritable with other people?” were significantly higher at follow-up than baseline in both groups. Other items of OHIP-14, as “Have you been self-conscious?”, “Have you felt tense?”, “Has your diet been unsatisfactory?”, “Have you found it difficult to relax?”, and “Have you been a bit embarrassed?” were higher in the cadets group, showing that the perception of oral health was impaired in the ship’s environment. This may induce mood swings and impair interpersonal relationships. In a Thailand study with military personnel, the oral problems that could possibly affect quality of life and work were assessed using questionnaires, and it was concluded that toothache/hypersensitivity was among the most common oral problems. In addition, the majority of military personnel admitted that oral problems affected quality of life and duty performance more than other factors, such as sleep deprivation and technical skills for work (15).

In order to evaluate the relationship between stress and self-perceived oral health status and to measure the impact of stress in self-perceived oral health, regression analysis was used. Our results showed that stress was a predictor of greater OHIP-14 scores. A Lithuanian study, among high school students, found a positive relationship between the prevalence of oral and/or systemic conditions with higher stress levels, even though the questionnaires they used were different from ours (16). The significant impact of stress ($B = 0.35, p < 0.001$) on the OHRQL, applying a multiple linear regression, was also demonstrated in a Portuguese study in elderly patients (17).

Our regression analysis showed that older individuals were 24% less likely to present higher OHIP-14 scores than younger ones. Likewise, lower age contributed to higher OHIP-14 scores in a Portuguese study mentioned above (17).

There is a limited number of oral health reports in military populations (17–21). A study conducted among Croatian military personnel, during a periodic annual evaluation, sought to determine the predictive value of dental readiness in OHRQL. OHIP-14 was applied, and a direct and positive relationship was found between a satisfactory dental condition and the quality of life recognized from self-perceived oral health. In addition, it was concluded that patients with better oral conditions were among the youngest and those with less time in military duty, which can be explained by their motivation to improve oral health in order to be permitted to participate in international peacekeeping missions (22).

In subjects from the Japanese military during the annual medical examination in 2008 (mean aged 35.7 ± 10.1 , range 15–59 years), the correlation between the number of missing teeth and the OHIP-14 scores were assessed. Only 0.2 to 1.9% reported frequent negative impacts with a mean OHIP-14 scores of 4.6 ± 6.7 . Thus, the results suggested that the magnitude of correlation between physical characteristics of oral health and perceived oral health was small in this military population (21).

When compared with non-military populations, the OHIP-14 scores by our subjects were lower than other previous studies. OHIP-14 scores of population-based studies were 13.75 in Israel (age 25 years old, male 75%) (23), 10 in Japan (male 41.6%) (24), 15.7 ± 8.4 in China (mean aged 37.7 ± 14.2 , male 44.1%) (25).

Some limitations may be considered when interpreting our findings. One of them is that it

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s crew during missions. The application of questionnaires, per se, involve limitations because of the respondents’ interpretation of questions or desire to report their emotions in a certain way; we cannot rule out information bias. The study only involved military personnel and comprised mostly of males who were physically and mentally fit.

There are some implications associated with the findings of this study. The following are suggested strategies based in the results of study: ensure physical activity programs aboard; train health staff technically and make sure supervisors support subordinate’s needs; encourage religious assistance aboard; emphasis the ship’s mission to military staff; organize social and corporate events aboard; establish a suitable place for oral hygiene; organize a periodic oral hygiene demonstration by a dentist aboard; and add dental supplies in to the welcome kit delivered aboard.

Conclusion

This longitudinal study showed that oral health related quality of life has worsened over time in the studied military population. Stress was an associated factor with it. The need to adjust management styles was highlighted as well as the need to prepare the staff to navigate stressful situations more effectively.

Declarations

Ethical Approval and Consent to participate:

This study was approved by Marcílio Dias Navy Hospital Research Ethics Committee, in Rio de Janeiro, Brazil, protocol 10751419.8.0000.5256/2019, and followed the ethical standards established by the Declaration of Helsinki.

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Consent for publication:

Consent for publication has been obtained.

Availability of data and materials:

All relevant data and materials are presented in this paper.

Competing interests:

The authors declare that they have no competing interests.

Funding:

Not applicable.

Authors' contributions:

Carlos J.C. was participated in the 2019 annual midshipmen training cruise. Carlos J.C. was the first writing author of the manuscript. Other experts participate in literature review, consensus discussion and suggestions. All authors read and approved the final manuscript.

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