Periodontal status and treatment needs among cardiac patients at Muhimbili National Hospital, Dar-es-Salaam, Tanzania

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Abstract
Background: Periodontal diseases have been reported to be associated with cardiovascular diseases.
Aim: The aim of this study was to determine the periodontal status and treatment needs among adult cardiac patients in Dar-es-Salaam, Tanzania.
Methodology: A hospital based descriptive cross-sectional study was conducted. A self-administered questionnaire was used to obtain socio-demographic information, followed by clinical examination for dental plaque, gingival bleeding, calculus, periodontal pockets (PPT) and gingival recession. To enable determination of periodontal treatment needs, data for periodontal conditions was transformed into Community Periodontal Index and Treatment Needs (CPITN) codes. Chi-square test was used to determine the associations of periodontal conditions with demographic variables studied. Level of significance was set at $p<0.05$.
Results: The prevalence of periodontal conditions was high for gingival bleeding (100%), dental plaque (99.4%)and calculus (99.7%), but very low for periodontal pockets ≥ 3.5 mm (9.4%).
Statistically significant higher mean percent site with plaque, calculus and gingival bleeding was seen in posterior teeth (t-tests = -16.07, 12.22, and -4.8; $p< 0.001$ respectively). Gingival recession and loss of attachment was statistically significantly higher in upper teeth (t-test= -3.45, $p< 0.001$), anterior teeth (t-test= 6.3 and 5.5; $p< 0.001$ respectively). Periodontal treatment needs was 100.0%, 99.7%, and 0.9% for oral hygiene **instructions (OHI), scaling and root planing (SRP), and periodontal surgery respectively.**
Conclusion: The prevalence of plaque, calculus and gingival bleeding was high among cardiac patients examined, but low for periodontal pocketing, gingival recession and loss attachment. The periodontal treatment needs were mainly oral hygiene instructions, scaling and root planning. Surgical periodontal therapy was limited to the few.

Key words: Periodontal status, cardiovascular diseases, cardiac patients, treatment needs, Muhimbili National Hospital.

Kessy SF, Simon T and Mumghamba EGS Periodontal status and treatment needs among cardiac patients at Muhimbili National Hospital, Dar-es-Salaam, Tanzania Tanz Dent J 2017; 20(1):1-8.

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Introduction

Periodontal diseases (PDs) are inflammatory diseases which affect the supporting tissues of the teeth. They are broadly grouped into gingivitis and periodontitis. While gingivitis is localized to the soft tissues surrounding the teeth, and can be reversed with treatment, periodontitis results in irreversible damage to teeth attachment apparatus leading to tooth loss (1).

In a recent extensive review by Nazil MA (2017) it was clearly shown that adolescents from developing nations have higher prevalence of calculus and bleeding on probing. The proportion of adolescents with calculus deposits ranged from 35% to 70% in developing countries while it ranged from 4% to 34% in developed nations. Similarly, 14-47% of adult populations in developed countries had calculus deposits compared to 36-63% of adults in developing nations. However, developed countries have higher percentage of individuals with periodontal pockets of 4-5 mm. Greater proportions of older individuals (65-74 years) exhibit periodontal pockets of 6 mm or above compared to adult populations in both developed and developing countries. Overall, periodontal disease affects about 20-50% of the population around the globe (2).

There is evidence from systematic reviews and meta-analyses which indicate that periodontitis is a risk factor for cardiovascular diseases (CVD) (3-5). Possible explanation for the association is that periodontitis leads to entry of bacteria in the blood stream. The bacteria activate the host inflammatory response by multiple mechanisms. The host

immune response favors atheroma formation, maturation and exacerbation (1, 6). In addition, inflammation in the periodontium can also act as a source of systemic inflammatory mediators that favor atheroma formation in blood vessels (6). In a systematic review and meta-analysis by Orlandi and colleagues (7), data from intervention studies suggested a beneficial effect of periodontal treatment on flow-mediated dilation indicating an improvement in endothelial function (7).

In Tanzania, periodontal diseases are common in child and adult populations. The mean scores for gingival bleeding was reported to be 4.9 (0.9) (8), mean sextants with gingivitis ranging from 0.25 in primary school children (9) to 0.6±0.9 among secondary school students (10). In adults, the prevalence of bleeding on gentle probing have been reported to vary from 93.8% - 100% (11 - 13). Shallow and deep pockets were reported in 26.8% and 3% respectively (13). No studies on periodontal status and treatment need among cardiac patients in Tanzania were retrieved.

Studying the prevalence of periodontal diseases in known cardiac patients can throw light on the extent to which these patients may be at risk of worsening their cardiac disease conditions. It may as well stimulate the need for controlling periodontal diseases in such patients to reduce the possible adverse consequences of coexistence of periodontal diseases and cardiac diseases. On the other hand, studying periodontal treatment needs in cardiac patients can inform on possible burden of treating periodontal diseases in cardiac patients. Ultimately such studies may help to point to the need for instituting preventive measures against periodontal diseases that are likely to be less expensive in terms of clinician time and finances on the part of cardiac patients. Therefore, the aim of the current study was to determine periodontal status and treatment needs among adult cardiac patients attending cardiac clinic at Muhimbili National Hospital.

Materials and methods

This was a descriptive cross-sectional study conducted at the dental clinic of Muhimbili University of Health and Allied Sciences (MUHAS) and the cardiac unit at Muhimbili National Hospital (MNH). A total of 340 subjects were recruited out of 384 was anticipated, giving a response rate of 88.5%. The participants were cardiac patients aged 18 years and above and who had attended cardiac clinic at Muhimbili National Hospital between July and Nov, 2013.

One dentist (SFK) conducted clinical examinations in clinical settings, using mouth mirror, periodontal probe and artificial light as per guideline outlined by Cutress and colleagues (14). The dental plaque, calculus and gingival bleeding were recorded as absent (score = 0) or present (score = 1). Gingival recession was measured as a distance from the CEJ to the tip of gingival margin using William's periodontal probe. The measured distances in millimeters were then recorded in interval scale as follows: Score 0 = < 1 mm; Score 1 = 1-3 mm; Score 2 = 4-5 mm and Score 3 = >5 mm.

The probing periodontal pocket depth (PD) was measured as a distance from the gingival margin to the bottom of the periodontal pocket using the CPI probe. The measured distance was recorded on interval scale as follows: Score 0 = < 3.5 mm; 1 = 3.5 – 5.5 mm; 2 = >5.5 mm. When recession was present, the periodontal attachment loss (PAL) was calculated by adding the probing pocket depth to the recession measurement (distance from CEJ to the gingival margin). When the gingival margin was coronal to the CEJ, the PAL was calculated by subtracting the gingival margin to CEJ distance from the probing depth. When the gingival margin was at the CEJ, no calculations were needed because the probing pocket depth was equal to the clinical attachment level. The distance was recorded on interval scale as follows: Score 0 = < 1 mm (health); Score 1= 1-2 mm (slight); Score 2 = 3-4 mm (moderate); Score 3= ≥ 5 mm (severe). Periodontal measurements were taken from all six sites of each tooth.

Every 10th subject was re-examined for periodontal conditions to generate pairs of data for determining intra-examiner reliability using kappa coefficients.

Data transformation and analysis

Data was entered into a computer and analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. The demographic characteristics studied were sex and age in years (18-80). To generate frequency distribution of the studied subjects by age and sex, age was categorized into age-groups. To allow comparison of periodontal conditions within the background variables studied, age was further dichotomized into younger adults (18-44 years) and older adults (45-80 years). Clinical indices were summarized as mean per cent sites with at least a condition measured for upper teeth, lower teeth, posterior teeth, anterior teeth, age and sex. T-test was used to compare the mean per cent sites with periodontal conditions between sexes, age, anterior and posterior teeth, and lower and upper teeth. Significance level was set at p-value <0.05.

To determine treatment needs, clinical data was transformed into CPI-TN, whereby the highest score for each sextant was recorded regardless of existence of other conditions considered as less

severe in CPI-TN index scoring. The frequency distribution of treatment needs as determined by CPI-TN index was generated.

Ethical considerations

Ethical clearance was obtained from the Ethical Clearance Committee of the Muhimbili University of Health and Allied Sciences through a letter with Reference No.MU/PGS/SAEC/Vol.IX/ dated 26th June 2013. Written informed consent was obtained from participants.

Results

The intra-examiner reliability for clinical indices ranged from 0.50-0.64. The age range of participants was 18-80 years. Participants' age and sex distribution is summarized in Table 1. Three quarters (75.6%) of participants were aged 45 years and above, females constituting 65.9%.

Table 1 Distribution of the study participants by age and sex

	Sex					
	Male		Female		All	
Age Group (Years)	n	%	n	%	n	%
18-44	28	24.1	55	24.6	83	24.4
45-80	88	75.9	169	75.4	257	75.6
Total	116	34.1	224	65.9	340	100.0

Proportions of participants with at least one site with a given periodontal condition examined are summarized in Table 2. Majority - 99.4%, 99.7%, and 100.0% of participants respectively had at least one site with plaque, calculus and bleeding on probing. Periodontal pockets of >3.5 was recorded in 9.4% of the participants.

Table 2 Distribution of participants having at least 1 site with studied periodontal conditions

Periodontal conditions	Number	Percent
Plaque	320	99.4
Calculus	339	99.7
Gingival Bleeding	340	100
Periodontal pockets 3.5+ mm	32	9.4
Gingival Recession 1+ mm	70	20.6
Loss of attachment 1+ mm	69	20.3

Table 3 presents the mean per cent sites with different periodontal conditions by sex. The conditions with highest mean per cent sites were calculus 56.0±14.4 and 54.6±15.5 for males and females respectively and plaque 43.7±17.8, and 42.9±15.3 respectively for the same sexes. Pocketing greater than 5.5 mm had the least mean per cent sites of 0.0 and 0.1±0.9 for male and females respectively. For both periodontal conditions studied, there were no statistically significant differences in the mean per cent sites between males and females.

Table 3 Mean percent sites and standard deviation (SD) with different periodontal conditions by sex

	Mean %sites (SD)			
Periodontal conditions	Male	Female	T-test	P-value
Plaque	43.7 ± 17.8	42.9 ± 15.3	0.433	0.665
Calculus	56.0 ± 14.4	54.6 ± 15.5	0.842	0.400
Gingival Bleeding	28.5 ± 17.1	25.5 16.8	1.574	0.116
Shallow pockets (<5.5 mm)	2.1 ± 10.3	1.2 ± 4.9	1.062	0.289
Deep pockets (>5.5mm)	0.0 ± 0.0	0.1 ± 0.9	-1.242	0.215
Gingival Recession ≥1mm	3.0 ± 7.3	3.8 ± 10.2	-0.693	0.489
Loss of attachment ≥1mm	4.7 ± 13.2	3.4 ± 7.8	1.200	0.231

The mean per cent sites with different periodontal conditions by age are summarized in Table 4. The conditions with highest mean per cent sites were calculus 55.3±12.8 and 55.0±15.8 for younger and older age-groups respectively and plaque 41.0±15.8, and 43.8±16.3 respectively for the same age-groups. Pocketing greater than 5.5 mm had the least mean per cent sites of 0.0 and 0.1±0.8 for younger and older adults respectively. No statistically significant differences were observed in the mean per cent sites between younger and older adults for both periodontal conditions studied.

Table 4 Mean percent and standard deviation (SD) of sites with different periodontal conditions by age

Periodontal conditions	Mean %sites (SD)		T-test	P-value
	Younger adults (<45 yrs)	Older adults (45+ yrs)		
Plaque	41.0 ± 15.8	43.8 ± 16.3	-1.396	0.164
Calculus	55.3 ± 12.8	55.0 ± 15.8	0.160	0.873
Gingival Bleeding	25.6 ± 14.4	26.8 ± 17.8	-0.563	0.574
Shallow pockets (<5.5 mm)	1.0 ± 3.6	1.7 ± 8.0	-0.782	0.435
Deep pockets (>5.5mm)	0.0 ± 0.0	0.1 ± 0.8	-0.980	0.328
Gingival Recession ≥1mm	4.5 ± 12.8	3.2 ± 7.4	1.180	0.239
Loss of attachment ≥1mm	3.5 ± 8.5	3.9 ± 10.4	-0.377	0.706

The mean per cent sites with different periodontal conditions by jaw type are summarized in Table 5. The conditions with highest mean per cent sites were calculus 54.4±16.2, and 55.8±17.2 for upper and lower jaws respectively and plaque 43.7±17.9, and 42.6±18.0 respectively for the same jaws. The lower jaw had statistically significantly higher mean per cent sites with gingival recession (4.4±10.9) and loss of attachment (4.6±11.3) compared to upper jaw that had mean per cent sites of 2.9±9.9 and 3.1±10.1 respectively for same periodontal conditions (*t-test* = -3.451, $p < 0.001$, and *t-test* = -3.487, $p < 0.001$ respectively).

Table 5 Mean percent and standard deviation (SD) of sites with different periodontal conditions for upper and lower teeth

Periodontal conditions	Mean %sites (SD)		T-test	P-value
	Upper teeth	Lower teeth		
Plaque	43.7 ± 17.9	42.6 ± 18.0	1.191	0.234
Calculus	54.4 ± 16.2	55.8 ± 17.2	-1.823	0.069
Gingival bleeding	26.6 ± 18.2	26.5 ± 18.6	0.086	0.932
Periodontal Pockets ≥ 3.5mm	1.5 ± 7.6	1.7 ± 8.1	-0.670	0.503
Gingival recession ≥ 1.0mm	2.9 ± 9.9	4.4 ± 10.9	-3.451	0.001
Loss of attachment ≥ 1.0mm	3.1 ± 10.1	4.6 ± 11.3	-3.487	0.001

Table 6 summarizes the mean per cent sites with different periodontal condition by posterior and anterior teeth. Posterior teeth had statistically significantly higher mean per cent sites with plaque (49.6±18.5), calculus (59.0±16.5), and gingival bleeding (28.2±19.7) compared to anterior teeth that had mean per cent sites of 34.1±18.6, 49.6±17.1 and 24.2±17.3, (*t-test* = -16.07, $p < 0.001$; *t-test* = -12.21, $p < 0.001$ and *t-test* = -4.79, $p < 0.001$ respectively). On the other hand anterior teeth had statistically significantly higher mean per cent sites with gingival recession (6.0±14.5) and loss of attachment (5.9±15.0) compared to posterior teeth that had mean per cent sites of 1.8±7.7 and 2.1±8.2, (*t-test* = 6.30, $p < 0.001$, and *t-test* = 5.50, $p < 0.001$ respectively).

Table 6 Mean percent and standard deviation (SD) of sites with different periodontal conditions for anterior and posterior teeth

Periodontal conditions	Mean %sites (SD)		T-test	P-value
	Anterior teeth	Posterior teeth		
Plaque	34.1 ± 18.6	49.6 ± 18.5	-16.074	0.001
Calculus	49.6 ± 17.1	59.0 ± 16.5	-12.215	0.001
Gingival bleeding	24.2 ± 17.3	28.2 ± 19.7	-4.792	0.001
Periodontal Pockets ≥ 3.5mm	1.5 ± 7.7	1.7 ± 8.0	-0.655	0.513
Gingival recession ≥ 1.0mm	6.0 ± 14.5	1.8 ± 7.7	6.303	0.001
Loss of attachment ≥ 1.0mm	5.9 ± 15.0	2.1 ± 8.2	5.499	0.001

The distribution of participants by periodontal treatment needs and sextants is shown in Table 7. Over 94% of participants were indicated for scaling and root planing in all the six sextants examined.

Table 7 Distribution of participants' particular periodontal treatment needs by sextants

Periodontal treatment need	Sextants 1 n (%)	Sextants 2 n (%)	Sextants 3 n (%)	Sextants 4 n (%)	Sextants 5 n (%)	Sextants 6 n (%)
No treatment needed	0 (0.0)	12 (3.5)	3 (0.9)	3 (0.9)	3 (0.9)	10 (3.0)
Oral hygiene instructions	2 (0.6)	7 (2.1)	7 (2.1)	6 (1.8)	4 (1.2)	6 (1.8)
Scaling and root planing	336 (98.8)	320 (94.1)	327 (96.2)	328 (96.5)	332 (97.6)	322 (94.7)
Periodontal surgery	0 (0.0)	1 (0.3)	0 (0.0)	2 (0.6)	1 (0.3)	0 (0.0)

Discussion

This study was conducted at the Muhimbili National Hospital, Tanzania. To the best of our understanding; this is the first study to investigate periodontal diseases among cardiac patients in Tanzania. Therefore, the results of this study will add knowledge in this area. The methodology applied in the current study was full mouth examination and therefore enabled picking of all the periodontal conditions in subjects studied. This is an added advantage over the method of using index teeth to represent sextants. Therefore, the findings reported in the current study reflect the true periodontal conditions in the population studied. Nevertheless, the kappa statistics for intra-examiner reliability for clinical indices were moderate. Therefore, the interpretation of the results in the current study needs to be undertaken with that caution in mind. However, this being a hospital based study; the findings cannot be generalized to the whole Tanzanian population.

In the current study, the most prevalent periodontal conditions were bleeding on probing, calculus and dental plaque. This means that the studied population had poor oral hygiene. These findings correspond well to those reported by Lembariti and colleagues among Tanzanian adults (11). The highest mean per cent sites were recorded for calculus for both male and females and for young and older subjects. This indicates that calculus is a common encounter in the studied population and that oral hygiene had been neglected for many years in majority of the subjects studied. The fact that pocketing greater than 5.5 mm had the least mean per cent sites for younger and older adults indicate that deep pocketing is a rare periodontal condition in the studied population. Taking into consideration the very low mean percent sites for periodontal pocketing and the high mean percent sites for calculus, suggest that in the studied group calculus does not directly influence periodontal health. The high mean percent scores for calculus, plaque and gingival bleeding and very low mean percent scores for deep pockets recorded in the current study are in agreement with the findings that were reported by Lembariti and colleagues among Tanzanian adult population (11). Similar findings have been reported in Brazil among Indian adult population (15) and recently in Spain by Almerich-Silla et al 2017 (16). The findings of the current study are lower than those reported among adults in Sri Lanka by Wellapuli and Ekanayake (2017) where the mean percent sites recorded were 8.40 (SE=0.34) and 1.37 (SE=0.11) for probing depths ≥4 and ≥6mm of periodontal pocketing (PPD) respectively (17). Further, the extent of periodontitis according to the mean percentages of sites with ≥3 and ≥5mm of clinical attachment loss (CAL) were 39.73 (SE=0.66) and 10.95 (SE=0.43) respectively. Although the measure of prevalence in the current study differ from that used in many other studies, the current findings are lower than those reported in Italian adult population (Aimetti et al 2015) where the prevalence estimates of severe and moderate periodontitis were 34.94% (95% CI: 31.23-38.74) and 40.78% (95% CI: 36.89-44.79) respectively (18), and among Lebanon adults where h.

The non-significant differences in periodontal conditions between younger and older population recorded in the current study differ from several studies which reported periodontal disease severity to increase with increasing age (13, 15, 18, 19, 21).

In the current study, lower jaw had statistically significantly higher mean per cent sites with gingival recession and loss of attachment compared to the upper jaw. This may be due to the fact that most people fail to brush the lingual parts of the lower teeth due to difficulties of positioning the tooth brush. These findings correspond well with those reported in Croatia and India (22, 23). Among adult Croatians, Spalj and Plancak reported a Cumulative minimal loss of attachment (0-3 mm) to be more often present in upper anterior sextant (21.2%, $p < 0.001$), while values 5-11 mm were more often in lower anterior sextant (25-43%, $p < 0.001$) (22). In India, Mythri and colleagues (Mythri et al 2015) reported significantly higher prevalence of gingival recession in mandibular anterior teeth than maxillary teeth (23). However, our findings differ from those reported by Anil S 2008 among cigarette smokers, where maxillary anterior teeth exhibited more loss of attachment

compared to lower anterior teeth (24). These differences may be attributed to the direct effect of smoke that impacts more on palatal side of the oral cavity compared to lower jaw.

Comparison of periodontal conditions between the anterior and posterior teeth indicate marked differences in most of the conditions studied except pockets ≥ 3.5 mm. Mean percent sites for both plaque, calculus, gingival bleeding, were higher in posterior teeth than in anterior teeth. On the other hand, gingival recession and loss of attachment were higher in anterior teeth than in posterior teeth. This indicates that majority were failing to maintain acceptable level of oral hygiene in posterior sextants. These findings are similar to those reported in Tanzania by van Palenstein Helderman et al (1998) (13) and Mythri and colleagues in India whereby the lower anterior teeth recorded the highest loss of attachment and recession (21). The findings of the current study differ from those reported in Japan by Yoneyama and colleagues who reported more attachment loss and recessions in posterior teeth compared to anterior teeth (23).

The predominant periodontal treatment need in the current study was scaling and root planning. This means that the predominant periodontal condition was calculus with minimal periodontal pocketing. Our findings differ from those reported by Diab et al (2017) (25), whereby only 42.3% of the subjects needed scaling and root planning only, but are similar to what was reported by Lembariti et al (1988) (11).

Since the study participants in our study were cardiac patients with different conditions, all categories of periodontal treatment needs determined in these patients call for treatment to limit or prevent any complications (26).

Despite that they are few in number, the cardiac patients with chronic periodontal disease are at a higher risk of developing serious complications particularly aneurysm (26), stroke (27), acute myocardial infarction (28, 29) and peripheral arterial disease (30, 31, 32). The clinical implication based on the findings of this study is that, cardiac patients with periodontal disease need to be considered seriously for systematic periodontal therapy.

Conclusion and recommendation

The prevalence of plaque, calculus and gingival bleeding on gentle probing was very high, but that of periodontal breakdown was low. The predominant treatment need was professional scaling and root planning. It is recommended that all cardiac patients be advised to maintain good oral hygiene to prevent possible exacerbation of cardiac diseases.

Acknowledgements

Authors are grateful to the Government of Tanzania for financial support and to MNH and MUHAS authorities for allowing the study to be conducted at their facilities. Special thanks go to the study participants for their participation.

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