PERIODONTAL HEALTH STATUS OF THE SANDY BAY FIRST NATION IN MANITOBA, CANADA

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ABSTRACT

Objectives. To determine the distribution and determinants of periodontal health in adult members of the Sandy Bay First Nation in Manitoba, Canada.

Study design. Cross-sectional study based on face-to-face interviews and oral examinations.

Methods. Face-to-face interviews and oral examinations were performed on a convenience sample of 107 individuals to assess Debris Index, Calculus Index, Gingival Index and clinical attachment loss (CAL). Chi-square, Fisher’s exact, Mann-Whitney and Kruskal-Wallis tests were used to find variables significantly associated with 2 outcome variables: dichotomous mean CAL (≤2.5mm and >2.5mm) and dichotomous severe periodontitis. Variables found to be significantly associated with either of the outcome variables were entered into logistic regression analysis to look for significant independent effects (P<0.05).

Results. The mean age for the sample was 36.1 (SD 11.6). The mean CAL for the group was 1.44mm (SD 1.14), with age-specific CAL (SD) values of 1.08 (0.69), 1.18 (0.97), 2.05 (1.57) and 2.10 (0.95) for subjects aged 18–27, 28–37, 38–47 and 48 years or above, respectively. Of the individuals studied, 4.6% suffered from moderate periodontitis, whereas .4% suffered from either localized or generalized severe periodontitis. Of the variables tested, tooth brushing frequency (p<0.05), flossing (p=0.001), Calculus Index (p=0.001), Gingival Index (p<0.05), age (p<0.05), diabetes (p<0.05) and DMFS (p<0.05) were found to be significantly associated with mean CAL, whereas, sex (p<0.05), tooth brushing frequency (p<0.05), Calculus Index (p<0.005), age (p<0.005) and DMFS (p<0.05) were found to be significantly associated with severe periodontitis. Age, tooth brushing frequency and flossing were found to have significant independent effects on mean CAL and severe periodontitis using logistic regression analysis.

Conclusions. Considering the high prevalence of periodontitis in this population, expanded availability of community-based dental services is urgently needed.

(Keywords: Periodontitis, Sandy Bay First Nation, prevalence, clinical attachment loss)
INTRODUCTION

The community of Sandy Bay First Nation, located 65 kilometres northwest of Winnipeg, Manitoba, with approximately 4,300 members, has the services of a dentist 1 day per week. When compared to a provincial population where dental service is available at a ratio of 1:1,700, this level of dental service was considered to be grossly inadequate for the size of the community. In 2001, the Sandy Bay First Nation and the University of Manitoba created a partnership to conduct an oral health status and treatment needs survey that would document the inequalities in oral health status and inequity in access to dental care experienced by Sandy Bay community members. The results of this study will be used to redefine the community's oral health programs and form a foundation from which to lobby for additional dental program resources.

Periodontal disease refers to conditions affecting the supporting structures of the teeth, i.e., the alveolar bone, cementum and the periodontal ligament. Gingivitis and periodontitis are the most common forms of periodontal disease (1). Gingivitis is the inflammation of the gingiva and is usually reversible, whereas in periodontitis, the periodontal structures are progressively weakened (2). An epidemiologic study of periodontal disease in the United States reported gingivitis to be present in over 50% of adults, whereas periodontitis, manifested as periodontal attachment loss of 3mm or more, was present in 40% of the population (3). After caries, periodontitis is the most common reason for tooth extraction in adults (4–6).

Dental plaque infection is known to be the major etiologic factor in the pathogenesis of periodontitis (7–10). Recently, however, the host immune response to bacterial plaque infection has been implicated as a key factor in determining the extent and severity of the disease in the host (11–13).

Common clinical signs of periodontitis are increased probing depths around the tooth, spontaneous bleeding or bleeding on probing of the periodontal pocket and progressive loosening and migration of teeth, manifested as space between the teeth. The presence of the disease, as well as its extent and severity, can be determined by measuring the periodontal attachment levels using a periodontal probe (2).

Information on the periodontal status of Aboriginal people in Canada is scarce. Klooz (14) used the Community Periodontal Index of Treatment Needs (CPITN) to evaluate children aged 5–15 on a Saskatchewan reserve and found that the majority of children in the 9–15 year-old group scored greater than a CPITN of 2, thus requiring periodontal treatment by a dentist or hygienist. Schuller and colleagues (15) found that in Inuit people older than 40 years of age, periodontitis and caries were equally responsible for tooth loss and that the periodontal disease levels among adults in the Keewatin region were similar to those in southern Canada. Rea and colleagues (16) also found periodontal disease to be common among adults in the Keewatin region of the Northwest Territories. More than 73% of the dentate individuals had gingival bleeding at one or more sites. Furthermore, mean periodontal pocket depth increased with age: 1.3 mm at 18–34 years of age, rising to 2.3 mm at 55 and older. Using a variety of data sources, Skrepinski and Niendorff (17) reported a trend towards a higher prevalence of incipient and overt periodontal disease among Native Americans over time. The authors found a higher prevalence of severe periodontal disease...
among Native Americans with diabetes than those without diabetes.

Diabetes is a significant risk factor for periodontal disease as periodontitis peaks at an earlier age in diabetic patients who also suffer more severe periodontitis than non-diabetic patients (18,19). Diabetes, predominantly type 2, has become a serious health problem among the First Nation (20). The trend to early onset of type 2 diabetes in First Nation adolescents has become apparent in Canadian communities and may result in an increased prevalence of periodontitis in a younger population (21).

Smoking has been shown to be another significant risk factor for periodontitis (22–25) and is reported to be more common among First Nation populations (26,27). Tobacco users in general have a higher occurrence rate and faster progress of periodontal attachment loss and demonstrate impaired healing after treatment (28).

The aim of this study was to determine the distribution and determinants of periodontal health in a convenience sample of 107 adult members of the Sandy Bay First Nation through face-to-face interviews and oral examinations.

MATERIAL AND METHODS

Ethics approval was obtained from both the Health Research Ethics Board at the University of Manitoba and the Leadership of the Sandy Bay First Nation.

Sample selection
Sample size calculations were made accordingly: the total population of adults as per documentation provided by the community leadership was 2,000. The shareware program Epistat, a statistical program for small data sets was used for the sample size calculation. The sample size we reported was based on the exact numbers presented.

The estimated prevalence rate of severe periodontitis was 20% (29) and it needs to be 95% certain that study prevalence rates are within 7% of the actual population rates. Based on these parameters, a sample size of 118 for the adult population was established. To account for potential dropouts or no-shows, a total of 150 adults, aged 18 and over, were selected and invited to participate. However, due to a high no-show rate for scheduled examination appointments, only 107 individuals completed the interviews and the examinations.

A sampling frame of all on-reserve members of Sandy Bay First Nation was obtained from community leaders. Computer-generated lists of random numbers were used to select study subjects to ensure that all residents had an equal opportunity for selection. Local people, trained as part of the research project, contacted all potential study subjects to explain the project and determine if they might be interested in participating. When potential subjects were not interested in participating, the individual whose name appeared next in the sampling frame was approached. This protocol was followed until the required number of subjects was obtained. Signed informed consent was obtained by a trained community member. Examinations and interviews took place only after consent was obtained.

In addition, a number of volunteer subjects were also examined and interviewed. These individuals were included whenever they were needed to fill in during “down time”
for the survey team who might be away for community holidays, funerals, school closures, and so on. An estimated 50% no-show rate at the scheduled examination time for sampling frame identified the subjects.

**Interviews and examinations**

Dental examinations were conducted according to the recommended oral health survey guidelines published by the World Health Organization (30). Examinations and interviews for all the residents were conducted either in the subjects’ homes on Sandy Bay First Nation using portable dental equipment or in the health centre’s dental clinic. The location was based on the participant’s personal preference.

The intra-oral examination included an assessment of the soft tissue, presence of plaque (Debris Index) (30), calculus (Calculus Index) (30) and gingival inflammation (31) using the following teeth: first maxillary right molar (#16), maxillary right central incisor (#11), first maxillary left molar (#26), first mandibular left molar (#36), mandibular left central incisor (#31) and first mandibular right molar (#46). The clinical attachment loss (CAL), the distance in mm from the cementoenamel junction to the bottom of the periodontal sulcus, was measured using a periodontal probe on the mesiobuccal, buccal, distobuccal, mesiolingual, lingual and distolingual surfaces of the following teeth: first maxillary right molar (#16), first maxillary right premolar (#14), maxillary left central incisor (#21), first maxillary left premolar (#24), first maxillary left molar (#26), first mandibular left molar (#36), first mandibular left premolar (#34), mandibular right central incisor (#41), first mandibular right premolar (#44) and first mandibular right molar (#46). An assessment of the occlusion and the need for dental care was made.

Examiner validity and reliability was addressed by using a protocol manual developed specifically for the survey, which stressed the WHO examination criteria and standards (30). Also, calibration sessions were held to discuss examination and recording methods for all examiners and recorders. In addition, in-field duplicate examinations on volunteer subjects were performed on the first day to further facilitate examiner calibration. Where variation was identified, examiners adjusted their cut-off points by mutual agreement.

Dental radiographs were not performed as a part of the dental examination survey as they were not considered to be an appropriate epidemiological screening tool. Examinations were done using portable dental equipment. All instruments and supplies were sterilized and kept on a clean tray following universal precautions consistent with the Standards of Practice of Dentistry in Manitoba.

Face-to-face oral health interviews were performed by the study dentist and the research assistant in participants’ homes and by the research assistant in the dental clinic setting. The principle investigator and community representatives ensured community acceptability and cultural sensitivity of the interviews through mutual agreement on the content and format of each interview. Appropriate training sessions of interviewers and pilot tests of the interview were performed by the principle investigator prior to initiating the interviews.
**Statistical analyses**
A research assistant trained in the use of the program performed data entry using EpiInfo 5.0. Data were analyzed using SPSS 14.0 for Windows to report frequencies, associations between disease and risk variables. Approximately 100 different variables were examined for their potential association with periodontitis. Bivariate analysis was used to find variables significantly associated with 2 outcome variables: dichotomous mean CAL (≤2.5mm and >2.5mm) and the dichotomous severe periodontitis (1 or more sites with ≥5mm CAL). Chi-square, Fisher’s exact, Mann-Whitney and Kruskall-Wallis tests were used. Those variables found to be significantly associated with either of the outcome variables were entered into logistic regression analysis using a backward stepwise approach to look for significant independent effects (p<0.05).

Extent and severity of periodontal disease is described according to the 1999 classification of periodontal diseases by the American Academy of Periodontology (32). Extent is characterized as localized (CAL in <30% of sites) or generalized (CAL in ≥30% of sites). Severity is characterized on the basis of the amount of CAL: slight loss refers to at least one site with CAL 1–2 mm, moderate loss refers to at least one site with CAL 3–4 mm and severe loss refers to 1 or more sites with ≥5mm CAL.

**RESULTS**

**Demographics**
The sample studied consisted of 107 individuals, 64 (59.8%) of whom were females. The mean age was 34.5±12.4 years (mean±SD) for females and 38.4±10.4 years for males. Smoking was very common among this population, with 82 subjects (77.4%) being current smokers. Table I summarizes the demographics for the population studied.

**Dental self-care**
Of the individuals examined in this population, only 69.9% brushed their teeth once/day or more and the remainder reported brushing their teeth occasionally. Flossing was performed less frequently. Of the individuals studied, 18.8% reported flossing their teeth once/day or more and the remainder reported flossing occasionally.

**Periodontal health**
Six subjects (5.6%) were edentulous. The mean number of remaining teeth was 24.6±7.2. Periodontal CAL categories are summarized in Table II. It is noted that 34% of the subjects examined had generalized slight attachment loss, whereas only 6.4% of the subjects suffered from generalized severe attachment loss.

**Risk variables**
Debris, calculus and gingivitis were commonly present in this population, although in small degrees. The mean Debris Index, Calculus Index and Gingival Index were 1.1±0.9, 1.4±1.0 and 1.3±0.8, respectively. These values correspond to relatively low amounts of debris and calculus and mild gingival inflammation.
Table I. Summary of demographics.

| Relevant medical status      | Number of subjects | (Valid %) |
|-----------------------------|--------------------|-----------|
| Rheumatic fever/ heart diseases (n=106) | 5                  | (4.7)     |
| Diabetes (n=107)            | 18                 | (16.8)    |
| Marital status (n=103)      |                    |           |
| Married                     | 32                 | (31.1)    |
| Common law                  | 32                 | (31.1)    |
| Divorced/separated          | 5                  | (4.8)     |
| Single                      | 34                 | (33.0)    |
| Marital status (n=103)      |                    |           |
| Married                     | 32                 | (31.1)    |
| Common law                  | 32                 | (31.1)    |
| Divorced/separated          | 5                  | (4.8)     |
| Single                      | 34                 | (33.0)    |
| Annual income (n=85)        |                    |           |
| <$10,000                    | 53                 | (62.4)    |
| $10-$19,999                 | 14                 | (16.5)    |
| ≥$20,000                    | 18                 | (21.2)    |
| Education (n=102)           |                    |           |
| Grade 8 or less             | 33                 | (32.4)    |
| Grades 9 or 10              | 37                 | (36.2)    |
| Grade 11 and 12             | 32                 | (31.4)    |
| Other education* (n=95)     |                    |           |
| None                        | 51                 | (53.7)    |
| Some training**             | 28                 | (29.5)    |
| Diploma/certificate/degree  | 16                 | (16.8)    |
| Smoking status (n=106)      |                    |           |
| Never/former                | 24                 | (22.6)    |
| Current                     | 82                 | (77.4)    |

* Additional training after high school.
** Additional training after high school, which did not lead to a degree or certificate.

Table II. Summary of periodontal clinical attachment loss by severity and extent.

|                | Number of subjects | (Valid %) |
|----------------|--------------------|-----------|
| Slight         |                    |           |
| Localized**    | 1                  | (1.1)     |
| Generalized**  | 32                 | (34.0)    |
| Moderate       |                    |           |
| Localized      | 25                 | (26.6)    |
| Generalized    | 15                 | (16.0)    |
| Severe         |                    |           |
| Localized      | 15                 | (16.0)    |
| Generalized    | 6                  | (6.4)     |
| Total          | 94                 | (100.1)   |

* Localized: <30% sites involved.
** Generalized: ≥30% sites involved.
Bivariate analysis

The following variables were assessed in a bivariate analysis: sex, education, gingivitis, DMFS, brushing teeth, diabetes, calculus, smoking, age and flossing. As can be seen in Table III, of the variables tested, brushing teeth, diabetes, age, DMFS, flossing, gingivitis and calculus were found to be significantly associated with mean CAL.

The following variables were found to be significantly associated with the presence of severe periodontitis (localized or generalized), as can be seen in Table IV: sex, brushing teeth, age, calculus and DMFS.

Those variables found to be significantly associated with either mean CAL or severe periodontitis were entered into a logistic regression analysis using a backward stepwise approach. Age, brushing teeth and flossing were found to have significant independent effects on mean CAL and severe periodontitis as can be seen in Tables V and VI. Calculus and gingivitis were not included in the logistic regression analysis to avoid problems with multicollinearity.

Table III. Variables significantly associated with dichotomous mean clinical attachment loss*.

| # Individuals with mean CAL >2.5mm | (Valid %) |
|-----------------------------------|-----------|
| **Brushing teeth**                |           |
| Occasionally or less (n=28)       | 9         | (32.1)** |
| Once/day or more (n=66)           | 6         | (9.1)    |
| **Flossing**                      |           |
| Never (n=37)                      | 11        | (29.7)***|
| Yes (n=55)                        | 3         | (5.5)    |
| **Calculus index**                |           |
| <1.5 (n=43)                       | 1         | (2.3)****|
| ≥1.5 (n=50)                       | 14        | (28.0)   |
| **Gingival index**                |           |
| <1.5 (n=43)                       | 3         | (7.0)*** |
| ≥1.5 (n=50)                       | 12        | (24.0)   |
| **Age**                           |           |
| 18-37 (n=63)                      | 5         | (7.9)*** |
| ≥38 (n=31)                        | 10        | (32.3)   |
| **Diabetes**                      |           |
| Yes (n=10)                        | 4         | (40.0)** |
| No (n=84)                         | 11        | (13.1)   |
| **DMFS****                        |           |
| 1-35 (n=36)                       | 3         | (8.3)*** |
| 36-80 (n=40)                      | 5         | (12.5)   |
| >80 (n=18)                        | 7         | (38.9)   |

* Mean CAL ≤2.5mm, mean CAL >2.5mm.
** p<0.05.
*** p=0.001.
**** A commonly used index that counts the number of decayed, missing or filled teeth to indicate an individual’s total lifetime caries experience.
Table IV. Variables significantly associated with severe periodontitis*.

| Variable               | # Individuals with severe periodontitis | (Valid %) |
|------------------------|----------------------------------------|-----------|
| **Sex**                |                                        |           |
| Male (n=36)            | 12                                     | 33.3**    |
| Female (n=58)          | 9                                      | 15.5      |
| **Brushing teeth**     |                                        |           |
| Occasionally or less   | 11                                     | 39.3**    |
| Once/day or more       | 10                                     | 15.2      |
| **Calculus index**     |                                        |           |
| <1.5 (n=43)            | 3                                      | 7.0***    |
| ≥1.5 (n=50)            | 18                                     | 36.0      |
| **Age**                |                                        |           |
| 18-37 (n=63)           | 6                                      | 9.5***    |
| ≥38 (n=31)             | 15                                     | 48.4      |
| **DMFS**               |                                        |           |
| 1-35 (n=36)            | 3                                      | 8.3**     |
| 36-80 (n=40)           | 10                                     | 25.0      |
| >80 (n=18)             | 8                                      | 44.4      |

* >5 mm clinical attachment loss in ≥ one site (see text).
** p<0.05.
*** p<0.005.
**** A commonly used index that counts the number of decayed, missing or filled teeth to indicate an individual's total lifetime caries experience.

Table V. Logistic regression analysis for dichotomous mean clinical attachment loss*.

| Variable               | B  | OR  | p-value | 95% CI  |
|------------------------|----|-----|---------|---------|
| **Age**                | 0.874 | 2.4 | 0.017   | 1.17-4.92 |
| (1=18-27; 2=28-37; 3=38-47; 4≥48) |     |     |         |         |
| **Brushing teeth**     | -1.457 | 0.2 | 0.036   | 0.06-0.91 |
| (1=<once/day; 2=once/day or more) |     |     |         |         |
| **Flossing**           | 1.704 | 5.5 | 0.021   | 1.29-23.46 |
| (1=never; 2=occasionally or more) |     |     |         |         |

* Mean CAL ≤2.5 mm, mean CAL >2.5 mm.

Table VI. Logistic regression analysis for severe periodontitis*.

| Variable               | B   | OR  | p-value | 95% CI  |
|------------------------|-----|-----|---------|---------|
| **Age**                | 1.136 | 3.1 | 0.001   | 1.59-6.08 |
| (1=18-27; 2=28-37; 3=38-47; 4≥48) |     |     |         |         |
| **Brushing teeth**     | -1.234 | 0.3 | 0.044   | 0.09-0.97 |
| (1=<once/day; 2=once/day or more) |     |     |         |         |
| **Flossing**           | 1.079 | 2.9 | 0.074   | 0.90-9.63 |
| (1=never; 2=occasionally or more) |     |     |         |         |

* >5 mm clinical attachment loss in ≥ one site (see text).
DISCUSSION

The primary objective in this project was to describe the periodontal health status of the adults in the Sandy Bay First Nation in Manitoba, Canada. When assessed for periodontal CAL, an indicator of chronic periodontitis, almost everyone in the study population suffered from some degree of the disease. In fact, 34.0% of subjects had generalized slight CAL, whereas 16.0% had generalized moderate CAL. Only 6.4% of the subjects had generalized severe involvement.

The prevalence of moderate to severe periodontitis in this population appears to be higher than that reported for the general population in North America. Using the National Health and Nutrition Examination Survey (NHANES) III, Albandar (33) reported the prevalence of moderate to severe periodontitis in the general population in the United States to be 53.1%. However, our results indicate the prevalence of the same disease category to be 65%, clearly higher than that for the general population in North America. It is noteworthy that, unlike the study by Albandar (33) in which oral radiographs were used to assess periodontal disease status, we used CAL measurements, a more accurate measure of periodontitis.

Skrepcinski and Niendroff (17) reported on the periodontitis status of Native Americans. The authors reported a trend towards a higher prevalence of incipient and overt periodontal disease among Native Americans over time. In another study, Rea et al. (16) examined the oral health status of 397 adults in the Keewatin region of the Northwest Territories in Canada. The authors found that among the subjects studied, periodontitis was not only common but also increased with age. The mean pocket depth was 1.3 mm for the 18–34 year-old group, rising to 2.3 mm for the 55 years old and older.

In another study, Locker and Leake (34) found that age, education, current smoking status and the number of teeth had the most consistent independent effects on periodontal disease experience in the general population of older adults living in Ontario, Canada. Our results indicate that age, the frequency of brushing teeth and flossing frequencies were independently associated with mean clinical attachment loss and the presence of severe periodontitis. It is noteworthy that Rea et al. (16) used periodontal pocket depth as a measure of periodontal disease, whereas in our study, CAL measurements, a more accurate measure of periodontitis, were used.

According to the Canadian Tobacco Use Monitoring Survey (CTUMS) in 2003, approximately 25% of Canadians 20-years of age and older smoke (35); however, there is a great variation in smoking rates among different ethnic groups (26). The highest prevalence of smoking has been reported for members of the Canadian First Nation. Millar (26) reported the prevalence of smoking among Canadian First Nation to be 59%. In our study, we found that the prevalence of smoking among the Sandy Bay First Nation was 77.4%, about 3 times the national rate.

Hyman (36) reported smoking to be a strong risk factor for periodontitis. Solomon et al. (37) reported that smokers had a higher prevalence of periodontal disease than non-smokers. Sheiham (38) believed that smoking contributed to periodontal disease, not directly, but through making the practice of oral hygiene more difficult. Finally, Bergstrom et al. (39) found 72 smokers among 235 professional musicians with good oral hygiene. They
reported the alveolar bone height to be significantly reduced in smokers versus non-smokers. In our study, smoking was found to be associated with periodontitis, although the association was not statistically significant due largely to the small number of non-smoking subjects and the confounding fact that these non-smoking subjects had a higher mean average age than current smokers (39.6 and 35.0 years, respectively).

As in other cross-sectional surveys, our study does not provide the same level of evidence as that produced in longitudinal studies. Also, although the number of edentulous individuals in the population studied was low, only 6 out of 107 individuals (5.6%), not every member of the population studied was dentate. Therefore, the results in this investigation should be interpreted with these limitations in mind. Another limitation was that a number of volunteer subjects were included in the sample to fill in during “down time” for the survey team and for an estimated 50% of no-shows at the scheduled examination time. Inclusion of these subjects will limit the ability to generalize these results to other community members who did not participate in the research. Finally, the small sample size used in the study precluded detection of smaller degrees of association between disease and risk variables, thus increasing the risk of a beta (Type II) error.

To recapitulate, this survey found that the periodontal health of this population was poor. Given the size of the community and the demonstrated periodontal health concerns evident in this adult population, timely and regular dental care is critical in preventing this condition. With only a single day of on-reserve dental service available for more than 4,300 community members, the observed inequalities in oral health are endemic in nature. As reflected by the poor periodontal health of the population, expanded availability of community-based dental services is urgently needed.

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