

# An Assessment of Oral Health on the Pine Ridge Indian Reservation

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The Oglala Sioux Tribe reviewed the protocol and helped make the study possible. Jason Krause of Henry Schein, Inc. donated the gloves, masks, and disposable mirrors used for dental examinations. The University Of Colorado School Of Dentistry donated toothbrushes and dental supplies for distribution to study participants. The recruiters, screeners, and recorders for the study were, in alphabetical order: Stormie Clifford BS, Patty Conroy, Dallas Daniels RDH, BS, Joaquin Gallegos, Maxine Janis MPH, RDH, Stacy Milakowitsch RDH, BS, and Kendra Velasquez BS. We thank Maxine Janis for recruitment of Lakota-speaking study participants. Sam Hoffman of Focus Photography provided expert photo retouching.

The principal investigator was Judith Albino Ph.D., Director of the Center for Native Oral Health Research in the Centers for American Indian and Alaska Native Health, Colorado School of Public Health. The project director and study dentist was Terry Batliner, DDS, MBA, a member of the Cherokee Nation of Oklahoma and Associate

Director for the Center for Native Oral Health Research.

## Abstract

**Background.** This study assessed the oral health of the Pine Ridge Oglala Lakota people, described a new oral health assessment tool for Indigenous people, and suggested ways to improve Native oral health.

**Methods.** The Check Up Study team of dentist and dental hygienists performed examinations of teeth and oral soft tissue for a convenience sample of 292 adults and children. Screening personnel counted the number of decayed, filled, sealed and total teeth, used probes to measure periodontal disease, and screened for oral lesions.

**Results.** Half of adults had 27 or fewer teeth. Sixteen percent of adults had at least one tooth with a pocket depth  $\geq 6$ mm. Participants had higher numbers of decayed teeth ( $p < 0.0001$ ), and lower numbers of filled teeth ( $p < 0.0001$ ) than those reflected in Indian Health Service cross-tribe aggregated data from 1999.

**Conclusions.** Amongst Oglala Lakota people of Pine Ridge, the Check Up study documented a high prevalence of caries and periodontal disease, numerous people with missing teeth, and many unmet dental needs.



**Figure 1. Study dentist Terry Batliner examines a study participant near the Bad Lands of South Dakota**

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### Introduction

The health disparities experienced by American Indians and Alaska Natives are many and far reaching, including oral/dental diseases, such as caries (cavities), periodontal

(gum) disease, tooth loss, and oral cancer. Adequate dental care can prevent and treat caries and reduce tooth loss.

Regular and systematic population-wide surveillance studies of oral health indicators have not been carried out repeatedly over time, yet American Indian tribes seeking to improve oral health and related services need accurate information about their oral health status.

This study looked at dental issues, periodontal disease, oral lesions, and need for dental care at the Pine Ridge Reservation for the Oglala Sioux tribe. There is a strong need for a comprehensive report on the oral health of the Oglala Lakota people. A description of the current oral health status of the Oglala Lakota people will help the tribe understand their needs for dental care and document oral health disparities in the American Indian community. The last Indian Health Service report on dental needs was published in 1999, and targeted only people who were Indian Health Service patients<sup>1</sup>. Inclusion of oral health status data from tribal individuals not accessing care from Indian Health Service dental clinics is merited to provide greater information about oral disease prevalence and needs. Most reports<sup>1, 2</sup> aggregated data across regions. In addition, the most recent report<sup>3</sup> did not include information on oral lesions.

“Check Up: An Oral Health Disparities Study” (referred to hereafter as the Check Up Study) assessed the adult and pediatric dental health among members of the Oglala Sioux Tribe and was funded by the W.K. Kellogg Foundation (<http://www.wkkf.org/>). We conducted a survey of the current oral health of 292 Oglala Lakota residents of the Pine Ridge Indian Reservation.

## Specific Aims

1. To obtain a baseline assessment of the oral health of the Oglala Lakota people on the Pine Ridge Indian Reservation.
2. To describe the use of a rapid oral health assessment method for Indigenous people designed and implemented by American Indian investigators.
3. To suggest possible ways to improve the oral health of the Oglala and other Native tribes.

## Study Site

The study was conducted in Pine Ridge Indian Reservation, the second largest reservation in the US. The population of roughly 32,000 is spread thinly over 4,353 square miles, an area larger than the state of Connecticut<sup>4</sup>. Many people on the reservation live in remote, rural locations and have limited access to health services. More than 62 percent of the current population of the Pine Ridge Indian Reservation lives below the federal poverty line<sup>5</sup>.

## Methods

The study protocol was reviewed by both the Colorado Multiple Institutional Review Board and the Oglala Sioux Tribe Research Review Board at Pine Ridge.

## Participant recruitment.

Study personnel recruited most study participants directly. The study personnel handed out flyers describing the study and

displayed posters at community sites such as grocery stores, health fairs, tribal government offices, tribal college centers, schools, and at the University of Colorado Denver Pine Ridge field office on the Pine Ridge Reservation. The majority of study recruitment occurred during the annual Oglala Lakota Nation Pow Wow in the town of Pine Ridge, South Dakota. Study participants gave written informed consent. In the case of children, participants gave assent, with written parental informed consent.

## Study Staff and Trainings.

A team of one dentist and three licensed dental hygienists conducted oral health screenings. One of the hygienists, who served as a study recruiter, is fluent in Lakota, the indigenous language of the Oglala people. A team of four recruiters collected informed consent documents and recorded survey information. A study manual guided the training of the examiners. The project director (TB) was considered the gold standard examiner. The Project Director trained two other screeners. Examiners learned the oral health needs classification criteria and proper use of survey instruments and techniques. During the training TB and the screeners served as mock study participants. Each screener conducted a visual oral examination, according to the study protocol, and recorded the results.

Training did not involve statistical tests of calibration. If the results obtained by the trainee differed from those of the gold standard examiner, the trainee and the gold standard examiner re-examined the patient together to ensure that the proper definitions were being used, and to achieve consensus.

## Sample.

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A total of 306 participants gave consent. Four participants completed consent, but then refused to be screened. One participant began, but did not complete the screening exam. Two participants were not residents of the Pine Ridge Indian Reservation, an inclusion criterion. Seven participants had missing or incongruent data. Incongruent data occurred when the total number of filled teeth exceeded the total number of teeth. The final analysis included 292 participants, with 135 adults and 157 children.

### Survey.

The study screened a convenience sample of adults and children from twenty different communities on the Pine Ridge Indian Reservation. Study participants received examinations in a folding chair (#MS10-092-012-08, Wal-Mart, Bentonville, AR). Screening personnel took standard universal precautions, including gloves, safety glasses, masks, and disposable mirrors and probes. The examiner sat on a portable stool (stool model #37800BLK1W, Wal-Mart, Bentonville, AR). The study dentist, Terry Batliner DDS, MBA, is shown examining a study participant in Figure 1. Screeners did not take radiographs or use explorers during the survey.

The examination took approximately 15 minutes per person, and consisted of a complete screening examination of teeth and oral soft tissue. The screeners identified areas on a tooth as carious if they were cavitated (visible loss of tooth structure and > 1mm in diameter or width). If the lesion was not cavitated and small (<1 mm in diameter or width) it was considered non-carious. Screening personnel counted the number of decayed, filled, sealed, and total teeth, including permanent and

deciduous teeth<sup>6</sup>, and recorded any intraoral lesion or dental abscess. After the examination, screeners gave study participants a brief summary of their dental condition and a recommendation for treatment.

Screeners assessed periodontal disease by measuring pocket (loss of tissue height and attachment) depth in the upper right, upper left, lower right, lower left, upper anterior, and lower anterior sextants of the mouth<sup>7</sup>. Examiners measured pocket depth with a community periodontal index of treatment needs (CPITN) Type C PDT sensor-probe, Type C 3.5-5.5-8.5-11.5 (Zila Dental Technologies Inc., Batesville, AR). The examiner measured each sextant of the mouth with the probe to find the greatest pocket depth. Screeners classified study participants who had at least one measurement of pocket depth greater than 4mm as having periodontal disease. Screeners diagnosed advanced periodontal disease if at least one measurement of pocket depth exceeded 6 mm.

### Statistical Methods

Analysts classified participants 18 years of age or older as adults. For comparison of outcomes to IHS data, analysts classified participants into age groups similar to those used in the 1999 IHS study<sup>1</sup>. The analysis of decayed and filled teeth compared the mean number of decayed and filled teeth stratified by age group in a generalized linear model with a Poisson link function. To assess the association between periodontal disease prevalence and age group, analysts used a Cochran-Mantel-Haenszel statistic with modridity scores, to account for the ordinal nature of both the rows and columns. Analysts used the same method to examine the association between dental

needs and age. The Cochran-Mantel-Haenszel statistic is useful for the analysis of ordinal categorical data.

Screeners categorized participants into one of three groups; the group classification depended on the screener's assessment of the study participant's dental, periodontal, and soft tissue health.

### **1. No oral health needs anticipated for the next six months.**

Screeners classified study participants as having no oral health needs for the next six months if they had no obvious dental, periodontal or soft tissue problems.

### **2. Needs oral health care within six months.**

Screeners classified study participants as needing oral health care within six months if they had at least one moderate dental, periodontal, or soft tissue problem. Moderate dental problems included a single large or multiple smaller areas of dark stain on any tooth, missing previously present dental restorations, or the presence of at least one non-painful unfilled carious lesion. Moderate periodontal problems included plaque or calculus buildup at least one millimeter above the gingival margin, plaque-induced gingivitis characterized by redness or swelling of the gingival tissue, or a periodontal pocket depth on any tooth of 4 or 5 millimeters. Moderate soft tissue problems included oral lesions of known traumatic origin.

### **3. Needs oral health care urgently.**

Screeners classified study participants as needing oral health care urgently if they had at

least one urgent dental, periodontal, or soft tissue problem. Urgent dental problems included at least one open carious lesion causing pain, an abscess, a fractured tooth causing pain, or broken and non-functioning dental restorations. Urgent periodontal needs included a periodontal pocket depth of 6 millimeters or deeper on any tooth, a periodontal abscess or any other infection of the supporting structures of the teeth. Urgent soft tissue problems included any oral soft tissue lesion of apparent non-infectious origin, including any areas of roughened or corrugated soft tissue visible on examination, or any soft tissue infection causing pain, distress, or interference with activities of daily life.

## **Results**

Table 1 describes the characteristics of the study participants. Two-thirds of the study population came from the Manderson, Oglala, Pine Ridge, and Porcupine areas, the districts with the highest population density on the Pine Ridge Indian Reservation.

On average, children had two decayed primary teeth and two decayed permanent teeth. Adults had an average of five decayed teeth (Table 2). Ninety percent of participants (261 of 292) had at least one decayed tooth. Eighty-four percent of children (132 of 157) children and 97 percent of adults (131 of 135) had at least one decayed tooth.

Adults with wisdom teeth may have 32 teeth; those with wisdom teeth removed have 28. About half of the adult study participants had 27 or fewer teeth (Figure 2). Thirty-four adults (25 percent) had 23 or fewer teeth. Fourteen adults (10 percent) had 16 or fewer teeth. Two adults had no teeth at all. One

**Table 1. Characteristics of Participants**

	No. of Participants	
	Children	Adults
<b>Age</b>	<b>N=157</b>	<b>N=135</b>
Mean age	9.5	36.9
Age range	5 to 17	18-74
<b>Gender — no. (percent)</b>		
Female	81 (51.6)	94 (69.6)
Male	74 (47.1)	41 (30.4)
Missing	2 (1.3)	

adult had only one tooth, and another adult had only two teeth.

When categorized by equivalent age groups, the Oglala Lakota population had significantly higher numbers of decayed teeth ( $F = 129.75$ ,  $ndf = 4$ ,  $ddf = 111$ ,  $p < 0.0001$ ) and significantly lower numbers of filled teeth ( $F = 133.50$ ,  $ndf = 4$ ,  $ddf = 111$ ,  $p < 0.0001$ ) than the 1999 Indian Health Service user population<sup>1</sup>.

Ninety-two adults (68 percent) had some evidence of periodontal disease, with 22 adults (16 percent) having advanced periodontal disease (at least one pocket depth 6 mm or greater). Periodontal disease presence and severity was worse in the Oglala Lakota population than in the Indian Health Service

user population (Indian Health Service, 1999) ( $p=0.0015$ ).

Screeners found one child (0.6 percent) and five adults (3.6 percent) to have areas of roughened or corrugated oral mucosa. Screeners found four areas of roughened or corrugated oral mucosa in adult males, one in an adult female, and one in an adolescent male. The prevalence of areas of roughened or corrugated oral mucosa in adult males was 10 percent.

Forty percent of the children (63 of 157) and 59 percent of the adults (80 of 135) had moderate or urgent dental care needs (Table 3). Adults were significantly more likely to need care ( $p=0.002$ ).

**Table 2. Mean (SD) number of decayed, filled, decayed and filled primary and permanent teeth in children and adults**

Group	Teeth	Decayed	Filled	Decayed or Filled	Sealed	Total Teeth
Children	Primary	1.5 (2.4)	2.0 (3.0)	3.5 (3.6)	0	7.7 (6.8)
Children	Permenant	2.2 (3.2)	0.5 (1.1)	2.6 (3.5)	1.7 (3.3)	15.9 (9.6)
Adults	Permenant	5.1 (4.5)	4.9 (4.1)	10.0 (4.5)	0.5 (1.4)	24.7 (6.7)*

*\*Adults with wisdom teeth have 32 teeth*

**Table 3. Oral health needs in adults and children.**

	No Immediate Needs	Needs Care Within Six Months	Urgent
Children	59.9%	29.3%	10.8%
Adults	40.7%	34.8%	24.4%

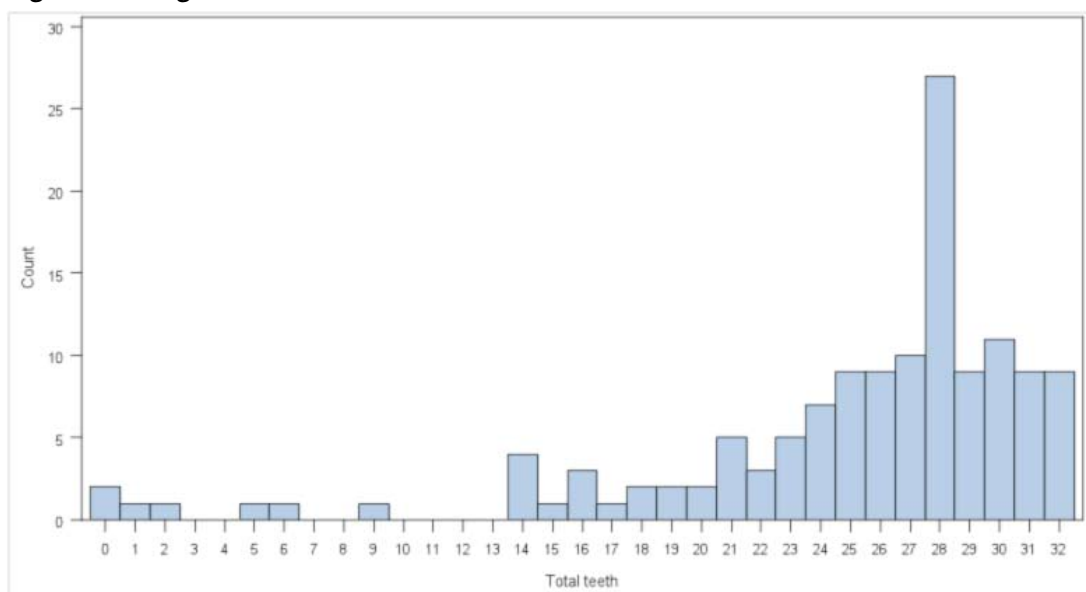
**Discussion**

One in ten adults surveyed had 16 or fewer total teeth. Difficulty chewing is correlated with missing teeth<sup>8,9</sup>. In older adults, missing teeth can cause the intake of fewer calories and necessitate a soft food diet higher in sugar and fat<sup>10</sup>. Thus poor dental health can have a strong effect on overall health and wellbeing. The lack of prosthetic services for adults makes the loss of teeth a significant problem on the Reservation. The high prevalence of decay and periodontal disease observed in the Check Up study is almost certainly associated with a high level of untreated pain.

Ten percent of the adult males surveyed in the Check Up Study had areas of roughened or corrugated oral mucosa. For comparison, studies of leukoplakia in other populations are listed in Table 4<sup>11,12,13,14</sup>. Sandler and colleagues (1963) used pathological confirmation of all lesions; the other studies relied on clinical impression, with biopsy reserved for questionable cases<sup>11,12,13,14</sup>. Future studies should query respondents about alcohol use, smoking, and use of oral tobacco products, in an effort to establish the causes of the high prevalence of oral lesions seen in the Check Up Study.

This is an observational study using convenience sampling. The study population may

**Figure 2. Histogram of total teeth in adults**





**Table 4. Prevalence of roughened or corrugated areas of oral mucosa from the Check Up study in Oglala Lakota adult males compared to the prevalence of lesions clinically diagnosed as leukoplakia in other studies**

Author	Population	Prevalence of lesions
Morger et al., 2010**	Swiss enlisted men	1%
Sandler et al., 1962*	VA population	3%
Bouquot et al., 1986**	White male Americans over the age of 35	4.3%
Check Up Study, 2010***	Adult males on the Pine Ridge Indian reservation	10%

\*all pathologically confirmed,

\*\* clinical judgment, with occasional pathological confirmation,

\*\*\*clinical judgment

not be representative of the general population of the Pine Ridge Indian Reservation. Residents with oral lesions, decayed teeth, or missing teeth may have been more likely to consent to the study than the general population, causing an upward bias in the prevalence of oral health problems. It is equally likely to suppose that residents with poor oral health avoided screening examinations, which would bias the prevalence downwards.

No information was collected on diet, tobacco, or alcohol use. The classification of oral health needs was a multi-component classification, and was not broken down into the three components of dental, periodontal, and soft tissue problems. Such information and a breakdown would be useful for planning solutions to the oral health problems of the Oglala Lakota people and other Native tribes.

### Identifying the Causes of Poor Oral Health.

It is unclear whether the poor oral health of the Oglala Lakota described in this study arises from structural health system problems, or from behavioral risk factors that affect dental and soft tissue disease.

Loss of the indigenous diet has been implicated in increased levels of dental caries and missing teeth<sup>15</sup>. The number of decayed and missing teeth observed in this study may be explained by the forced loss of the tribe's traditional diet of buffalo, berries, and roots<sup>16</sup>, and its replacement by a diet high in sweetened beverages and fat, and low in fruits and vegetables<sup>17</sup>. A number of studies have indicated that the diets of American Indians are high in refined carbohydrates, sugars, sweetened beverages, and other foods labeled as high risk factors for caries formation<sup>18,19</sup>. Some studies have suggested that changing dietary beliefs resulting from acculturation, including changes in traditional eating behaviors, can further deter healthful eating and increase risk for Early Childhood Caries (ECC) and obesity<sup>20</sup>.

Native Americans have high rates of behavioral risk factors that contribute to cancer of the oral cavity and pharynx<sup>2</sup>. These include smoking<sup>21</sup> and high use of smokeless tobacco products, even among school children<sup>22,23</sup>. The Centers for Disease Control estimates that one in four high school males in Bureau of Indian Affairs funded schools use smokeless tobacco<sup>24</sup>. Smokeless tobacco use has been

shown to increase the rate of leukoplakia, a potentially pre-malignant lesion<sup>25</sup>. Northern Plains tribes experience high rates of cancer of the oral cavity and pharynx<sup>26</sup>.

The high prevalence of oral health problems may be attributable not only to behavioral risk factors, but to barriers that prevent access to oral health care. The barriers to access to care for the Oglala Lakota include poverty, a paucity of oral health providers and difficulty in transportation. More than 46 percent of the current population of the Pine Ridge Indian Reservation lives below the federal poverty line<sup>27</sup>. Many people on the reservation live in remote, rural locations at great distance from any oral health services. On the Pine Ridge Indian Reservation, there are three staffed Indian Health service dental clinics: one in the village of Pine Ridge, the largest settlement, one in Kyle (51 miles from Pine Ridge) and Wamblee (99 miles from Pine Ridge). The population is spread thinly over 4,353 square miles, an area larger than the state of Connecticut<sup>27,29</sup>. The population of 32,000 people is served by only 9 dentists, a ratio of 31 dentists per 100,000 people<sup>30</sup>. By contrast, the state of Connecticut has 66.3 dentists per 100,000 people<sup>30</sup>. Broderick and colleagues (2000) note that "Large amounts of dental needs go unmet each year in the Native American population..." because "...dental services are prioritized and rationed<sup>31</sup>."

### Policy Implications and Potential Solutions.

Alaska Natives face many of the same challenges as the Oglala Lakota people. Both people experience poor oral health. In Alaska, new legislation has allowed mid-level dental providers to provide dental care to the Alaska Native Community. The first reports of

outcomes are promising. Bolin (2008) analyzed the dental records of patients treated by dentists and dental health aide therapists, and showed that the two classes of dental providers had similar outcomes for irreversible dental procedures<sup>32</sup>. Wetterhall, et al. (2010) studied the first cohort of dental therapists working in Alaska and found that the therapists were "technically competent"<sup>33</sup>. The patients of the dental therapists were "generally very satisfied"<sup>33</sup>.

The Oglala Sioux Tribe recently adopted a resolution for a Dental Health Aide Therapist program (DHAT), which allows DHAT's trained at the Oglala Lakota College to practice on the Pine Ridge Reservation. This resolution has been supported by the Oglala Lakota College in training local people to provide basic dental care on the reservation (OST resolution). It would be beneficial to study whether Dental Health Aide Therapists could provide cost effective, geographically accessible, and sufficiently high quality oral health care to improve the oral health of the Oglala Lakota people. Dental health aide therapists could also implement broad-based prevention programs promoting good oral hygiene and oral disease prevention.

### Conclusion

By any measure, the oral health of the Oglala Lakota people is poor. The Check Up Study documented a high prevalence of caries and periodontal disease, numerous people with missing teeth, and many unmet dental needs. Any future survey needs to measure pain, difficulties in activities of daily living, oral-health related quality of life, and orthodontic needs. Future studies of oral health-related behaviors and access to oral health care are needed to

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explain the dental, periodontal, and soft tissue problems that adversely affect the Oglala Lakota tribe.

A revised version of the oral health survey developed for the Oglala Lakota people will be used for other Native communities.

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### About the Author

Dr Terry Batliner, DDS is currently PI of a five-year clinical trial, testing the effectiveness of motivational interviewing as an intervention to reduce early childhood caries (ECC) in a Northern Plains American Indian (AI) tribe. He is also involved in several other studies aimed at reducing early childhood caries in Native populations. As a dentist and member of the Cherokee Nation of Oklahoma with experience in the Indian Health Service, Dr. Batliner is interested in changing the high rate of ECC that has afflicted many AI communities for decades. The rate of ECC has not declined in the past 25 years and may be on the rise in some AI communities. He is interested in a multi-pronged approach combining biological interventions based on an understanding of the microbiology of ECC coupled with behavioral interventions designed to improved oral hygiene and diet.

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