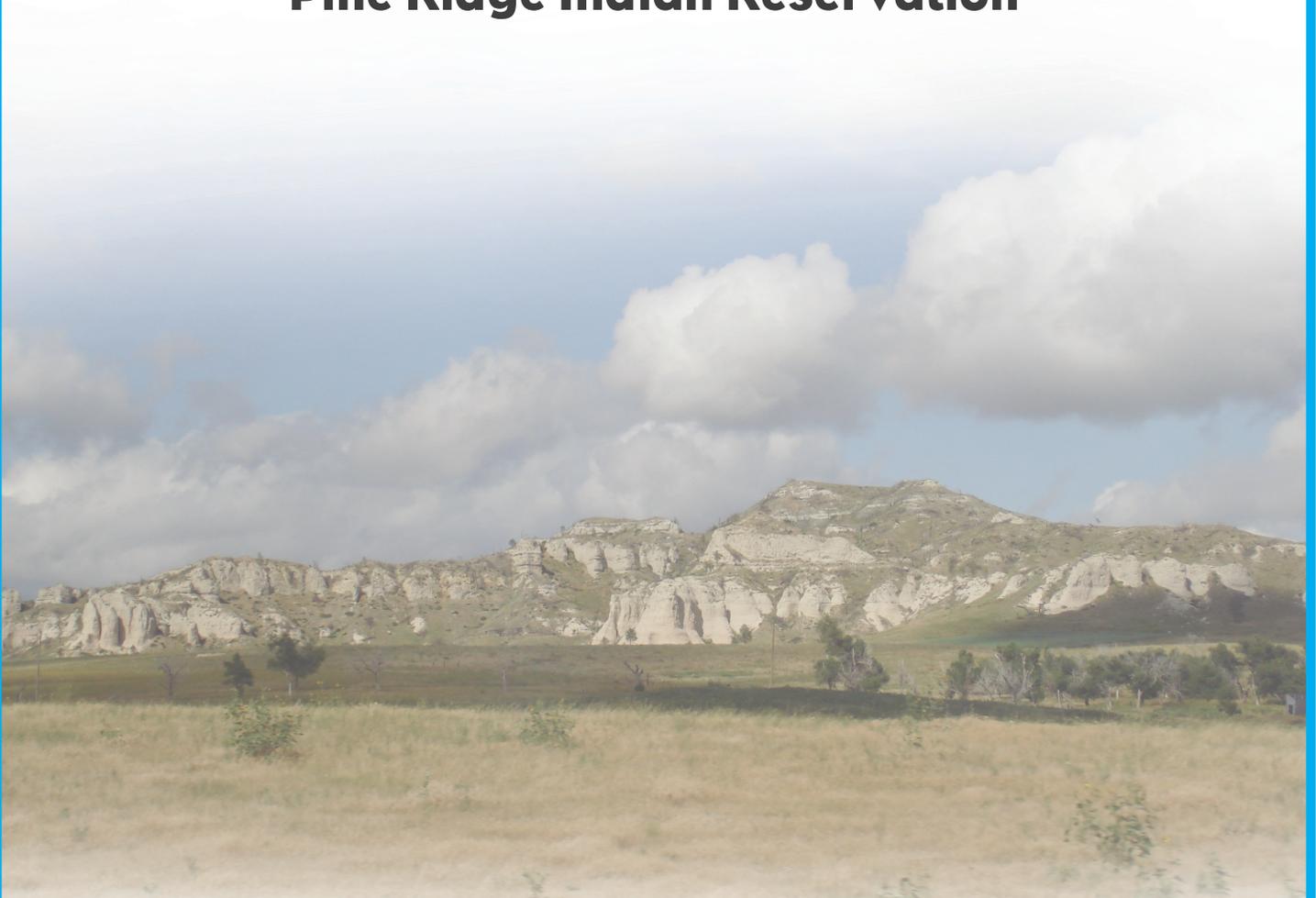


AN
ASSESSMENT OF
ORAL HEALTH
ON THE
Pine Ridge Indian Reservation



 **W.K. KELLOGG**
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An Assessment of Oral Health on the Pine Ridge Indian Reservation

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Abstract

Background. We 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. A study team of dentists 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 the adults screened had 27 or fewer teeth. Sixteen percent of adults had at least one tooth with a pocket depth > 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 (IHS) cross-tribe aggregated data from 1999.

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

Clinical Implications. Future studies of oral health-related behaviors and access to oral health care are needed to explain the dental, periodontal, and soft tissue problems that adversely affect the Oglala Lakota tribe.

Key Words. American Indians, Native, Indigenous, dental caries, periodontal, poverty

Introduction

The objectives of this study are: 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; and 3) to suggest possible ways to improve the oral health of the Oglala and other Native tribes.

Supplying the Lakota people with accurate information about their oral health status is the first step toward helping the community improve their oral health. In turn, the model developed for the Lakota can be used for other Native communities. In some ways, the barriers to good oral health faced by Oglala Lakota people are the same barriers that face many other Native tribes.

There is a strong need for a comprehensive report on the oral health of the Oglala Lakota people. The last Indian Health Service (IHS) report on dental needs was published in 1999 and targeted only people who were IHS patients¹. Most reports^{1,2} aggregated data across regions. In addition, the most recent report did not include information on oral lesions.

To fill this gap, we conducted a survey of the current oral health of 292 Oglala Lakota study participants, residents of the Pine Ridge Indian Reservation. The study looked at dental issues, periodontal disease, oral lesions, and need for dental care.

Methods

“An Assessment of Oral Health on the Pine Ridge Indian Reservation” (referred to hereafter as the Oral Health Study) assessed the adult and pediatric dental health among members of the Oglala Sioux Tribe. The W.K. Kellogg Foundation (<http://www.wkkf.org/>) funded the Oral Health Study. Both the Colorado Multiple Institutional Review Board and the Oglala Sioux Tribe Research Review Board at Pine Ridge approved a written protocol for the study.

The study screened a convenience sample of adults and children from 20 different communities on the Pine Ridge Indian Reservation. 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 screeners collected data between July 31 and August 8, 2010. Most study recruitment occurred during the annual Oglala Lakota Nation Pow Wow, held August 5 through 8, in the town of Pine Ridge, SD. A team of one dentist and three licensed hygienists conducted oral health surveys. 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.

Study participants gave written informed consent. In the case of children, participants gave assent with written parental informed consent. 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.



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

A study manual guided the training of the examiners. Project Director Terry Batliner was considered the gold standard examiner. On July 30, 2010, Batliner trained two other screeners. Examiners learned the oral health needs classification criteria and proper use of survey instruments and techniques. During the training, Batliner and the screeners served as mock study participants. Each screener conducted a visual oral examination, according to the study protocol, and recorded the results. Three licensed dental hygienists, including the gold standard examiner, participated in the survey.

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.

The examination took approximately 15 minutes per person and consisted of a complete examination of teeth and oral soft tissue. The screeners identified spots on a tooth as carious if they were cavitated. 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 teeth³, and recorded any lesion or abscess seen in the mouth. 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 depth in the upper right, upper left, lower right, lower left, upper anterior, and lower anterior sextants of the mouth⁴. 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 4 mm as having periodontal disease. Screeners diagnosed advanced periodontal disease if at least one measurement of pocket depth exceeded 6 mm.

Screeners categorized participants into one of three groups: (1) No oral health needs anticipated for the next 6 months; (2) Needs oral health care within 6 months; or (3) Needs oral health care urgently. The group classification depended on the screener's assessment of the study participant's dental, periodontal, and soft tissue health.

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 mm 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.

Screeners classified study participants as needing oral health care within 6 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 1 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.

Screeners classified study participants as having no oral health needs for the next 6 months if they had no obvious dental, periodontal, or soft tissue problems.

The protocol called for accruing 200 adults and 200 children. 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.

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 study¹. 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 modridit 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.

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.

Table 1. *Characteristics of participants*

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

On average, children had two decayed primary teeth and two decayed permanent teeth. On average, adults had 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% of adults (131 of 135) had at least one decayed tooth.

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	Permanent	2.2 (3.2)	0.5 (1.1)	2.6 (3.5)	1.7 (3.3)	15.9 (9.6)
Adults	Permanent	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.*

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%) had 23 or fewer teeth. Fourteen adults (10%) had 16 or fewer teeth. Two adults had no teeth at all. One had only one tooth, and one had two.

When categorized by equivalent age groups, the Pine Ridge 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 IHS user population¹.

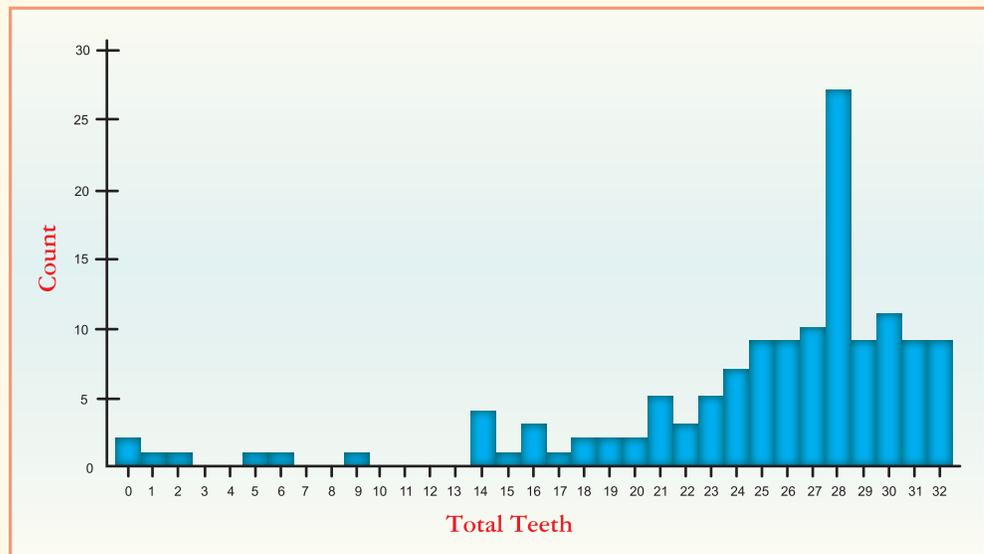


Figure 2. Histogram of total teeth in adults

Ninety-two adults (68%) had some evidence of periodontal disease, with 22 adults (16%) having advanced periodontal disease (at least one pocket depth greater than 6 mm). Periodontal disease presence and severity was worse in the Oglala Lakota population than in the IHS user population (IHS, 1999) (Cochran-Mantel-Haenszel $X^2 = 0.81$; $p = 0.0015$).

Screeners found one child (0.6%) and five adults (3.6%) 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%.

Forty percent of the children (63 of 157) and 59% of the adults (80 of 135) had moderate or urgent dental care needs (Table 3). Adults were significantly more likely to need care (Cochran-Mantel-Haenszel $X^2 = 13.7$, $p = 0.002$).

Table 3. Oral health needs in adults and children

	Oral Health Needs		
	No Immediate Needs	Needs Care Within 6 Months	Urgent
Children	59.9%	29.3%	10.8%
Adults	40.7%	34.8%	24.4%

Discussion

Summary

Of those surveyed, 1 in 10 adults had 16 or fewer total teeth. Difficulty chewing is correlated with missing teeth^{5,6}. In older adults, missing teeth can cause the intake of fewer calories and increased amount of sugar and fat⁷. Thus poor dental health can have a strong effect on overall health and well-being. 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 Oral Health Study is almost certainly associated with a high level of untreated pain. Finally, access to orthodontic services is virtually non-existent for most of the residents on Pine Ridge. This could have been a contributing factor for the relatively poor state of periodontal health observed. Crowding and other malocclusions have been identified as contributing factors to periodontal disease⁸.

Ten percent of the adult males surveyed in the Oral Health Study had areas of roughened or corrugated oral mucosa. For comparison, studies of leukoplakia in other populations are listed in Table 4^{9,10,11,12}. Sandler et al. (1963) used pathological confirmation of all lesions: the other studies relied on clinical impression, with biopsy reserved for questionable cases^{9,10,11,12}. 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 Oral Health Study.

Table 4. *Prevalence of roughened or corrugated areas of oral mucosa from the Oral Health 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%
Oral Health Study, 2010***	Adult males on the Pine Ridge Indian reservation	10%

all pathologically confirmed **clinical judgment, with occasional pathological confirmation *clinical judgment*

Limitations of the Study

This is an observational study using convenience sampling. The study population may 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 use, 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 teeth¹³. 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 roots¹⁴, and its replacement by a diet high in sweetened beverages and fat, and low in fruits and vegetables¹⁵.

Native Americans have high rates of behavioral risk factors that contribute to cancer of the oral cavity and pharynx². These include smoking¹⁶ and high use of smokeless tobacco products, even among school children (T. Batliner, DDS, oral communication, October 2010)¹⁷. The Centers for Disease Control estimates that one in four high school males in Bureau of Indian Affairs-funded schools use smokeless tobacco¹⁸. Smokeless tobacco use has been shown to increase the rate of leukoplakia, a potentially pre-malignant lesion¹⁹. Northern Plains tribes experience high rates of cancer of the oral cavity and pharynx²⁰.

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 for the Oglala Lakota include poverty, a paucity of oral health providers and great distances between patients and oral health providers. More than 46% of the current population of the Pine Ridge Indian Reservation lives below the federal poverty line²¹. 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 IHS dental clinics: one in the town of Pine Ridge, the biggest settlement, one in Kyle (51 miles from Pine Ridge), and one in Wamblee (99 miles from Pine Ridge). The population is spread thinly over 3,159 square miles, an area larger than the state of Connecticut^{22, 23}. The population of 28,797 people is served by only nine dentists, a ratio of 31 dentists per 100,000 people²⁴. By contrast, the state of Connecticut has 66.3 dentists per 100,000 people²⁴. Broderick et al. (2000) notes that "Large amounts of dental needs go unmet each year in the Native American population implying, "...dental services are prioritized and rationed"²⁵.

Policy Implications and Potential Solutions

Alaska Natives face many of the same challenges as the Oglala Lakota people. Both peoples 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 procedures²⁶. Wetterhall, et al. (2010) studied the first cohort of dental therapists working in Alaska and found that the therapists were "technically competent"²⁷. The patients of the dental therapists were "generally very satisfied"²⁷.

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.

Another policy approach to improve the oral health of the tribe would be a state policy which allows licensed hygienists to practice as dental therapists. In the state of Minnesota, licensed dental hygienists with advanced training can serve as dental therapists. The Master of Science in Oral Health Care Practitioner

program prepares licensed hygienists to serve as dental therapists in areas with considerable unmet oral health needs. In the Oral Health Study, dental hygienists were an essential component in the assessment of oral health needs. It is likely that dental hygienists will be a principal component of the solution to the poor oral health status of the Oglala Lakota.

Another option is for the tribe to implement its own oral health care system. Public Law 93-638, the Indian Self-Determination and Education Assistance Act of 1975, Titles I and III, allows tribes to take federal dollars and control their own health-related programs.

Conclusion

By any measure, the oral health of the Oglala Lakota people is poor. The Oral Health 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 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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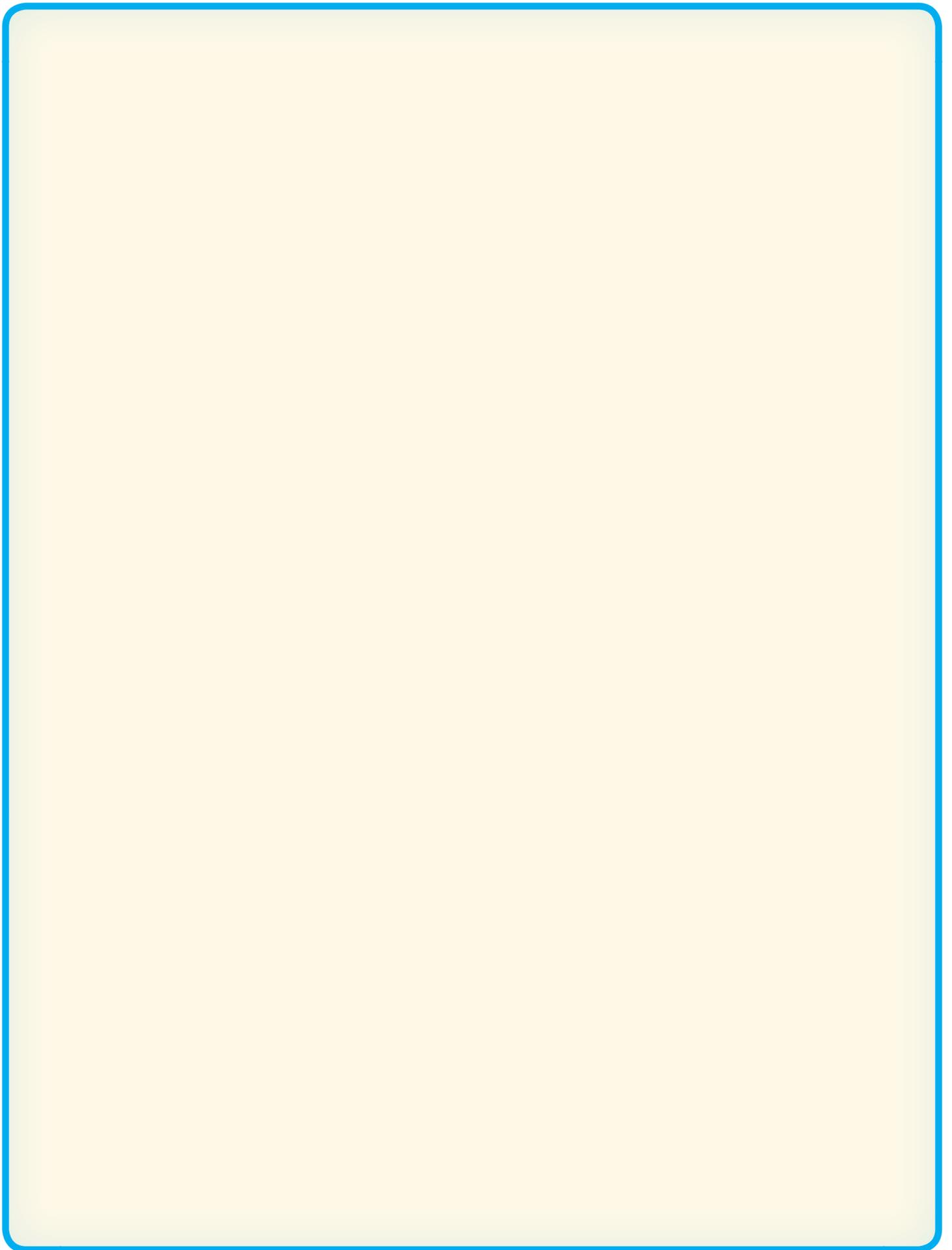
The comments of three anonymous reviewers strongly improved the manuscript.

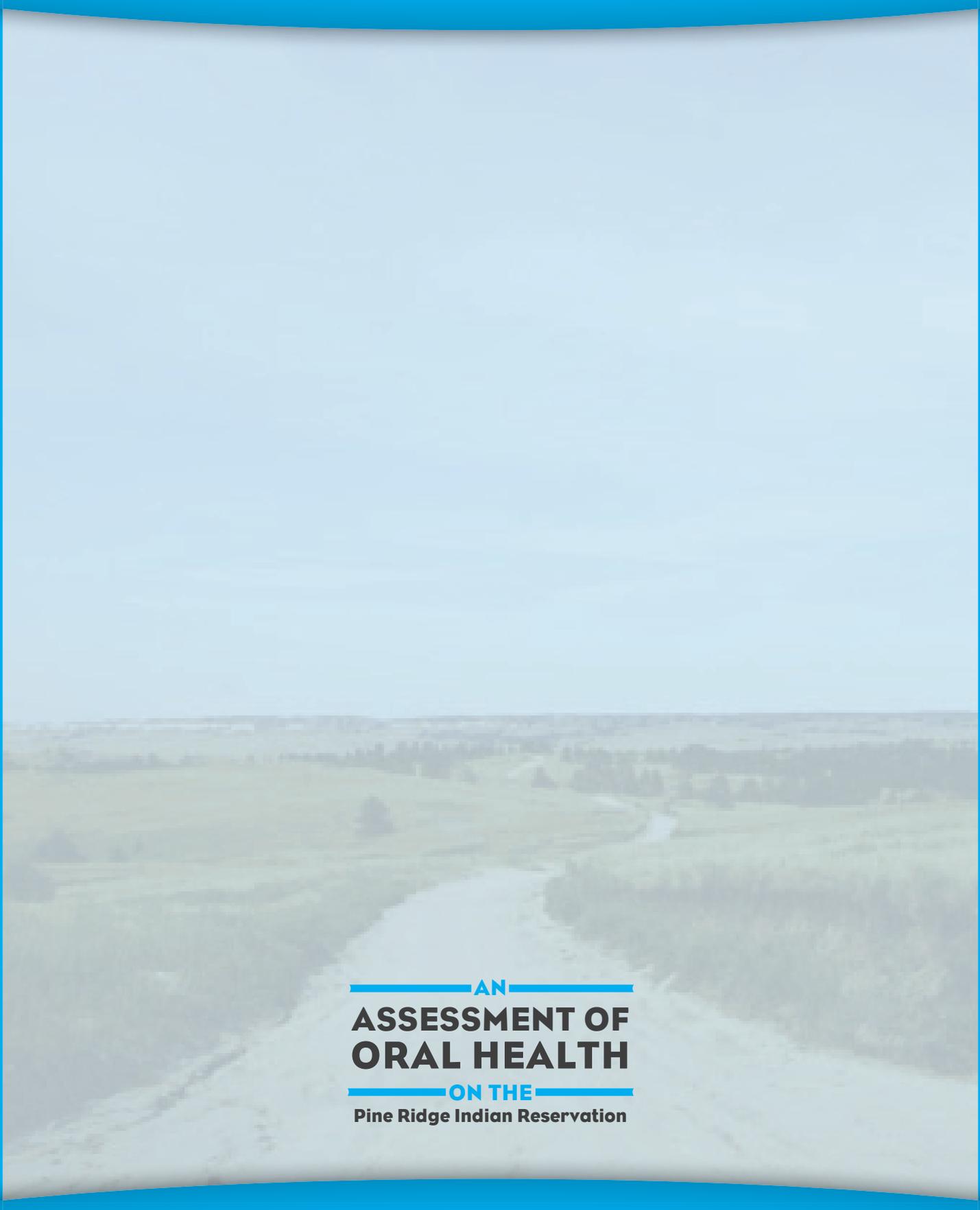
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Maxine Brings Him Back-Janis





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