



5-15-2023

The relationship between diabetes and oral health status, and dental visits among American Indian, Alaska Native, and Native Hawaiian elders

Shawnda Schroeder

University of North Dakota, shawnda.schroeder@med.UND.edu

Collette Adamsen

University of North Dakota

Robin Besse

University of North Dakota

[How does access to this work benefit you? Let us know!](#)

Follow this and additional works at: <https://commons.und.edu/ih-fac>



Part of the [Dentistry Commons](#), and the [Diseases Commons](#)

Recommended Citation

Schroeder, S., Adamsen, C. & Besse, R. (2021). The relationship between diabetes and oral health status, and dental visits among American Indian, Alaska Native, and Native Hawaiian elders. *Journal of the American Dental Association*, 152(4), 293-301. doi: 10.1016/j.adaj.2020.12.008

This Article is brought to you for free and open access by the Department of Indigenous Health at UND Scholarly Commons. It has been accepted for inclusion in Indigenous Health Faculty Publications by an authorized administrator of UND Scholarly Commons. For more information, please contact und.common@library.und.edu.

The relationship between diabetes and oral health status, and dental visits among American Indian, Alaska Native, and Native Hawaiian elders

Shawnda Schroeder, PhD

Research Associate Professor

Center for Rural Health

University of North Dakota School of Medicine & Health Sciences

Shawnda.schroeder@unde.edu

1301 N. Columbia Rd. Stop 9037

Grand Forks, North Dakota 582020

Collette Adamsen, PhD

Director, National Resource Center of Native American Aging

University of North Dakota School of Medicine & Health Sciences

Robin Besse, PhD

Center for Rural Health

University of North Dakota School of Medicine & Health Sciences

This work was supported by grant 90OI0008-03-00 from the US Department of Health and Human Services , Administration for Community Living .

Please cite as follows:

Schroeder, S., Adamsen, C. & Besse, R. (2021). The relationship between diabetes and oral health status, and dental visits among American Indian, Alaska Native, and Native Hawaiian elders. *Journal of the American Dental Association*, 152(4), 293-301. doi: 10.1016/j.adaj.2020.12.008

ABSTRACT

Background: American Indian (AI), Alaska Native (AN), and Native Hawaiian (NH) populations report higher rates of diabetes, poorer oral health, and fewer dental visits than their peers. The authors aimed to identify relationships between oral health and dental visits and diabetes diagnosis among AI, AN, and NH elders. **Methods:** Data were obtained from a national survey of AI, AN, and NH elders 55 years and older (April 2014-2017) and included 16,136 respondents. Frequencies and χ^2 tests were used to assess the relationship between oral health and dental visits, and diabetes. **Results:** Nearly one-half of the elders reported receiving a diagnosis of diabetes (49.2%). A significantly ($P < .01$) greater proportion of elders with diabetes reported a dental visit in the past year (57.8%) than those without. Differences ($P < .01$) were found between reported diabetes and need for extraction, denture work, and relief of dental pain. The authors found lower dental visit rates among elders with diabetes who were low income, older, unemployed, not enrolled in the tribe, lived on the reservation, and had only public insurance. **Conclusions:** There is a need to increase oral health literacy and dental visits among elders with diabetes and, more urgently, a need to focus on providing care for subpopulations reporting lower visit rates. **Practical Implications:** Dental providers must serve as a referral resource for at-risk elders and must work with and educate about the importance of oral health those who assist tribal elders with diabetes management, including primary care physicians, certified diabetes educators, nutritionists and dietitians, and public health care professionals.

Key Words: Oral health; American Indian; elder; Alaska Native; Native Hawaiian; aging; dental; diabetes.

INTRODUCTION

American Indian (AI), Alaska Native (AN), and Native Hawaiian (NH) populations, regardless of US region or age, report substantial health disparities around rates of diabetes and oral health care use and treatment need.¹⁻⁷ Researchers exploring the general relationship between diabetes and oral health have reported a bidirectional adverse relationship.⁸⁻¹²

AI and AN people are twice as likely as white people to have diabetes.⁵ During 2015, the overall age-adjusted prevalence of diabetes was highest among AI and AN populations compared with any other race or ethnicity.¹³⁻¹⁴ Diabetes was also the fourth leading cause of death for AI and AN populations in 2017.¹⁵ For all-race diagnoses, prevalence of diabetes increases with age.¹⁶ In a study on AI and AN elders published in 2018, researchers found that 53.9% of those who had at least 1 chronic disease reported receiving a diagnosis of diabetes.¹⁶ NHs or other Pacific Islanders have higher rates of diabetes than all other races and ethnicities in Hawaii.¹⁷⁻¹⁸

AI, AN, and NH populations have a history of low oral health care use and poor oral health.^{3, 4, 19, 20} The Centers for Disease Control and Prevention identified the lowest dental visit rate among AIs and ANs (55.9%) compared with any other race or ethnicity.³ Similarly, in 2017 researchers reported that NHs had the largest proportion of excess tooth loss.²⁰ In a 2015 study of AIs and ANs who did have a dental visit, the Indian Health Service, Division of Oral Health reported that in every age category, AI and AN dental patients reported considerably higher rates of untreated caries than patients in the United States overall.¹⁹ Among US residents, 26% of those aged 50 through 64 years and 19% of those aged 65 through 74 years had untreated caries compared with 54% and 45% of AI and AN populations, respectively.¹⁹ During 2014 through 2017, 59.9% of AI, AN, and NH elders aged 55 through 64 years reported a dental visit

compared with 49.3% of those 75 years or older.² Barriers to care for AI and AN elders include access, affordability, transportation, historical trauma, and low oral health literacy.^{1, 21}

AI, AN, and NH elder populations are disproportionately represented among people with diabetes, low oral health care use, and poor oral health. Researchers exploring the general relationship between diabetes and oral health found a bidirectional adverse relationship.⁸⁻¹² High blood sugar levels increase a person's risk of developing dry mouth, caries, gingivitis, periodontitis, and tooth loss.^{8, 9, 11, 12, 22} Unmanaged diabetes can have a direct impact on oral health, and poor oral health can affect nutrition diabetes management.

The purpose of our study was to better understand the relationship between diabetes and oral health among AI, AN, and NH elders and to identify any oral health disparities specifically among those elders with diabetes. Data analysis centered around the following research aims: identify the relationship between diabetes diagnosis and oral health care visits, explore any relationship between reported diabetes diagnosis and multiple oral health indicators, and explore any differences between socioeconomic variables and reported oral health care use among AI, AN, and NH elders who received a diagnosis of diabetes.

METHODS

The National Resource Center of Native American Aging (NRCNAA) conducted a survey among AI, AN, and NH elders 55 years and older throughout the United States.² This research received funding from the Administration for Community Living on Aging through the US Department of Health and Human Services. The purpose of the survey was to collect information to inform tribes of their community members' self-reported health and social needs and to compare them with other villages, tribes, and homesteads nationally. "Self-reported

measures in the Survey of Elders include general health status; activities of daily living; vision, hearing, and oral health care screenings; health care access; tobacco and alcohol use; weight and nutrition; social support and housing; demographic characteristics; and social functioning.”²

The survey data assist tribes. There are also several articles that include findings on various health conditions using this large dataset. As a result, the survey methodology, inclusion criteria, sample size, and sample demographic characteristics are the same in each publication. The following discussion related to participant inclusion and survey procedures might appear in other publications or on the NRCNAA survey resource page.^{2, 16} More detailed information on the methodology is available on the NRCNAA research methods page.²³

Participants

In cycle 6 of the survey, which ran from April 2014 through March 2017, there were 27,693 people 55 years or older who were affiliated with 1 of the 267 tribes that agreed to participate in the survey; 18,134 of the 27,639 eligible elders completed the paper survey (65.6% response rate). Participants were excluded from analysis if they did not answer either the question assessing diabetes diagnosis or the question about whether they had been to the dentist in the past year. After exclusions, researchers analyzed the health status of 16,136 AI, AN, and NH elders.

Survey Procedures

The Institutional Review Board at the University of North Dakota approved the survey. The NRCNAA research team also secured a tribal resolution from the Official Tribal Council for participating sites. The Title VI Nutrition and Caregiving grant program director within each

participating tribe distributed the paper survey among the tribal elders. To be eligible for the Title VI Nutrition and Caregiving grant, a federally recognized tribe must represent a minimum of 50 AI, AN, and NH elders.²⁴

Variable Selection

Primary variables used in analyses included diabetes diagnosis (yes or no) and dental visit in the past 12 months (yes or no). Demographic variables included age, health insurance coverage (yes or no), multiple health insurance coverage (yes or no), type of insurance (public, private, both), annual income, employment (full-time, part-time, none), education, being an enrolled member of a federally recognized tribe (yes or no), and residence (residing on a reservation, trust land, or Indian community or not).

Some variables were modified from their original measure. Age was recoded into the 3 main age groups (55-64 years, 65-74 years, ≥ 75 years). Participants were recorded as having health insurance coverage if they reported at least 1 type of insurance. Those who reported having insurance through Medicare, Medicaid, Veterans Health Administration, Indian Health Service, Alaska Native Health Organization, or Indian Health or Tribal Insurance were grouped as having public insurance. Education was collapsed from 5 main categories to 3. Oral health indicators were unmodified. Participants self-reported (yes or no) need for teeth to be restored or replaced, teeth to be extracted, gingiva treatment, denture work, dental treatment to improve appearance, and relief of dental pain.

Data Analysis

We used t^2 tests ($P < .05$) to assess differences between diabetes diagnosis and dental visits with regard to several oral health indicators and demographic variables. All data analyses were conducted using SPSS, Version 25 (SPSS). This was a descriptive, baseline study and more comprehensive analyses are proposed for future research.

RESULTS

Total sample and demographic characteristics of elders with diabetes

Of the 16,136 AI, AN, and NH elders, 56.5% reported a dental visit in the past 12 months, and 49.2% indicated they had received a diagnosis of diabetes. The greatest proportion of survey respondents for each demographic category were those aged 65 through 74 years, reporting an annual personal income of less than \$15,000, unemployed, with a high school diploma only, covered under Tribal Health Insurance, living on a reservation, and identifying as American Indian. **Table 1.**

There was a statistically significant difference between reported diabetes diagnosis and health insurance ($P < .01$). A greater proportion of elders who were publicly insured reported receiving a diagnosis of diabetes (50.8%) than those with private insurance (34.3%). **Figure 1.**

Relationship between diabetes diagnosis and oral health care visit rates

There was a significant difference between receiving a diagnosis of diabetes and whether a person indicated a dental visit in the past 12 months ($P < .01$). Among AI, AN, and NH elders who reported receiving a diagnosis of diabetes, 57.8% reported visiting a dentist in the past year.

The proportion of elders who reported receiving a diagnosis of diabetes and indicated a dental visit was even slightly greater than the proportion of all AI, AN, and NH elders who reported a dental visit (56.5%).

Relationship between diabetes diagnosis and multiple oral health indicators

There were no significant differences between receiving a diagnosis of diabetes and need for teeth to be restored or replaced, gingiva treatment, or dental treatment to improve appearance. There was a significant difference between receiving a diagnosis of diabetes and identifying a need for teeth to be extracted ($P < .01$), denture work ($P < .0001$), and relief of dental pain ($P < .0001$). **Figure 2.**

Oral health care use and oral health status among AI, AN, and NH elders with diabetes according to demographic characteristics

Among elders with diabetes, there was a significant difference ($P < .01$) between dental visit status and reported need for teeth to be restored or replaced and denture work. Among elders with diabetes who reported visiting the dentist, 29.6% identified a need for their teeth to be restored or replaced compared with only 18.7% of those who had not been to the dentist. In addition, 23.4% of those indicating a dental visit reported the need for denture work compared with 32.0% of those who had not visited the dentist. There was no significant difference between dental visit status and the need for teeth to be extracted, gingiva treatment, relief of dental pain, or treatment to improve appearance.

There were significant differences ($P < .01$) in the proportions of AI, AN, and NH elders with diabetes who reported a dental visit in the past 12 months according to age, tribal

enrollment, residence (on or off reservation), employment status, insurance coverage type, and dual insurance status (**Figure 3**). For example, 49.1% of AI, AN, and NH elders with diabetes who had a personal income of less than \$5,000 indicated a dental visit in the past 12 months compared with 77.1% of those with a personal income of \$50,000 or more.

DISCUSSION

AI, AN, and NH populations are at increased risk of having both diabetes and low oral health care use; this is especially true among aging populations.^{1-6,13,14,16,19,21} Researchers also have reported a strong correlation between poor oral health and low rates of dental visits and increased risk of developing or receiving a diagnosis of chronic conditions.^{8-12,22} We recognized the disparities between oral health and receiving a diagnosis of diabetes among AI, AN, and NH elders, as well as the allocation of federal resources to address diabetes prevention and management among AI, AN, and NH populations, and sought to better understand the relationship between reported oral health and dental visits, and diabetes.

Relationship between receiving a diagnosis of diabetes and dental visit rates and oral health care needs

More than one-half (57.8%) of AI, AN, and NH elders with diabetes indicated having a dental visit in the past 12 months. This was considerably greater than the percentage of all AI, AN, and NH elders, but still lower than the national average for all adults 65 years and older (64.4%).²⁵ This is a notable finding, given that 2011 data indicated that adults with diabetes were less likely to have had a preventive dental visit than those without diabetes.²⁶ Data from 2014 reiterated this and researchers noted that dental visits and services of any kind were less frequent among those with diabetes than among those without.²⁷

It is likely that, because most AI, AN, and NH elders had tribal insurance (76.4% of elders with diabetes had tribal insurance), they sought care at integrated health systems. Unlike the US health care model, the Indian Health Service model commonly colocates medical and oral health care services. It might be that elders who were receiving care for diabetes had better dental visit rates than the overall AI, AN, and NH elder population because they were already seeking and receiving a level of medical care to manage their chronic disease and had the ease of care management or referral as a result of the collocation of services. Colocating oral health care and medical care can overcome barriers of time, transportation, not-showing up, and future mitigating circumstances. Specifically, the elder is already in the diabetes clinic and can be referred down the hall to see a dental provider, as opposed to scheduling a visit with a dental provider offsite that requires the elder to again arrange transportation and time off from work.

Of concern among this subpopulation is the 42.3% of elders with diabetes who are at risk of developing dry mouth, caries, gingivitis, periodontitis, and tooth loss because they indicated no dental visit in the past year.^{8,9} There was a substantial difference between reporting having received a diagnosis of diabetes and whether they indicated a need for urgent treatments, including the need for teeth to be extracted, denture work, and treatment to relieve dental pain. There is disparity and a need to address the oral health of all AI, AN, and NH elders with diabetes, but an even more imperative need to address oral health in diverse medical settings in an effort to catch the 42.3% who are not making it into a dental office. This will also require clear referral relationships with local dental clinics.

Among elders with diabetes, a significantly greater proportion of those who indicated no dental visit reported a need for denture work (32.0%) than those who had visited a dentist (23.4%). In addition, a greater proportion of elders with diabetes who also indicated a dental visit

identified need for restorative care as opposed to extraction. For example, 29.6% of elders with diabetes who indicated a dental visit understood that they had teeth that needed to be restored (compared with only 18.7% of those reporting no dental visit). Comparatively, a greater proportion of elders indicating no dental visit identified a need for a tooth to be extracted than did those who reported a dental visit. Visiting a dentist provides the opportunity to receive not only direct primary and secondary preventive services, but oral health education as well. Patients who visit the dentist are more likely to receive restorations than those who visit less frequently and use the dental clinic primarily for urgent treatment and extraction. In an effort to prevent the need for more invasive and urgent dental treatment, community, tribal, and health interventions must address oral health literacy as well as dental referrals among AI, AN, and NH elders with diabetes. According to the American Dental Association,²⁸ oral health literacy is the capacity to obtain, process, and understand information as it relate to basic oral health care needs. Oral health literacy includes using simple and culturally relevant language to discuss oral health and oral health care availability, as well as ensuring comprehension of provided content. The American Dental Association offers several examples and tools for ensuring and increasing oral health literacy among diverse populations.²⁸

It is important to prepare medical professionals to assess both oral health literacy and oral health status among patients with diabetes. Primary care professionals, public health care professionals, certified diabetes educators, nutritionists, dietitians, community health workers, and other medical team members who assist tribal elders with management of their diabetes should receive adequate training and resources in an effort to better prepare them to educate elders with diabetes about the importance of oral health and regular preventive dental visits.

Similarly, dental teams have an opportunity to partner with local diabetes management programs within tribal communities to serve as a clinical and cultural resource and referral point.

Results of national research on diabetes management showed that patients with diabetes report limited awareness or understanding of oral health concerns associated with diabetes.^{29,30} It is likely that this is heightened among tribal elders. Results of a survey of certified diabetes educators in South Carolina showed that diabetes educators lacked knowledge about the relationship between oral health and diabetes, and they did not routinely provide oral health education.³¹ In 2012, 150 medical and dental professionals from 8 countries came together to discuss management of diabetes and oral disease. They concluded that we must move toward improved communication and collaboration between health care professionals who treat patients with diabetes in an effort to improve patients' overall health and oral health effects of diabetes.³² Our study calls for the same action but encourages that these interventions also take into consideration cultural and tribal traditions, as well as historical trauma related to oral health care.

Social determinants of health

Although the interventions mentioned would have a substantial impact on the oral health status of AI, AN, and NH elders with diabetes, it is also important to address the social determinants of health, as well as identify service gaps among various demographic groups within this subpopulation.

Lower dental visit rates were reported for AI, AN, and NH elders with diabetes who were low income, older (75 years), not enrolled in the tribe, lived on the reservation, were unemployed, had lower educational attainment, and had public insurance only. AI, AN, and NH populations often report health inequities that are rooted in historical trauma and structural

racism, which can partially explain rates of poverty, unemployment, lower educational attainment, and inadequate access to cultural responsive health services (or health services more generally). Addressing oral health and providing dental referrals in diabetes management settings and primary care have the potential to improve the oral health, and subsequently the overall health, of AI, AN, and NH elders with diabetes. However, it is also important that community programs and interventions target social determinants of health and improve access to all health care and prevention programs for those subpopulations with lower use of health care services.

LIMITATIONS

This study relies on self-reporting of health conditions and diagnoses, and research has noted that self-reported oral health care use might be overestimated by nearly 30%.³³ However, given that medical and dental records that track patients do not merge, and because tribal elders also shift between care through Indian Health Service and medical or oral health care off of the reservation, this survey remains, to our knowledge, the only broad-based exploration of health conditions among tribal elders in the United States.

CONCLUSIONS

Our study identified the need to improve oral health care access among AI, AN, and NH elders, and likely underestimates the dire need to address these inequities.

Table 1. Demographic categories for American Indian, Alaska Native, and Native Hawaiian elders according to total sample and diabetes diagnosis, cycle 6.*

CHARACTERISTIC	TOTAL SAMPLE, NO. (% BASED ON GROUP TOTAL)	DIABETES DIAGNOSIS, NO. (% BASED ON GROUP TOTAL)
Total Sample	16,136 (100.0)	7,932 (49.2)
Age, y		
55-64	5,902 (36.6)	2,533 (31.9)
65-74	6,180 (38.3)	3,237 (40.8)
≥ 75	4,054 (25.1)	2,162 (27.3)
Personal Annual Income, \$		
< 15,000	6,668 (41.3)	3,446 (43.4)
15,000-49,999	6,381 (39.5)	3,047 (38.4)
≥ 50,000	1,269 (7.9)	555 (7.0)
Missing	1,818 (11.3)	884 (11.1)
Employment		
Employed	4,797 (29.7)	1,996 (25.2)
Unemployed	10,860 (67.3)	5,688 (71.7)
Missing	479 (3.0)	248 (3.1)
Education		
< 12	1,162 (7.2)	554 (7.0)
High school diploma only	8,165 (50.6)	4,067 (51.3)
> High school	6,520 (40.4)	3,165 (39.9)
Missing	289 (1.8)	146 (1.8)
Insurance Coverage		
Medicare	9,447 (58.5)	5,111 (64.4)
Medicaid	3,884 (24.1)	2,040 (25.7)
Private	3,945 (24.4)	1,777 (22.4)
Veterans Health Administration	1,115 (6.9)	592 (7.5)
Tribal (Indian Health Service)	11,892 (73.7)	6,059 (76.4)
None	286 (1.8)	119 (1.5)
Other	667 (4.1)	312 (3.9)
Residence		
On reservation	10,002 (62.0)	5,003 (63.1)
Off reservation	5,767 (35.7)	2,769 (34.9)
Missing	367 (2.3)	160 (2.0)
Affiliation		
American Indian	13,101 (81.2)	6,817 (85.9)
Native Hawaiian	237 (1.5)	99 (1.2)
Alaska Native	1,259 (7.8)	325 (4.1)
Descendant or other	886 (5.5)	369 (4.7)
Missing	653 (4.0)	322 (4.1)

* Values in the table include only those who answered both the question assessing diabetes diagnosis (yes or no) and the question assessing dental visit status (yes or no).

Figure 1. Proportion of American Indian, Alaska Native, and Native Hawaiian elders who received a diagnosis of diabetes, according to insurance coverage, cycle 6.

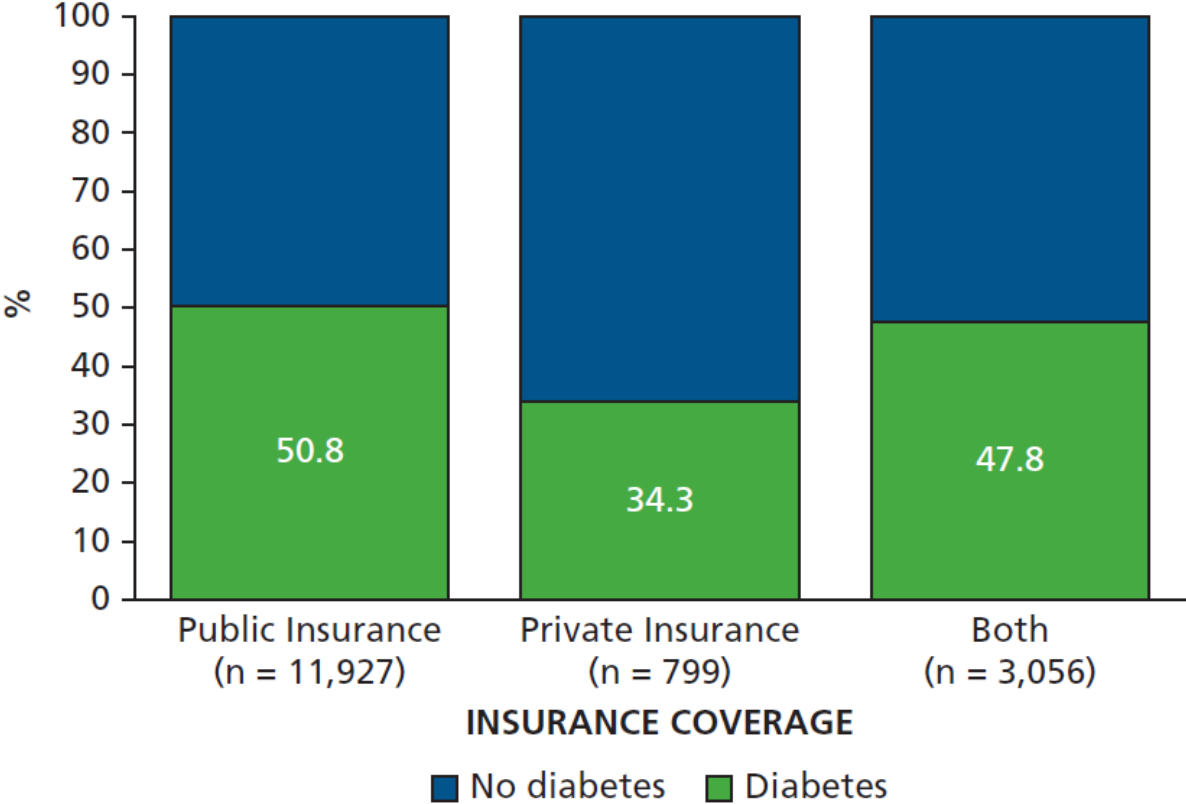
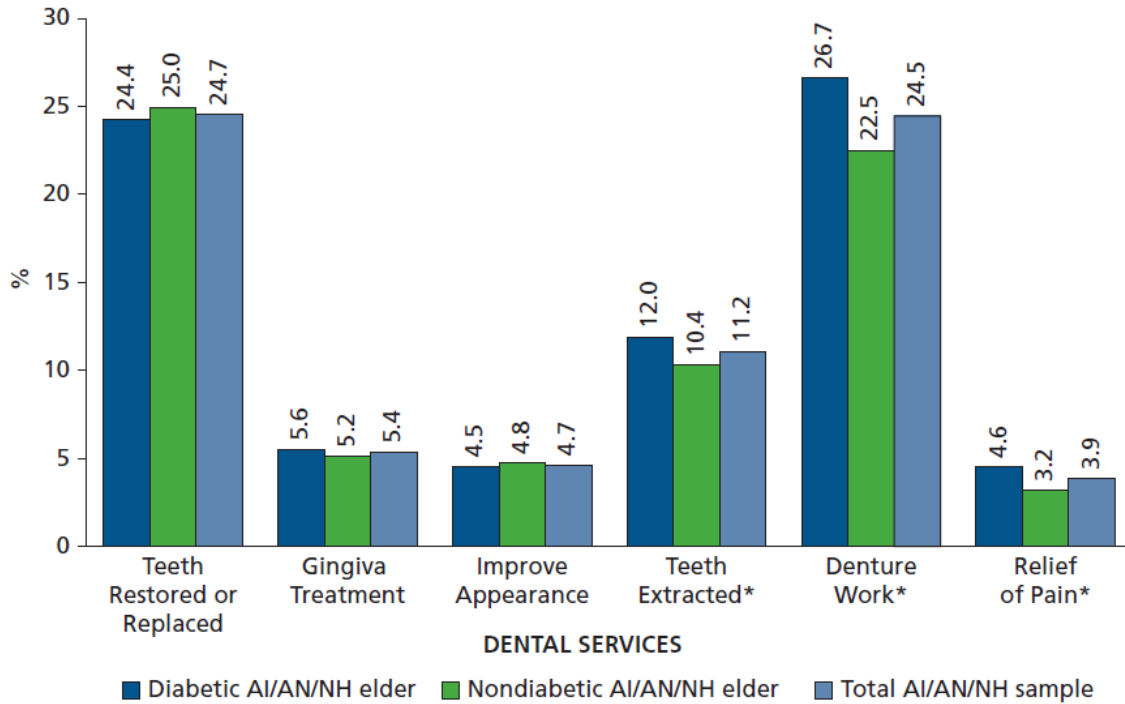
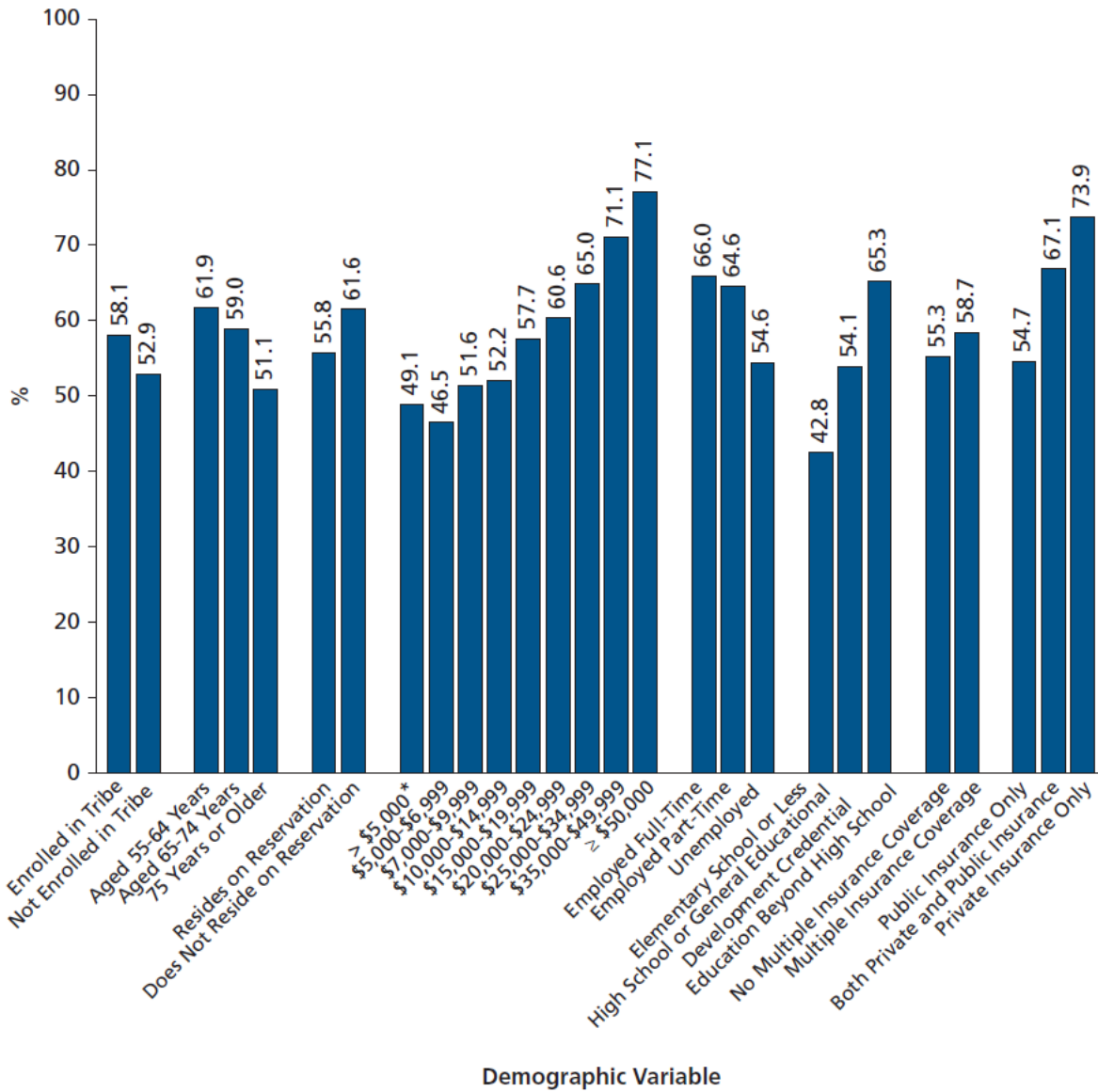


Figure 2. Differences between receiving a diagnosis of diabetes and oral health indicators among those who reported needing respective oral health care services, cycle 6.



* Difference is statistically significant at $P < .01$.
 AI: American Indian. AN: Alaska Native. NH: Native Hawaiian.

Figure 3. Percentage of American Indian, Alaska Native, and Native Hawaiian elders with diabetes who had a dental visit, according to demographic variables, cycle 6.



All differences between groups are statistically significant at $P < .01$.

* Personal annual income.

REFERENCES

1. US Department of Health and Human Services, Indian Health Service. History of dental services. In: Indian Health Manual: Chapter 2-Dental, part 3-2.1B. Available at: <https://www.ihs.gov/ihtm/pc/part-3/p3c2/#3-2.1B>. Accessed March 12, 2020.
2. Schroeder S., Adamsen C., Ward C.: Dental care utilization and service needs among American Indian/Alaska Native/Native Hawaiian elders: 2008 to 2017. *J Aging Health* 2019; 31: pp. 1917-1940.
3. United Health Foundation: America's health rankings: annual report, dental visits. Available at: <https://www.americashealthrankings.org/explore/annual/measure/dental/state/ALL>. Accessed March 12, 2020
4. Horner-Johnson W., Dobbertin K., Beilstein-Wedel E. Disparities in dental care associated with disability and race and ethnicity. *JADA* 2015; 146: pp. 366-374.
5. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion: Vital signs: Native Americans with diabetes. Available at: <https://www.cdc.gov/vitalsigns/aian-diabetes/index.html>. Accessed April 15, 2020
6. US Department of Health and Human Services Office of Minority Health: Diabetes and American Indians/Alaska Natives. Available at: <https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=33>. Accessed March 12, 2020
7. Furubayashi J.K., Look M.A.: Type 2 diabetes in native Hawaiians and Pacific Islanders in Hawaii. *Pac Health Dialog* 2005; 12: pp. 103-110.
8. Kaur G., Holtfreter B., Schwahn C., et. al.: Association between type 1 and type 2 diabetes with periodontal disease and tooth loss. *J Clin Periodontol* 2009; 36: pp. 765-774.
9. Jimenez M., Hu F.B., Marino M., Joshipura K.: Type 2 diabetes mellitus and 20 year incidence of periodontitis and tooth loss. *Diabetes Res Clin Pract* 2012; 98: pp. 494-500.
10. Department of Scientific Information, Evidence Synthesis & Translation Research, American Dental Association Science and Research Institute: Oral health topics: diabetes. Available at: <https://www.ada.org/en/member-center/oral-health-topics/diabetes>. Accessed March 12, 2020
11. Mayo Foundation for Medical Education and Research: Diabetes and dental care: guide to a healthy mouth. Available at: <https://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes/art-20043848>. Accessed April 15, 2020
12. US Department of Health and Human Services: National Institutes of Health, National Institute of Dental and Craniofacial Research. Health info: diabetes & oral health. Available at: <https://www.nidcr-nih.gov.ezproxylr.med.und.edu/health-info/diabetes/more-info>. Accessed March 12, 2020
13. Centers for Disease Control and Prevention, National Center for Health Statistics, Health, United States, 2017: data finder. Available at: https://www.cdc.gov/nchs/hus/contents2017.htm?search=,American_Indian_or_Alaska_Native. Accessed February 19, 2021.
14. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, National diabetes statistics report, 2020: estimates of diabetes and its burden in the United States, Available at: <https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf>. Accessed February 19, 2021.
15. Heron M.: Deaths: leading causes for 2017. *Natl Vital Stat Rep* 2019; 68: pp. 1-77.

16. Adamsen C., Schroeder S., LeMire S., Carter P.: Education, income, and employment and prevalence of chronic disease among American Indian/Alaska Native elders. *Prev Chronic Dis* 2018; 15: pp. E37.
17. Hawaii Health Data Warehouse, Hawaii State Department of Health: Diabetes prevalence (categorical), for the State of Hawaii, for the year(s) 2011, 2012, 2013, 2014. Behavioral Risk Factor Surveillance System. Available at: http://hhdw.org/wp-content/uploads/BRFSS_Diabetes_IND_00001_2011.pdf Accessed March 12, 2020
18. Uchima O., Wu Y.Y., Browne C., Braun K.: Disparities in diabetes prevalence among Native Hawaiians/other Pacific Islanders and Asians in Hawai'i. *Prev Chronic Dis* 2019; 16: pp. E22.
19. Phipps K.R., Ricks T.L.: The oral health of American Indian and Alaska Native adult dental patients: results of the 2015 IHS oral health survey. US Department of Health and Human Services, Indian Health Service, Division of Oral Health. Available at: https://www.ihs.gov/DOH/documents/IHS_Data_Brief_March_2016_Oral_Health%20Survey_35_pl us.pdf. Accessed March 16, 2020
20. Deguchi M., Mau M.M., Davis J., Niederman R.: Preventable tooth loss in Hawai'i: the role of socioeconomic status, diabetes, and dental visits. *Prev Chronic Dis* 2017; 14: pp. E115.
21. Jamieson L.M., Divaris K., Parker E.J., Lee J.Y.: Oral health literacy comparisons between indigenous Australians and American Indians. *Community Dent Health* 2013; 30: pp. 52-57.
22. US Department of Health and Human Services, National Institutes of Health, National Institute of Dental and Craniofacial Research: Diabetes: Dental tips. Available at: <https://www-nidcr-nih-gov.ezproxylr.med.und.edu/sites/default/files/2019-03/diabetes-dental-tips.pdf>. Accessed April 12, 2020
23. National Resource Center of Native American Aging: Needs assessment, identifying our needs: a survey of elders. Available at: <https://www.nrnaa.org/needs-assessment>. Accessed March 16, 2020
24. US Department of Health and Human Services: Administration for Community Living. Services for Native Americans (OAA Title VI). Available at: <https://acl.gov/programs/services-native-americans-oaa-title-vi>. Accessed April 12, 2020
25. Centers for Disease Control and Prevention, National Center for Health Statistics: FastStats: oral and dental health. Available at: <https://www.cdc.gov/nchs/fastats/dental.htm>. Accessed March 12, 2020
26. Weiner R.C., Shen C., Sambamoorthi N., Sambamoorthi U.: Preventive dental care in older adults with diabetes. *JADA* 2016; 147: pp. 797-802.
27. Luo H., Bell R.A., Wright W., Wu Q., Wu B.: Trends in annual dental visits among US dentate adults with and without self-reported diabetes and prediabetes, 2004-2014. *JADA* 2018; 149: pp. 460-469.
28. American Dental Association: Health literacy in dentistry. Available at: <https://www.ada.org/en/public-programs/health-literacy-in-dentistry>. Accessed March 12, 2020
29. Valerio M.A., Kanjirath P.P., Klausner C.P., Peters M.C.: A qualitative examination of patient awareness and understanding of type 2 diabetes and oral health care needs. *Diabetes Res Clin Pract* 2011; 93: pp. 159-165.
30. Yuen H.K., Marlow N.M., Mahoney S., Slate E., Jenkins C., London S.: Oral health content in diabetes self-management education programs. *Diabetes Res Clin Pract* 2010; 90: pp. e82-e84.
31. Yuen H.K., Onicescu G., Hill E.G., Jenkins C.: A survey of oral health education provided by certified diabetes educators. *Diabetes Res Clin Pract* 2010; 88: pp. 48-55.
32. Albert D.A., Ward A., Allweiss P., et al.: Diabetes and oral disease: implications for health professionals. *Ann N Y Acad Sci* 2012; 1255: pp. 1-15.

33. Macek M.D., Manski R.J., Varga C.M., Moeller J.: Comparing oral health care utilization estimates in the United States across three nationally representative surveys. *Health Serv Res* 2002; 37: pp. 499-521.