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Social determinants of oral health in an indigenous community of Chile: preliminary data of a mixed qualitative and quantitative study

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Abstract

Introduction Certain aspects of indigenous communities, such as cultural practices and access to care, have been discussed as potential determinants of oral health. However, research on this topic remains limited. Understanding the factors influencing oral health and their perceptions is crucial for developing culturally appropriate interventions. This study aims to evaluate the determinants and self-perception of oral health through a mixed study within a specific indigenous community in the north of Chile. Furthermore, this is the first study to examine oral health in the Quechua and Aymara communities of Chile.

Methods This exploratory study was conducted in in two phases: a quantitative phase, involving clinical examination and administration of questionnaires; and qualitative phase, consisting of interviews with subset of participants from the quantitative phase. A descriptive statistic of the quantitative data was performed.

Results While no significant differences were found between indigenous and non-indigenous population in this city of Chile, differences were observed between the two main indigenous communities (Aymaras and Quechuas). Historical factors appeared to influence these differences. Belonging to the Aymara community emerges as a significant determinant of oral health, characterized by a greater need for oral rehabilitation, barriers to accessing dental care, lower self-perception of the quality of oral health. Educational level and rurality were identified as factors potentially affecting the oral health status of this community.

Conclusion Ethnicity can influence in oral health, primarily in relation to rurality and educational level. This study found no significant overall differences in oral health between Indigenous and non-Indigenous participants. However, Quechuas exhibited better oral health than Aymaras. Participants demonstrated good oral health knowledge and a positive attitude towards prevention, despite recalling limited education in their youth. We emphasize the need for

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implementing strategies for oral health promotion and prevention that consider cultural, linguistic and specific needs of these communities.

Keywords Oral health, Indigenous population, Health status disparities, Health knowledge, Self-perception

Introduction

Indigenous communities globally experience poor health outcomes due to a complex interplay of historical, social, and economic factors. Historical and societal discrimination, forced relocations, and cultural disruption have led to significant health disparities and barriers to accessing both general and dental healthcare services [1, 2]. Publications in the United States of America and Australia highlight significant differences in access to care and life expectancy compared to non-indigenous population [2, 3]. The World Health Organization (WHO) recognizes that these health disparities are further exacerbated by stigma, racism, limited access to quality health services, higher levels of poverty, and limited educational opportunities [4, 5]. These inequalities often begin in utero, with community-level factors such as rural versus urban residence and neighborhood socioeconomic status, significantly influencing perinatal and infant health outcomes [6].

Oral health disparities disproportionately affect indigenous communities, with a higher prevalence of preventable oral diseases such as dental caries and periodontal disease [7, 8]. Limited access to dental care, inadequate oral hygiene practices, and a lack of oral health awareness contribute to a significant burden of poor self-reported oral health and reduced oral health-related quality of life [9]. Innovative community-based interventions, such as focus group discussions and mobile technology networks, have shown promise in improving oral health outcomes among these populations [10].

Elucidating the differences leading to a worse oral and general health in indigenous communities is crucial for developing effective public health interventions. For instance, in remote Aboriginal communities, lifestyle changes and increased availability of sugary foods have exacerbated oral health challenges, underscoring the need for community-driven strategies and school-based oral health promotion programs [11]. Public health interventions must be tailored to the unique cultural, social, and economic contexts of each indigenous community. Successful approaches often integrate community engagement, utilize technology, and incorporate culturally appropriate interventions [10]. Understanding the macro-level determinants of health, such as socioeconomic status, access to healthcare, and historical trauma, is essential for designing comprehensive strategies to reduce health disparities and improve overall oral health outcomes [6, 11]. By targeting both individual-level factors (e.g., oral hygiene practices) and community-level factors (e.g., access to care, cultural norms), public health initiatives can create greater awareness and understanding within indigenous communities, finally improving diagnostic accuracy, and facilitating personalized treatment plans.

Previous research across diverse indigenous communities in Latin America, including Chile, Brazil, Colombia, and Ecuador, has identified common oral health determinants, deeply influenced by social, economic, and historical factors, resulting in significant oral health inequities and limited access to healthcare services. While some indigenous communities rely on traditional practices and plants for oral hygiene and disease prevention, public health policies in Latin America predominantly focus on clinical, individualized, and curative care, neglecting the crucial role of health promotion and community participation in addressing these disparities [7, 8, 12–18]. Interventions employing community-based research approaches, culturally tailored strategies, and involvement of community workers have shown some success but face challenges in implementation and sustainability [17, 18]. To effectively address oral health disparities, a comprehensive approach is needed, encompassing rigorous epidemiological studies, evidence-based policies, and a multisectoral strategy addressing the social determinants of health. Additionally, involving community members as true partners in research and intervention efforts are critical for optimizing their quality of life and oral health outcomes.

In Chile, 12.8% of the total population is self-identified as indigenous according to the last population census [19]. The Aymara are the main indigenous people inhabiting the north of the country, in the regions of Arica and Parinacota, Tarapacá, and Antofagasta. They also inhabit the Bolivian Altiplano, southern Peru, and northwestern Argentina. They constitute 7.2% of the total indigenous population of Chile, being the second largest indigenous group after the Mapuche [20, 21]. Although studies on oral health among indigenous peoples in Chile are scarce, a high prevalence of dental caries has been reported in the Aymara population [22]. The Quechuas have recently undergone a process of recognition of the community in Chile, known as reethinification or desaymarization, because there were previously identified as Aymaras [23].

This research aims to elucidate whether the reported inequities are also observed in an indigenous population of the north of Chile compared to an urban population. The study evaluates the determinants and self-perception

of oral health in an indigenous community using a mixed method approach.

Methodology

Study design and settings

A cross-sectional, mixed quantitative and qualitative method study was conducted in the city of Pica, Region of Tarapacá, Chile.

Participants and ethical approval

The target population comprised adults residing in the city of Pica, who were enrolled after signing the informed consent. This study was approved by the Research Ethics Committee of Universidad de los Andes, Chile (CEC2023107). From the individuals included in the quantitative study (clinical exam and questionaries), only a part of them were selected for the semi-structured interview (qualitative study).

Inclusion criteria: Adults residing in Pica and who access dental care operations of the Arturo Prat University, who speak Spanish and who agree to participate in the research and express it by signing the informed consent.

Exclusion criteria: adults who are not autonomous or who have difficulties communicating that may hinder their understanding of what it means to participate in this study, people who have dental stress or anxiety, or who have any contraindication to undergo the dental examination, such as herpes of the lip or oral mucosa.

Sample size

Convenience consecutive sampling was employed, engaging community leaders from senior clubs and neighborhood councils who had previously participated in dental care programs organized by the School of Dentistry of Arturo Prat University in the municipality of Pica, who were asked to invite their communities to the dental care programs.

The population of Pica projected by the National Statistics Institute of Chile in 2021 for those over 15 years of age is 4720, however, for the calculation of the sample size, the adult population (over 18 years of age) registered and validated by the Family Health Center of the municipality of Pica as of June 2023 has been considered, which corresponds to 4813 people. The prevalence of caries in Chile is 54.6%, as estimated in the National Health Survey 2016–2017 [24] and the in the Aymara population, the prevalence of 61.8% [22]. It was considered a confidence level of 95%, but due to 77 volunteers being included in this preliminary data, the level of estimation error is 10%, with a response distribution of 50%, according to the calculation made by raosoft.com/samplesize.

Convenience sampling was applied, aiming for data saturation with a subsample of 10 participants in the operative, seeking data saturation. Finally, 18 participants were included.

Data collection

Data were collected as follows:

Clinical exam and clinical data collection

Data was collected using the WHO Oral Health Assessment Form for Adults (1997) [25]. The translated instrument is in Supplementary file 1. Oral health examination was conducted by trained examiners, assessed by GY in the dental operation site. The form included questions about extraoral lesions, TMJ disorders, oral mucosal lesions, enamel disorders, periodontal disease, dental treatment needs, prosthetic needs, dental anomalies, and urgent consultation needs. The inter-examiner and intra-examiner reliability scores indicated substantial agreement. The study subjects received primary dental treatment (extractions, periodontal treatment, and dental restorations) and individualized oral health education, and they received appropriate referral when a more complex dental treatment was needed.

Examiners were the sixth-year students from the Dentistry school of Arturo Prat University, calibrated during their training process for dental examinations using this clinical record. Calibration sessions included a theoretical session where they are presented with the clinical record to be used in the field operations to standardize diagnostic criteria, followed by a clinical session where they examine ten patients who are being treated at the university's dental clinic.

Survey

After the exam, a survey about cultural habits, educational level, socioeconomic status, employment status, self-perception of oral health, reason for last dental visit, quality of life and residence was administered. The survey was developed by all authors after reviewing the relevant literature and was designed based on questions from the ENS 2016–2017 (Chilean National Health Survey) and the ENCAVI 2015–2016 (Chilean Quality of Life and Health Survey), including OHIP-7Sp survey questions form comparability. The survey was piloted on a few participants. The instrument in Spanish is in Supplementary file 2.

Semi-structured interview

A semi-structured interview explored knowledge about oral health impact on lives, current past oral health practices, and caregivers' experience regarding dental care for children. Guided by an interview (Supplementary file 3), conducted and audio-recorded by project researchers. Transcripts were analyzed through open coding and content analysis using Atlas.ti 24.1.1, with categories agreed

upon by two separate researchers. Ethnographic analysis described and interpreted the cultural context of oral health among participants, providing insights into behavior, values and health perceptions [26].

Statistical analysis

Quantitative data was analyzed using SPSSv.25 and descriptive statistics was used. The comparison of variables of interest was performed using Pearson's chi square test for analyzing categorical data and t-test to determine differences between the means of quantitative data. The observed differences were considered statistically significant with a p-value less than 0.05.

Results

Clinical data of participants

In the quantitative study 77 (age range 41 to 83 years-old) participants were included in the clinical exam and survey, of which 18 were referred for the interviews, then transcribed and analyzed. Table I provides an overview of the clinical data of the individuals included in the study (only variables of the WHO form with significant differences were included). Table II provides data related to surveys applied for dental students.

The analysis revealed no significant differences between indigenous and non-indigenous populations. However, participants self-identified as Quechuas had better oral health parameters compared to Aymaras (Table I), including lower rates to periodontal disease (38.5% vs. 55.6%; $p = 0.058$) and fewer decayed teeth (0.47 vs. 2.40; $p = 0.022$), with a higher proportion of patients with dental treatment needs (30% vs. 68.9%). It can also be noted that the Quechua population has a higher proportion of patients with a technical and professional educational level (47.1% vs. 25%).

Survey results

In the survey (Table II), 31,6% of Aymaras reported that their teeth or dentures interfered with their social relationships, compared to 23,5% of Quechuas. Regarding tooth sensitivity, only 35% of Aymaras answered "never" or "rarely", compared to 51,5% of Quechuas and 80% of the non-indigenous population. Other survey questions did not show significant differences.

Qualitative sub-study results on knowledge and attitudes regarding oral health

Eighteen semi-structured individual interviews were conducted, including 13 women and five were men, with ages ranging from 62 to 83 years (average age 71 years). All participants reside in rural areas, with nine identifying as members of indigenous communities. Educational levels range from basic to professional (Table III).

Knowledge about oral health and disease: conditions, affected mouth structures, and perceived risk factors

Participants mentioned caries, tooth loss, and halitosis as common oral diseases. Most identified teeth and gums as the mouth structures prone to disease. Only a few mentioned other sites such as lips (associated with skin cancer due to sun exposure), tongue, palate, throat, and cheeks.

Perception of oral health: effects, benefits, and consequences

The participants of the study referred to good or poor oral health with the presence or absence of teeth, the absence of caries, and bad breath. Some individuals also mentioned the lack of inflammation and normal salivation. *"For me, having good oral health is not having caries, not having bad breath, and having normal salivation"* (Interview 8, female, 74 years old).

Good oral health is perceived as positive, enabling proper communication, and eating, and contributing to personal appearance, work, and self-esteem: *"For appearance, for work, and oneself"* (Interview 1, female, 74 years old). *"To feel good, to feel calm, to work calmly"* (Interview 17, male, 67 years old). Participants view good oral health as a reflection of overall health: *"Because if I had poor oral health, I wouldn't feel well, I would be sad, I would feel bad, I would feel sick"* (Interview 16, Quechua, female, 66 years old). It also enhances social participation: *"Enjoy chewing, smiling, communicating, talking with others"* (Interview 11, female, 62 years old).

Those who perceive their oral health as good often report not having bad breath or caries and having all their teeth. Participants with removable prostheses also perceived that they did not have oral health problems. *"Because I have taken care of it* (their oral health is good), *and at least the ones in the front are borrowed* (laughs), *but the ones at the bottom are all mine"* (Interview 1, female, 74 years old).

They report that poor oral health affects self-esteem, mood, and relationships, and prevents them from smiling in public. The majority emphasized that poor oral health leads to bad breath: *"Public relations because bad breath isolates people, and you lose social interaction, yes, you lose the company"* (Interview 8, female, 74 years old). *"Not being able to eat properly, because if you are invited somewhere and there are things you cannot eat"* and *"Self-esteem, mostly because you cannot smile due to the lack of teeth"* (Interview 14, Quechua, female, 64 years old). They even recognize that poor oral health affects other organs such as the stomach and the heart: *"If you have bad teeth, you get sick from many things, apart from the stomach, and you cannot eat well either"* (Interview 9, Diaguita, female, 63 years old). *"Well, there are many heart problems caused by oral bacteria"* (Interview 7, Quechua, female, 75 years old).

Table I Association of ethnicity and rurality with clinical parameters

Parameter	Ethnicity			p value	Rurality*		p value	Total
	Aymara n (%)	Quechua n (%)	Other n (%)		Urban n (%)	Rural n (%)		
Gender								
Male	6 (30)	6 (35.3)	16 (40)		1 (16.7)	27 (39.1)		28
Female	14 (70)	11 (64.7)	14 (70)	0.74	5 (83.3)	42 (60.9)	0.27	49
Age								
< 70 years-old	10 (50)	10 (58,8)	13 (32.5)		4 (66.7)	29 (42)		33
≥ 70 years-old	10 (50)	7 (41.2)	27 (67.5)	0.14	2 (33.3)	40 (58)	0.24	44
Rurality*								
Urban	2 (10)	1 (6.3)	3 (7.7)		-	-	-	6
Rural	18 (90)	15 (93.8)	36 (92.3)	0.91	-	-	-	69
Educational level								
Pre-scholar	1 (5)	0 (0)	0 (0)		0 (0)	1 (1.5)		1
Basic	9 (45)	3 (17.6)	15 (38.5)		2 (33.3)	25 (36.8)		27
Media	5 (25)	6 (35.3)	12 (30.8)		1 (16.7)	22 (32.4)		23
Technical	4 (20)	6 (35.3)	8 (20.5)		3 (50)	15 (22.1)		18
Professional	1 (5)	2 (11.8)	4 (10.3)	0.53	0 (0)	5 (7.4)	0.60	7
Employment status								
Dependent	4 (20)	2 (11.8)	5 (12.8)		2 (33.3)	9 (13.2)		11
Independent	2 (10)	7 (41.2)	2 (5.1)		0 (0)	11 (16.2)		11
Retired	8 (40)	5 (29.4)	25 (64.1)		4 (66.7)	32 (47.1)		38
Housewife	6 (30)	2 (11.8)	6 (15.4)		0 (0)	14 (20.6)		14
Inactive	0 (0)	1 (5.9)	1 (2.6)	**0.019**	0 (0)	2 (2.9)	0.365	2
Periodontal disease								
No	0 (0)	4 (30.8)	2 (6.3)		0 (0)	6 (10.2)		6
Gingivitis	8 (44.4)	4 (30.8)	13 (40.6)		1 (33.3)	23 (39)		25
Periodontitis	10 (55.6)	5 (38.5)	17 (53.1)	**0.058**	2 (66.7)	30 (50.8)	0.792	32
TMJ clicking								
No	15 (78.9)	14 (82.4)	29 (72.5)		1 (16.7)	55 (80.9)		56
Yes	4 (21.1)	3 (17.6)	11 (27.5)	0.691	5 (83.3)	13 (19.1)	**< 0.001**	18
Denture wearing								
No	10 (50)	11 (64.7)	16 (40)		4 (66.7)	33 (47.8)		37
Fixed rehabilitation	0 (0)	1 (5.9)	5 (12.5)		0 (0)	5 (7.2)		6
Partial denture	7 (35)	2 (11.8)	13 (32.5)		1 (16.7)	21 (30.4)		22
Total denture	3 (15)	3 (17.6)	5 (12.5)		1 (16.7)	9 (13)		11
Non registered	0 (0)	0 (0)	1 (2.5)	0.468	0 (0)	1 (1.4)	0.856	1
Dental treatment needs								
No	5 (31.3)	7 (70)	6 (18.8)		2 (40)	16 (30.8)		18
Filling or crown	9 (56.3)	2 (20)	23 (71.9)		1 (20)	32 (61.5)		33
Extraction	1 (6.3)	0 (0)	2 (6.3)		1 (20)	2 (3.8)		3
Other need	1 (6.3)	1 (10)	1 (3.1)	0.078	1 (20)	2 (3.8)	0.111	3
Denture needs								
No	1 (5)	6 (35.3)	7 (17.5)		0 (0)	14 (20.3)		14
Crown	1 (5)	3 (17.6)	6 (15)		1 (16.7)	9 (13)		10
Partial denture	13 (65)	8 (47.1)	20 (50)		2 (33.3)	37 (53.6)		41
Total denture	5 (25)	0 (0)	7 (17.5)	0.100	3 (50)	9 (13)	0.093	12
Functional dentition								
No	8 (40)	13 (76.5)	31 (77.5)		4 (66.7)	50 (72.5)		52
Yes	12 (60)	4 (23.5)	9 (22.5)	0.331	2 (33.3)	19 (27.5)	0.762	25
Total	20	17	40		6	69		77
	Aymara mean (DS)	Quechua mean (DS)	Other mean (DS)	p value	Urban mean (DS)	Rural mean (DS)	p value	
DMFT	12.75 (7.84)	11.65 (7.86)	13.63 (9.663)	0.738	15.67 (11.29)	12.51 (8.55)	0.441	
Decayed	2.40 (3.16)	0.47 (0.94)	2.08 (2.05)	**0.022**	0.5 (0.83)	1.9 (2.3)	0.118	

Table 1 (continued)

Parameter	Ethnicity			p value	Rurality*		p value	Total
	Aymara n (%)	Quechua n (%)	Other n (%)		Urban n (%)	Rural n (%)		
Missing	5.85 (7.96)	4.47 (8.04)	8.05 (9.55)	0.340	11.33 (12.89)	5.96 (8.21)	0.070	
Filled	4.50 (4.53)	6.71 (5.18)	3.50 (3.65)	**0.039**	3.83 (3.92)	4.65 (4.44)	0.821	
Missing upper anterior teeth	3.85 (2.60)	4.41 (2.45)	4.38 (2.22)	0.687	3.83 (2.99)	4.32 (2.28)	0.226	

* Only 75 individuals give the information (2 participants were lost)

Participants consider their current oral health status as a reflection of their childhood care, nutrition, and access to treatment. Tooth loss was attributed to poor past care and lack of access to treatments: *"We were country people, so we didn't have oral hygiene before, no, that didn't exist, so we are suffering from what is happening now, we didn't brush our teeth, you understand, so the teeth started falling out because of that"* (Interview 6, male, 71 years old). Childhood diet experiences varied: *"What happens* (poor health) *is that I was poorly nourished because I didn't have breast milk"* (Interview 4, Quechua, female, 72 years old). *"I have very good teeth because when I was a child, I always ate a lot of fruit"* (Interview 11, female, 62 years old).

Customs: childhood oral health care and changes over time

The participants mentioned that the instructions received from their parents or caregivers when they were children to take care of their oral health were mainly focused on hygiene and avoiding sweets. These instructions were often irregular and not strictly enforced: *"Mom said to rinse, to brush, but hygiene was not as strict as it is now"* (Interview 4, Quechua, female, 72 years old). *"We shouldn't abuse it, well, as I say, it was a pretty rudimentary way to avoid eating a lot of candy because it rots the teeth"* (Interview 3, Aymara, male, 83 years old). They report that oral hygiene practices of the past were different; some participants did not have access to toothbrushes or toothpaste, and relied on rinsing with salt, water, or bicarbonate, cleaning with a finger and salt, or sharing a toothbrush with the rest of the family: *"It was very deficient, we were eight siblings and very poor, so in my house there were two toothbrushes, no more"* (Interview 7, Quechua, female, 75 years old). *"When I was a child, we were not taught to brush our teeth well. I come from a mining town, so there weren't the means. Our parents lacked resources"* (Interview 14, Quechua, female, 64 years old).

For treatment, those in rural areas traveled to the city or used herbal remedies known by their parents. The dental care was limited to extractions or restorations, with no education from dentists: *"There was not much oral education, even when you went to the dentist, they just pulled out the tooth, just like that"* (Interview 14, Quechua, female, 64 years old).

Participants report that there is now greater access to knowledge of oral health care, especially through schools, social media, television, and radio: *"In kindergarten, they already are educated to clean their teeth and everything, but for us, it was different"* (Interview 5, female, 80 years old). *"Well, now there is much more dissemination, of course, through social media, television, and radio, and in person, before there was none of that"* (Interview 3, Aymara, male, 83 years old).

Moreover, they report that there is a heightened appreciation for oral health, leading to better care practices and a desire to keep their teeth: *"Because one is already more careful with oneself and values it more", "There is more concern about cleaning, toothpaste, mouthwash..."* (Interview 6, male, 71 years old). *"He* (his father) *died with all his teeth, I ask God for that"* (Interview 11, female, 62 years old).

They observe that access to dentist check-ups has improved for young people and children, facilitated by referrals from well-child check-ups or preventive exams in primary health care: *"When they do the EMPA* (Chilean annual preventive exam) *or the young healthy check-up, mostly are referred to the dentist and the dentist always gives an oral health talk to all the children"* (Interview 14, Quechua, female, 64 years old).

Legacy: knowledge and values of oral health passed to new generations

Value is placed on oral health and maintaining healthy teeth through good oral hygiene. They reported that when they were children, they did not have the means or knowledge for proper care. However, they took better care of their children and now their grandchildren: "When I had my children, I was more responsible" "And now I continue with my grandchildren, I make them clean their teeth" (Interview 11, female, 62 years old). "I have grandchildren, so I talk to them, I tell them about caries, and I tell them, look, you will be without teeth" (Interview 13, Aymara, female, 63 years old). "Because you teach your children, and the children replicate it" (Interview 14, Quechua, female, 64 years old).

Finally, participants expressed a desire to learn more about oral health: "Hopefully, we could have access to something like a school or something that would guide

Table II Association of ethnicity with self-reported parameters

Question	Ethnicity			p value
	Aymara n (%)	Quechua n (%)	Other n (%)	
In general, how would you rate your oral health?				
Very good or good	7 (35)	6 (35.3)	14 (35)	
Regular	11 (55)	10 (58.8)	18 (45)	
Very bad or bad	2 (10)	0 (0)	8 (20)	0.738
When was the last time you visited the dentist?				
Less than 1 year	15 (75)	11 (64.7)	28 (70)	
Between 1 and 2 years	1 (5)	2 (11.8)	2 (5)	
More than 2 years	4 (20)	4 (23.5)	10 (25)	0.826
Do my teeth or dentures bother me when I talk?				
Never or almost never	11 (61.1)	12 (12)	28 (70)	
Sometimes	3 (16.7)	3 (18.8)	6 (15)	
Allways or almost allways	4 (22.2)	1 (6.3)	6 (15)	0.945
Do my teeth or dentures cause discomfort when I eat?				
Never or almost never	8 (42.1)	8 (50)	25 (62.5)	
Sometimes	6 (31.6)	5 (31.3)	7 (17.5)	
Allways or almost allways	5 (26.3)	3 (18.8)	8 (20)	0.833
Do my teeth or dentures interfere with my daily activities?				
Never or almost never	13 (68.5)	14 (87.6)	33 (82.5)	
Sometimes	2 (10.5)	0 (0)	2 (5)	
Allways or almost allways	4 (21.1)	2 (12.6)	5 (12.5)	0.233
Do my teeth or dentures interfere with my social relationships?				
Never or almost never	13 (68.5)	13 (86.7)	28 (70)	
Sometimes	2 (10.5)	0 (0)	6 (15)	
Allways or almost allways	4 (21.1)	4 (23.5)	6 (15)	**0.007**
You would say your health is:				
Very good or good	11 (55)	5 (29.4)	21 (52.5)	
Regular	8 (40)	10 (58.8)	17 (42.5)	
Very bad or bad	1 (5)	2 (11.8)	2 (5)	0.686
How would you rate your quality of life?				
Very good or good	0 (0)	1 (5.9)	4 (10)	
Regular	9 (45)	5 (29.4)	9 (22.5)	
Very bad or bad	11 (55)	11 (64.7)	27 (67.5)	0.551
Have you had sensitive teeth, for example, due to cold foods or liquids?				
Never or almost never	7 (35)	8 (51.1)	32 (80)	
Sometimes	9 (45)	6 (37.5)	5 (12.5)	
Allways or almost allways	4 (20)	2 (12.5)	3 (7.5)	**0.024**
Have people misunderstood any of your words due to problems with your teeth, mouth, or dentures?				
Never or almost never	12 (60)	15 (88.2)	29 (72.5)	
Sometimes	7 (35)	1 (5.9)	8 (20)	
Allways or almost allways	1 (5)	1 (5.9)	2 (5)	
Does not know	0 (0)	0 (0)	1 (2.5)	0.147
Total	18	16	40	

us about oral health" (Interview 13, Aymara, female, 63 years old).

Discussion

Research has indicated that being a member of an indigenous community is a determinant of poor oral health, which is attributed to factors such as historical inequities, difficulties in accessing dental care, rurality, educational level, and cultural beliefs associated with health, disease, and cultural medicine [12, 27, 28]. However, the current study did not find significant differences in oral health between indigenous communities in the north of Chile and the non-indigenous population.

Table III Characterization of semi-structured interview participants

ID interview	Age	Gender	Occupation	Ethnicity	Educational level
1	74	Female	Housewife	Does not self-identify as indigenous	Basic
2	81	Female	Retired	Does not self-identify as indigenous	Basic
3	83	Male	Retired	Aymara	Media
4	72	Female	Retired	Quechua	Basic
5	80	Female	Retired	Does not self-identify as indigenous	Basic
6	71	Male	Retired	Does not self-identify as indigenous	Basic
7	75	Female	Independent	Quechua	Professional
8	74	Female	Retired	Does not self-identify as indigenous	Media
9	63	Female	Housewife	Diaguita	Media
10	66	Male	Independent	Quechua	Primary
11	62	Female	Housewife	Does not self-identify as indigenous	Media
12	79	Female	Retired	Does not self-identify as indigenous	Basic
13	63	Female	Dependent	Aymara	Technical
14	64	Female	Dependent	Quechua	Technical
15	81	Female	Independent	Does not self-identify as indigenous	Basic
16	66	Female	Retired	Quechua	Media
17	67	Female	Dependent	Does not self-identify as indigenous	Basic
18	67	Female	Dependent	Aymara	Basic

On the other side, differences were noted between two indigenous communities. The Quechua Community exhibited better oral health conditions and perceptions than the Aymara community. This can be partly attributed to the higher educational levels among Quechua participants. Additionally, over the past decade, the Quechua community has undergone a process of ethnic recognition or re-ethnification [29]. Historically, when these territories were annexed to Chile, all Indigenous communities were identified as Aymara, leading Quechua descendants through a process of de-aymarization to reclaim their culture and language [23]. It is acknowledge that Quechuas had historical ties to authorities in the Inca Empire, unlike the Aymaras, highlighting historical differences since pre-Columbian times [23].

In Chile, indigenous identity is based on self-identification [30], which could introduce bias. Additionally, self-identified Quechuas have a higher educational level and are semi-urbanized, unlike the Aymara communities, which are in remote and isolated areas of the Tarapacá region [31].

It is important to mention that our sample size is small for quantitative results, affecting the statistical significance. Efforts are underway to establish an epidemiological observatory of Oral Health in the Tarapacá region to achieve a larger sample size. Additionally, the northern Chilean communities are generally well-integrated into the country [32], contrasting with the more isolated tribal communities described in studies from the Amazon or Oceania [28]. It was recently reported that both Indigenous and non-Indigenous populations in Queensland, Australia, exhibit the occurrence of oral squamous cell carcinoma at earlier ages, with significantly worse survival and prognosis [33]. Furthermore, indigenous individuals have lower cancer survival rates. This disparity is attributed to various factors, including remoteness from healthcare services [34].

The qualitative study revealed interesting results, indicating an improved oral health condition in the community included in the study. Most participants resided in rural areas relatively close to urban Pica. It is noteworthy that distant Aymara communities will be included in future reports.

The findings of the qualitative sub-study reveal a diverse and complex understanding of oral health among older adults in Pica. Participants primarily identified caries, tooth loss, and halitosis as the main oral diseases, recognizing teeth and gums as the structures most prone to pathology. Some participants also mentioned lips, tongue, palate, throat, and cheeks, indicating a broader knowledge of potential oral pathologies. This contrasts with other studies that have reported a lack of knowledge about oral diseases and oral health care among older adult populations [35–39].

Culturally adapted interventions for Australian Indigenous peoples, including workshops, activities, and healthy eating programs, resulted in improvements in oral health literacy, health knowledge, and psychosocial factors. However, the low participant retention rates act as a barrier in the design of these interventions [40, 41]. The translation of prevention and promotion manual on oral cavity care and oral health promotion aims to reduce the language barrier between dentists and the Indigenous population, which led to improved knowledge after participants used the culturally adapted document [42].

The perception of good oral health is strongly associated with the presence of teeth, absence of caries, and the absence of bad breath. Good oral health was seen as a facilitator of communication, eating, and self-esteem, while poor oral health negatively impacted on self-esteem, social relationships, and general health. These findings highlight the importance of oral health for physical, psychological, and social well-being. This aligns with evidence showing that the physical and psychosocial well-being in older adults is affected by complications such as malnutrition, social isolation, and low self-esteem related to tooth loss or other oral diseases [35–37, 43].

A relevant aspect is that this group placed a higher value on maintaining their teeth rather than replacing them with prostheses. In contrast with other studies where teeth are considered replaceable and tooth loss with age is viewed as natural [38, 39]. For the participants in this study, tooth loss in old age is not natural but a disease and a consequence of inadequate dental care in the past, rudimentary hygiene practices, and poor nutrition. This historical perspective provides important context for understanding disparities in oral health across generations, as participants observe an evolution in practices and access to oral health information. Older adults perceive a greater value and care for oral health in younger generations, facilitated by education in schools and access to media.

In this group, there is an intention to pass on to future generations the importance of daily dental care from a young age to reach adulthood with good oral health. Other studies express concern about the lack of knowledge because older adults, who often care for young children, must know how to care for the oral health of children [37].

Participants expressed a continuous desire to learn and improve their oral care practices, reflecting a positive attitude toward ongoing education and prevention. This finding underscores the importance of implementing continuous educational programs that support knowledge and oral health practices throughout life and improve participation in dental care and treatment [44, 45].

The evaluation of oral health programs implemented in Indigenous communities across various countries (Australia, Canada, New Zealand, Brazil, and the United States), highlighted that culturally appropriate design, community participation, and integration of interventions into existing services are critical to improve oral health knowledge and behaviors [46]. Furthermore, addressing social determinants of health, such as poverty and social exclusion, and ensuring cultural competency among providers are essential for reducing oral health inequalities [47]. While some studies have shown improvements in periodontal health, caries reduction, and oral health literacy [12], challenges persist, including unstable funding, difficulties in retaining staff, community engagement issues, lack of infrastructure and cultural barriers. Notably, early childhood interventions have demonstrated promising results. For example, a study in Australian Indigenous communities found that providing dental treatment to mothers during pregnancy, applying fluoride varnish to children, and conducting motivational interviews with anticipatory guidance led to a lower incidence of caries in children, emphasizing the importance of early intervention [48].

A strength of this study is its incorporation of mixed methodologies. Understanding the knowledge, attitudes, and practices in this group, as well as their oral health status, allows the development of strategies to improve the oral health among older adults in these communities [49]. However, a limitation is the sampling bias, because although participants share many characteristics, this study was limited to a population seeking care, which could overestimate the knowledge of adults in comparison with those who do not seek care. People with higher levels of knowledge about oral health are more likely to seek care than those with lower levels [37, 50]. The characteristics of our sample may limit the generalizability of our findings to the broader population. Future studies could benefit from employing stratified sampling techniques to ensure a more representative sample.

In conclusion, this study did not observe marked differences between indigenous communities and non-indigenous populations among the participants, suggesting that educational level and rurality are more significant factors for a poor oral health than the self-reporting as indigenous. However, differences in oral health status were observed between Aymaras and Quechuas. These communities consider that it is necessary to include cultural aspects in oral health education and care.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

Conceptualization: WAGA, DAF and RFR. Funding acquisition: WAGA. Resources: GY. Methodology: WAGA and CC. Formal analysis: WAGA. Investigation: WAGA, CC, GY, AMCT, DAF, RFR, ARSS and JNS. Data curation: WAGA , CC and IMA. Writing original draft: WAGA and CC. Writing - Review & Editing: GY, DAF, JNS, AMCT and IMA. Supervision: WAGA and ARSS.

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Data availability
Data is provided within the manuscript or supplementary information files.

Declarations

Ethics approval and consent to participate
Our study and its methodology adhered to the Declaration of Helsinki for medical research involving human participants. This study was approved by the Research Ethics Committee of Universidad de los Andes, Chile (CEC2023107).

Consent for publication
All enrolled participants signed the informed consent.

Competing interests
The authors declare no competing interests.

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