



Oral Health and Dental Care in Deaf and Hard of Hearing Population: A Scoping Review

Valeria Campos^a / Ricardo Cartes-Velásquez^b / Michael McKee^c

Purpose: To compile the literature available about the oral health and dental care of the deaf and hard of hearing (DHH) population.

Materials and Methods: The study question of this scoping review was ‘What are the main findings reported in the literature about oral health and dental care of the DHH population?’ The following databases were included: Web of Science, LILACS, SciELO, MEDLINE, Scopus, EMBASE, GoogleScholar and Redalyc. Full-text articles published in peer-reviewed journals, in Spanish, Portuguese, and English, from the January 2000 to January 2018 were selected with qualitative and quantitative methods. All study designs were included in the review with the exception of letters to the editor and case reports

Results: A total of fifty articles were selected for analysis. DHH population has poorer oral hygiene and a higher prevalence of caries than their non DHH peers. DHH also report significant struggles with oral health and dental access. Most dentists experienced difficulties communicating with their DHH patients

Conclusions: This scoping review is the first known that centers on DHH oral health and their dental care. Efforts to develop accessible dental health programmes are needed to address apparent oral health inequities in the DHH population.

Key words: communication aids for disabled, deaf, hard of hearing, hearing loss, persons with disabilities, special care

*Oral Health Prev Dent 2020; 18: 417–426.
doi: 10.3290/j.ohpd.a44687*

Submitted for publication: 13.02.19; accepted for publication: 20.05.19

Hearing loss ranks third amongst disabilities.¹⁰⁴ According to its aetiology, it can be genetic, congenital or acquired; according to its location, it can be classified as conductive, sensorineural, mixed, or central. Hearing loss can range from mild (less than 40 dB) to profound (more than 90 dB). Depending on the time of hearing loss onset, it can be prelingual, perilingual, or postlingual, which means before, during, or after language acquisition,^{77,105} or later onset (e.g. post-educational or post-vocational). Worldwide,

more than 360 million people live with moderate to profound hearing loss. There is a prevalence of 1.4% in children between 5 and 14 years old, and about 10% among people 15 years old and above. A greater proportion of deaf and hard of hearing (DHH) live in low- and middle-income countries.^{85,105}

People with prelingual hearing loss often identify themselves with the Deaf Community, a world with its own language and culture.⁶¹ The Deaf Community has several distinctive characteristics, customs and values which have emerged from their hearing condition. People in this community use sign language as their preferred method of communication.^{37,43,105} Sign language differs from spoken languages in its linguistic structure, is not universal,^{43,87} but is recognised in more than 30 countries.²⁶

DHH individuals are more likely to have lower socioeconomic status, including lower household income, poorer educational achievement, and higher rates of unemployment.¹⁷ Furthermore, DHH individuals are associated with a number of adverse health outcomes.^{34,99} Hearing loss represents a major communication barrier in health care settings, impacting the quality of health care delivered to individuals with hearing loss.¹³ This is cause for concern, since poor health care communication adversely affects many health outcomes.^{13,48, 49} Many DHH individuals strug-

^a Assistant Professor, Department of Preventive and Public Health Dentistry, School of Dentistry, University of Concepción, Concepción, Chile. Study concept and design, collected and interpreted the data, wrote and proofread the manuscript, contributed substantially to discussion.

^b Associate Professor, Faculty of Dentistry, Universidad Andrés Bello, Concepción, Talcahuano, Chile. Study concept and design, interpreted the data, wrote and proofread the manuscript, contributed substantially to discussion.

^c Assistant Professor, Department of Family Medicine, University of Michigan Medical School, Ann Arbor, MI, USA. Study design, interpreted the data, wrote and proofread the manuscript, contributed substantially to discussion.

Correspondence: Dr. Valeria Campos, Department of Preventive and Public Health Dentistry, School of Dentistry, Roosevelt 1550, Barrio Universitario, Concepción, Chile. Tel: +56-41-220-4232; e-mail: valeriacamposcannobbio@gmail.com

gle with lower health literacy and reading literacy level compared to non-DHH persons,^{14,47,94,68,100} further complicating efforts to disseminate health information to this community. On the other hand, health personnel frequently lack training to address the specific needs of this population (e.g. communication, culture), which leads to patient dissatisfaction, reduced health care accessibility, inadequate information, and lower health care education and communication quality.^{16,41,84}

Regular dental visits provide the basis of oral healthcare, so it is important that dentists obtain basic knowledge and competencies to deliver adequate dental care to the DHH population. Oral health is an important yet frequently overlooked element of a population's health. Thus, little is known about the DHH oral health. In addition to the communication barriers experienced by the DHH, dentists similarly experience barriers to giving proper oral health care to this population. However, until now there no reviews have been available up to now which summarise the relevant issues on oral health and dental care in DHH.

The aim of this scoping review is to compile the literature about oral health and dental care of the DHH population.

MATERIALS AND METHODOLOGY

Research Question and Strategy

The guiding question of this scoping review was 'What are the main findings reported in the literature about oral health and dental care of the DHH population?' A DHH population was defined as those with hearing loss, either self-reported or objectively assessed by an audiometry instrument, in the primary articles included for this scoping review.

The search query included the following keywords: hearing impairment, deafness, deaf, hearing loss, people with disabilities, people with hearing impairment, oral health, dental care for persons with disabilities, Dental Plaque Index, DMF Index, Index of Orthodontic Treatment Need, Oral Hygiene Index, Periodontal Index, dentistry, dental health of people with disabilities, caries, oral hygiene, communication, bioethics, sign language, malocclusion, Deaf culture, Deaf community. The search query was adapted in an algorithm according to the requirements of each database.

As the literature used a range of criteria to categorise the DHH population, this situation was compensated by excluding articles regarding presbycusis (hearing loss associated to aging) or with older DHH populations. However, most of the articles did not mention or classified the severity/aetiology of the hearing loss, and the majority were children, giving more homogeneity to the studies.

A secondary search step included a 'snowball' technique to increase the number of relevant articles. For all articles found in the databases above, their literature citations were searched to find any other relevant articles that were not initially included. This process was repeated once more for articles included in the secondary step.

Data Source

The databases were selected according to their coverage of biomedical disciplines: Web of Science, LILACS, SciELO, MEDLINE, Scopus, EMBASE, GoogleScholar and Redalyc. Initially, no limits were set on date, language, type of article, country, or any other filter.

Eligibility Criteria

The following were included in the final analysis: full-text articles published in peer-reviewed journals; in Spanish, Portuguese, and English; from the January 2000 to January 2018. The exclusion criteria included letters to the editor and case reports; articles with no clear numeric results, using not validated indices or instruments, sample sizes less than 10 subjects, and combining results of the DHH population with other groups.

Data Characterisation and Summary

For all articles, the following variables were recorded in an Excel spreadsheet: title, authors, country, year, type (qualitative/quantitative), methodological design, and comparisons with other populations.

For quantitative articles, the numeric data from indices or instruments used were gathered and summarised in tables and text. For qualitative articles, main topics and findings were summarised in the text.

RESULTS

Characterisation of the Studies

A total of 51 articles were selected for analysis. Nineteen articles were published before and 32 were published after 2009; 15 were published in 2014 and 2015. The country of origin for most of the articles was India (17), followed by Brazil (6), Thailand (3), Romania (3), Nigeria (3), and Saudi Arabia (3). Three articles used qualitative methodology, and the remaining 48 used a quantitative methods. Among quantitative articles, 6 were experimental, and the remaining 42 were observational. Twenty studies included DHH and individuals with other disabilities; four studies included DHH and people without disabilities; and three included DHH, as well as people with other disabilities and those without disabilities.

Preventive Dental Health

Multiple studies reported low rates of toothbrushing twice per day among DHH children and adolescents, ranging from 6%-14.7%.^{60,67,72} In China and Thailand, the rate of good oral hygiene among DHH was much lower than among non-DHH peers (e.g. toothbrushing 2x/day 15.3% vs 37.7%,¹⁰¹ and 86% vs 97%⁹⁸). There appeared to be significant knowledge differences between non-DHH and DHH students on awareness of how to brush their teeth properly, with a prevalence of 79.1% and 55%, respectively.¹⁰¹

On the other hand, Suhani et al,⁸⁹ using the WHO indices, reported a higher prevalence of deleterious oral habits, such as thumbsucking, mouth breathing, tongue thrust

Table 1 DMFT, dmft and caries prevalence in DHH population

Country, year, reference	N	Age (years)	D	M	F	DMFT (SD)	d	m	f	dmft (SD)	Caries prevalence
Venezuela, 2003 ⁴⁴	50	3–17	1.44	0.14	0.48	2.06	1.82	0.38	0.52	2.72	92%
Saudi Arabia, 2004 ³ †	23	6–7	0.87	0	0	0.87 (1.25)	7.09	0.05	0.22	7.35 (3.82)	95.7%
	57	11–12	4.79	0.25	0.08	5.12 (3.45)	1.9	0.18	0.03	2.11 (2.53)	93%
India, 2008 ³⁹	18	5–8	0.5	0	0 (0)	0.50 (0.79)	N/A	N/A	N/A	2.17 (1.98)	N/A
	37	9–12	1.81	0.02	0.02	1.76 (1.74)	N/A	N/A	N/A	1.59 (2.03)	93.33%
	43	13–17	2.67	0.12	0.16	2.95 (2.0)	N/A	N/A	N/A	0.16 (0.61)	87.4%
	29	18–22	3.48	0.62	0.38	4.48 (2.43)	N/A	N/A	N/A	0.00 (0.00)	N/A
India, 2014 ⁷⁴	195	6–20	1.64	0.14	0.02	1.80 (1.26)	0.33	N/A	N/A	0.33 (0.24)	N/A
India, 2013 ³⁸ †	297	4–23	1.68	0.20	0.09	1.97 (1.93)	0.23	N/A	0.02	0.26 (0.85)	N/A
Iran, 2007 ¹ †	462	5–16	N/A	N/A	N/A	5.69	N/A	N/A	N/A	0.23	66%
Brazil, 2010 ⁵⁵ †	50	3–12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	46%
Thailand, 2014 ⁹⁸ †	97	≥18	1.63	0.32	1.95	3.90 (3.22)	N/A	N/A	N/A	N/A	82.5%
India, 2015 ⁵² †	132	3–15	0.74	0.02	0	0.76 (1.56)	0.73	0.01	0.03 ‡	0.77 (1.91)	N/A
Albania, 2014 ³³ †	147	3–18	N/A	N/A	N/A	4.7 (3.9)	N/A	N/A	N/A	2.8 (2.9)	88.4%*
											65.9%**
India, 2014 ²³ †	155	3–22	N/A	N/A	N/A	1.10 (1.58)	N/A	N/A	N/A	0.85 (1.76)	45.8%
India, 2013 ⁶⁶ †	95	7–17	1.38	0.02	0	1.4 (1.95)	0.34	0.14	0	0.47 (1.01)	N/A
China, 2012 ¹⁰¹ †	229	17–27	1.07	0.10	0.12	1.40 (1.89)	N/A	N/A	N/A	N/A	55.9%
South Africa, 2012 ⁵⁷ †	30	3–6	N/A	N/A	N/A	N/A	2.33	0.37	0.70	3.40 (3.87)	42.42%**
	33	7–9	N/A	N/A	N/A	N/A	1.73	1.06	0.18	2.97 (3.17)	
	13	10–12	0.15	0.08	0.00	0.23 (0.60)	N/A	N/A	N/A	N/A	18.18%*
	8	13–15	1.12	0.63	0.00	1.75 (3.24)	N/A	N/A	N/A	N/A	
India, 2016 ⁷²	50	6–8	1.4	0.04	0.16	1.6 (1.3)	2.5	0.1	0.1	2.8 (2.2)	66%
	72	9–12	1.9	0.08	0.01	1.9 (1.2)	1.7	0.4	0.04	2.1 (1.5)	79.2%
	58	13–16	2.0	0.16	0.05	2.2 (1.2)	0.5	0.6	0.07	1.1 (1.3)	46.6%
India, 2005 ¹⁰	280	6–18	N/A	N/A	N/A	1.64	N/A	N/A	N/A	N/A	93.9%
India, 2014 ⁸⁰ †	200	5–16	N/A	N/A	N/A	2.1	N/A	N/A	N/A	1.3	69%
India, 2010 ⁶⁵	137	7–18	2.46	1.20	0.00	2.53 (1.72)	N/A	N/A	N/A	N/A	35.32%
India, 2011 ¹² †	264	5–16	N/A	N/A	N/A	3.18	N/A	N/A	N/A	N/A	72.43%
Malaysia, 2015 ⁶³	63	6–14	2.7	0.15	2.1	4.9 (3.28)	5.6	N/A	0.4	6.1 (4.14)	85%**
											88%*
Yemen, 2015 ² †	92	6–14	N/A	N/A	N/A	1.91 (2.07)	N/A	N/A	N/A	4.37 (3.11)	N/A
Kuwait, 2000 ⁸³ †	312	3–29	N/A	N/A	N/A	5.0	N/A	N/A	N/A	5.3	88.3%**
											83.6%*

* permanent dentition; ** deciduous dentition; † comparative study with other disabilities; ‡ comparative study with non-deaf population; ¥ filled, with caries

(53.3% vs 40.6%), as well as malocclusion (79.3% vs 57%) among DHH children compared to hearing children. Avasthi et al¹² found a 59.78% prevalence of malocclusion signs, such as the presence of spacing, crowding, crossbite, increased overjet or others in DHH children.

Oral health educational interventions have demonstrated good results reducing gingival indices,^{11,62} bleeding,¹¹ and plaque indices^{7,11,62} among DHH students. Furthermore, it

has been found that a chlorhexidine gel containing aspartame or saccharin reduced the count of *Streptococcus mutans* in the deaf population.²⁹

DHH Oral Disease Burden

Caries prevalence in the DHH population varied widely between 18.18% and 95.7%, as shown on Table 1. Only three studies have made comparisons with non-DHH population.

Chinese DHH adolescents have a caries prevalence of 55.9% and a DMFT index of 1.40 ± 1.89 vs 13.8% and 1.36 ± 1.72 in their non-DHH peers, respectively.¹⁰¹ In Brazil, DHH children have a caries prevalence of 46%, compared to 31% in non-DHH children.⁴² Also, in Thailand the prevalence of caries was 53.6% with a DMFT of 4.83 ± 4.39 and 50.6% and 3.90 ± 3.22 among DHH students and non-DHH, respectively.⁹⁸

Additionally, from 65.3%³ to 79.5%³⁹ of DHH needed single-surface restorations; according to Ajami et al,¹ Mehta et al⁵³ and Nqocobo et al,⁵⁸ 100% of DHH subjects required dental treatment. Oredgduba et al⁵⁹ and Reddy et al⁶⁶ reported that from 88% to 100% of DHH subjects have never visited a dentist nor received dental care. According to Champion and Holt,²² 82 of 84 DHH children have visited a dentist, of whom 45 received dental care and 38 did not. In Thailand, 97.5% DHH had not received preventive dental care vs 84.2% of their non-DHH peers.⁹⁸

Periodontal status and oral hygiene were evaluated using several indices across the studies included, as shown in Table 2.

From 59.7% to 75% of DHH showed Angle class I occlusion,^{1,25,59} class II was found in 13% to 26%,^{25,29,59} and class III comprised between 8% and 10.8% in the DHH population.^{1,25,59}

Using the Dental Aesthetics Index (DAI), it was reported that 77.1% of the DHH population have normal occlusion or slight malocclusion.⁹⁶ According to the WHO indices, between 50.6%⁹⁶ and 44.5%³¹ DHH subjects have normal occlusion, and 31.5%³¹ to 33.8%⁷⁸ showed a slight malocclusion.

Using the Index of Orthodontic Treatment Need (IOTN), the Dental Health component did not differ statistically significantly between deaf and non-deaf teenagers (30% vs 22.4%).^{5,6} However, for the aesthetic component, the difference was statistically significant (43% vs 39.4%).⁵

DHH Barriers to Dental Care

Qualitative studies found that DHH people rarely, if ever, can communicate effectively with their dentists.^{20,30} This demonstrates the need for communication provisions, including interpreters during healthcare encounters.^{21,30} Furthermore, parents of DHH children report always being the interpreter during dental sessions, even as the children age.²² This can compromise the children's right to privacy. Parents of DHH children emphasise that dentists should be able to communicate directly and effectively with their children.²²

DHH individuals report acceptable communication with their dentist only in very simple specific situations where complex explanations are not necessary (e.g. 'spitting'). Furthermore, one article highlighted positive experiences from DHH patients when they received dental care from a DHH dentist who was able to effectively communicate with them, demonstrating the importance of cultural and communication competency.²¹

Regarding dental care, 46.15% DHH individuals self-reported experiencing discrimination, mainly because of communication issues, although further reasons are not reported.³³ In addition, 87% of DHH⁷¹ and 61.1% of parents

of DHH children²² reported communication barriers and/or breakdowns during their dental care. Furthermore, according to the findings of Rocha et al,⁷⁰ only 22.3% of DHH people perceived good communication with the dentist.

The most commonly mentioned concerns when receiving dental care were: communication with the dentist (52.4% in a survey of parents of DHH children²² and 76% in a survey of adult DHH patients⁷¹), communication with the dental assistant (41.7%²² and 61.8%⁷¹), being called from the waiting room (38.1%²² and 68.1%⁷¹), understanding what will take place during the appointment (46.4%²² and 57.84%⁷¹), not pulling the face mask down to allow the DHH patient to lipread (32.9%²² and 62%⁷¹) and the presence of background noise (36.5%²² and 55%⁷¹). 100% reported that dentists did not understand sign language.³² Such difficulties increased significantly with increased hearing loss severity.⁷¹

Regarding dental anxiety, Suhani et al⁸⁸ found that 59.7% of DHH people have moderate to extreme dental anxiety, and 5.3% have dental phobia, which is statistically significantly more prevalent in people with previous negative experiences with dentists (48.4 ± 15.14 and 36.6 ± 17.8 , respectively) ($p < 0.001$).

Dentists' Perceptions of DHH Dental Care

In two studies, most dentists experienced difficulties communicating with their DHH patients (97.5%⁹⁰ and 56.2%⁷⁰). Moreover, 68% of the dentists interviewed did not feel qualified to work with DHH patients.⁹⁰ Dentists used a variety of communication methods with their DHH patients; 90.75% of dentists combined different methods, such as lipreading, writing, or sign language interpreters.⁷³ According to Garbin et al,³³ all of the dentists who cared for DHH individuals reported that family members or friends, not professional interpreters, functioned as their interpreters. The majority of dentists interviewed (60%) identified costs as a reason for not hiring professional interpreters,⁹⁰ and according to Rocha et al,⁷⁰ 97.8% of the dentists reported the lack of an interpreter in their Family Health Care Units.

Regarding dental care, 69.7% of the dentists said that dental appointments with DHH patients required more time, while 34.5% felt that equitable dental care for DHH was not feasible.⁹⁰ More worrying was the fact that one study demonstrated that 16% of dentists refused dental care provision to DHH patients due to their communication needs.⁹⁰ However, this differed among DHH children. One study in Saudi Arabia found that 78% of dentists perceived that DHH children were able to receive the same orthodontic treatment as non-DHH children.⁴ Finally, 86.6% of dentists believed that DHH patients' oral health was poorer than that of the general population.⁹⁰

DISCUSSION

To the authors' knowledge, this is the first scoping review focused on DHH oral health. This study demonstrates that DHH struggle with significant oral health and dental access

Table 2 Periodontal and oral hygiene indices in the DHH population

Country, year, reference	N	Age (years)	index	Results (SD)				
India, 2008 ⁴¹	23	5–9	OHI–S	Mean score 1.57 (0.73).				
	48	10–14	OHI–S	Mean score 1.90 (0.67).				
	48	15–19	OHI–S	Mean score 1.88 (1.02).				
	8	20–24	OHI–S	Mean score 2.26 (0.94).				
	57	12–17	CPTIN	40% IPC0	42% IPC1	18% IPC2–4		
	29	18–23	CPTIN	45% IPC0	24% IPC1	31% IPC2–4		
India, 2005 ⁶⁴	112	3–20	OHI–S	Mean score 1.49 (0.88).				
India, 2011 ¹²	264	5–16	Gingival index	Prevalence 9.65%				
India, 2010 ⁶⁵	137	7–18	OHI–S	Mean score 1.49(0.76)				
			Löe and Sillness	Mean score 0.81(1.46)				
			OHI–S	Mean score 0.46 (0.31)				
			Attachment loss	0.26 (0.15)mm				
Albany, 2014 ³³	147	3–18	OHI–S	Mean score 2.42.				
India, 2016 ⁷²	180	6–16	CPTIN	Mean score 1.7 (0.61)				
India, 2013 ³⁸	297	4–23	IPC	IPC ₀ : 24.2%	IPC ₁ : 21.2%	IPC ₂ : 11.1%	IPC ₃ : 35.4%	IPC ₄ : 8.1%
India, 2014 ⁷³	372	6–16	Löe and Sillness	Mean score 1.66				
			Gingivitis	Mean score 1.61				
India, 2012 ⁷	150	14–17	Plaque score	Mean score 1.25 (0.35)				
			OHI–S	Mean score 2.52 (1.08).				
			CPTIN	7.7% IPC ₀ ,			0.7% IPC ₁	
India, 2015 ⁶¹	315	6 to >15	Plaque index*	Mean score 1.59.				
Thailand, 2012 ¹¹	66	6–10	Löe and Sillness	Mean score 0.94.				
India, 2015 ¹	56	5–17	Plaque index	Mean score 0.284 in permant teeth, 0.335 in mixed dentition, 0.437in deciduous teeth.				
Irán, 2007 ⁷⁴	462	5–17	OHI–S	67.8% good	25.0% fair	8.2% poor		
			Gingival index	51.1% good	39.6% fair	9.3% poor		
Saudi Arabia, 2004 ⁷²	23	6–7	Oral health index	17.4% good	60.9% fair	21.7% poor		
	57	11–12	Oral health index	7% good	45.6% fair	47.4% poor		
India, 2013 ⁶⁶	95	7–17	OHI–S	Mean score 1.15 (0.72).				
Bulgaria, 2015 ²⁸	100	5–12	OHI–S	Mean score 2.21 (0.54).				
India, 2015 ⁵²	132	3–15	Gingival bleeding	Prevalence 66.6%				
Tanzania, 2008 ⁷⁹	25	7–9	Gingival bleeding index	Mean score 0.13				
			Calculus index	Mean score 0.16.				
	51	10–12	Gingival bleeding index	Mean score 0.23				
			Calculus index	Mean score 0.32.				
	56	13–14	Gingival bleeding index	Mean score 0.29				
			Calculus index	Mean score 0.41				
	61	15–16	Gingival bleeding index	Mean score 0.36				
			Calculus index	Mean score 0.53				
	36	17–22	Gingival bleeding index	Mean score 0.46				
			Calculus index	Mean score 0.66				
Yemen, 2015 ²	92	6–14	Löe and Sillness	Mean score 1.19 (0.54)				
			Gingival index	Mean score 1.13 (0.60)				

*Turesky-Gilmore-Glickman with Quigley–Hein modification.

difficulties. The findings of this study call for a systematic examination of the dental experiences, complications, costs, quality of care, and outcomes of DHH individuals. Given the cross-sectional nature of the articles included in the study, it is difficult to determine the causal factors associated with poor oral health in DHH populations.

The information available on oral health status of this population is limited. Although a great variability is apparent in the history of caries (DMFT/dmf), tooth decay (D/d) is the major contributor in all the articles cited, with the exception of Vichayarant et al,⁹⁸ where the major contributor is restorations (F/f). In addition, the findings of Reddy et al⁶⁷ and Oregduba et al,⁶⁰ where over 80% of the DHH population have never visited a dentist, clearly expresses the need for dental treatment in this population. Regarding malocclusions and periodontal health, there are not enough comparative studies with a non-DHH population to establish an association; in addition, general agreement of the indices used is lacking, which makes it difficult to make accurate comparisons between these studies. Finally, although DHH populations largely experience poorer oral hygiene, there are successful examples in which this can be reversed through appropriate oral health education through visual methods.^{11,62,73}

There are several potential factors that may contribute to the above disparities. First, hearing loss represents a major source of miscommunication in the health care setting.⁵¹ This affects a variety of health-related outcomes, especially health knowledge, behaviour, treatment adherence, and patient satisfaction.^{15,27,52,86,93}

Second, the DHH struggle with lower health literacy and access to health information, including incidental learning opportunities.⁴⁸ poor health literacy affects the quality of health care, including oral health,⁵⁷ and may result in poorer oral health outcomes for DHH individuals. Also, multiple studies demonstrated lower health knowledge among DHH individuals on a variety of medical topics.^{36,50,57,63,91,102,103} It is not known whether this is the same for oral health knowledge among DHH individuals.

Third, DHH individuals are more likely to be poorer and require public assistance, including public dental insurance. Blanchfield et al¹⁷ analysed data from multiple national datasets (NHIS, NHANES, NHISD) and found that DHH individuals were significantly more likely to be publicly insured, unemployed, and have lower family incomes. Lower socio-economic status has been shown to be a strong driver of decreased access to dental health care.³⁵

DHH people communicate via sign language, speech, lipreading or a combination thereof. Regardless the communication method, many of the above articles point out the importance of good health care provider awareness on how to effectively communicate with DHH patients in clinical settings.⁵⁵ Specifically, for patients with limited English proficiency, the use of professional language interpreters in the UK is correlated with improved clinical care, and DHH report positive experiences in health care encounters when experienced professional sign language is offered. Also, in New Zealand, DHH access to professional interpreters is

associated with advantages such as access to better health services and more information, improved ability to engage in leisure activities and live in a healthy environment.⁴¹ On the other hand, in Brazil, it was concluded that speech is not sufficient to establish a link between the DHH patient and the health professional.²⁴ It is important to point out that as most of the DHH populations included in this study are functionally illiterate because of the educational and social barriers they face every day, written notes and speech are not adequate for communication.^{24,33,82,84,95}

The lack of availability of specialised oral health personnel for DHH individuals in primary care is due to the absence of training in their curricula, and this scenario is repeated in every other health profession. It was found that health professionals are not adequately prepared to care for DHH patients.^{19,24} In addition, a high proportion of health professionals do not feel qualified to meet the needs of the DHH; they report a lower probability of providing health care to the DHH and point out that these patients are the most complex to address due to communication barriers.^{40,53,70,90} This situation hinders the delivery of health services, putting at risk the successful treatment of these patients.

Due to the many communication barriers and existing oral health disparities, dentists and oral health professionals should consider strategies to address these gaps. This may include training on how to effectively communicate with DHH patients, establishing relationships with professional interpreters, and providing accessible oral health programmes to increase knowledge on good oral hygiene and techniques. It is necessary to understand the daily reality to which DHH patients are exposed, in order to create a health professional-patient connection, improve trust and patient satisfaction, increase patients' use of preventive health measures and health appointment attendance, thus benefiting their health.⁷⁶ There are very few but still successful programmes that have been developed for the training of medical, dental and pharmacy students in treating DHH patients, resulting in professionals with better attitudes towards the DHH. Yet these programmes have not been established as a mandatory part of the curricula.^{41,44,45-47,69,40,75,76,92,97}

A promising effort in Chile, through the funding from the National Disability Service, has developed approaches aimed at eliminating the communication issues DHH experience in dental care, involving the joint work of dentists, deaf people and Chilean sign language interpreters using mobile software that gives relevant information about dental care. This facilitates diagnosis and treatment, and improves the oral health care experience of the deaf patient through pre-recorded sign language videos.¹⁸ Other efforts around the globe have proved successful in addressing DHH health inequities. For example, the establishment of specialised primary health-care centres, although scarce, has been well received by DHH patients, since they aim to eliminate the communication, health education and access barriers previously described. In Scotland, the 'Sensory Support Centre WISC' has a high level of health profes-

sional-patient satisfaction with the service received; handicapped patients particularly appreciate the way in which WISC staff demonstrate knowledge and empathy with the challenges they face due to sensory impairment (visual or hearing loss), improving their quality of life.⁸³ In Austria, the 'Health Centre for the Deaf' has been developed where true health access is provided through staff competent in deaf culture who are able to communicate in sign language. DHH patients also have access to education programmes on diabetes and to mental health care.⁴¹ Finally, in France, there is an outpatient service for the primary care of DHH people, which has also been favourably received by the population.⁹

Limitations

The study limitations warrant consideration. First, there was a relative paucity of good quality publications and data on DHH oral health. The articles varied in the data type, methodology, and DHH sample (e.g. deaf signers vs individuals with any hearing loss).

Studies on DHH dental health use several indices, especially for periodontal disease; thus is quite difficult to determine the magnitude of oral diseases in this population. Also, there is a geographically asymmetric distribution of the studies, as most of them are from Asia, with limited studies in the Americas. This conveys unrepresentative data from DHH populations around the globe. This is noteworthy, as there are countries where health access for DHH population is greater, meaning that this population probably enjoys better dental health.

Moreover, only four studies compared the DHH population's oral health with a hearing population. This lack of comparative studies hinders the possibility of assessing a clear impact of hearing disabilities on dental health.

Despite these limitations, this review helps to demonstrate areas of oral health needs for the DHH population.

CONCLUSION

This scoping review is the first to focus on DHH persons' oral health and their dental care, which is a neglected issue in oral health research worldwide. The review highlights the need for further research using longitudinal data and standardised measures of oral health to understand the causes of oral health disparities in the DHH population. In this regard, special considerations must be taken, as the approach to the DHH population demands social and communication adjustments. Tailored health programmes are needed to educate DHH on how to adequately care for their teeth. Thus, efforts to develop accessible dental health programmes are needed to address apparent oral health inequities in the DHH population.

ACKNOWLEDGEMENTS

This study was funded by VRID 216.105.010-1.OIN2016 from Universidad de Concepción, Chile.

REFERENCES

1. Ajami BA, Shabzendedar M, Rezay YA, Asgary M. Dental treatment needs of children with disabilities. *J Dent Res Dent Clin Dent Prospects* 2007;1:93-98.
2. Al-Maweri SA, Zimmer S. Oral health survey of 6-14-year-old children with disabilities attending special schools Yemen. *J Clin Pediatr Dent* 2015;39:272-276.
3. Al-Qahtani Z, Wyne AH. Caries Experience and oral hygiene status of blind, deaf and mentally retarded female children in Riyadh, Saudi Arabia. *Odontostomatol Trop* 2004;27:37-40.
4. AlSarheed M, Bedi R, Alkhatib MN, Hunt NP. Dentists' attitudes and practices toward provision of orthodontic treatment for children with visual and hearing impairments. *Spec Care Dentist* 2006;26:30-36.
5. Al-Sarheed M, Bedi R, Hunt NP. Orthodontic treatment need and self-perception of 11-16-year-old Saudi Arabian children with a sensory impairment attending special schools. *J Orthod* 2003;30:39-44.
6. Al-Sarheed M, Bedi R, Hunt NP. The views and attitudes of parents of children with a sensory impairment towards orthodontic care. *Eur J Orthod* 2004;26:87-91.
7. Aise AS, Anandkrishna L, Chandra P, Ramya M, Kamath PS, Shetty AK. Educational intervention on the plaque score among hearing impaired children. *J Advanced Clin Res Insights* 2015;1:26-30.
8. Ameer N, Palaparathi R, Neerudu M, Palakuru SK, Singam HR, Durvasula S. Oral hygiene and periodontal status of teenagers with special needs in the district of Nalgonda, India. *J Indian Soc Periodontol* 2012; 16:421.
9. Amoros T, Bonnefond H, Martinez C, Charles R. A dedicated ambulatory system for the primary healthcare of the deaf people. *Sante publique* 2014;26:205-215.
10. Aruna CN, Chandu GN, Shafiulla MD. Dental caries experience among deaf and dumb children in Davangere, Karnataka. *J Indian Assoc Publ Health Dent* 2005;5:1-4.
11. Arunakul M, Kuphasuk Y, Boonyathanasit R. Effectiveness of oral hygiene instruction media on periodontal health among hearing impaired children. *Southeast Asian J Trop Med Public Health* 2012;43:1297.
12. Avasthi K, Bansal K, Mittal M, Marwaha M. Oral health status of sensory impaired children in Delhi and Gurgaon. *Int J dent clin* 2011;3:21-23.
13. Bainbridge KE, Wallhagen MI. Hearing loss in an aging American population: extent, impact, and management. *Annu Rev Public Health* 2014;35:139-152.
14. Barajas C, González-Cuenca AM, Carrero F. Comprehension of texts by deaf elementary school students: The role of grammatical understanding. *Res Dev Disabil* 2016;59:8-23.
15. Barnett DD, Koul R, Coppola NM. Satisfaction with health care among people with hearing impairment: a survey of Medicare beneficiaries. *Disabil Rehabil* 2014;36:39-48.
16. Barnett S, Mckee M, Smith SR, Pearson TA. Deaf sign language users, health inequities, and public health: opportunity for social justice. *Prev Chronic Dis* 2011;8:A45.
17. Blanchfield BB, Feldman JJ, Dunbar JL, Gardner EN. The severely to profoundly hearing-impaired population in the United States: prevalence estimates and demographics. *J Am Acad Audiol* 2001;12:183-189.
18. Campos V, Cartes-Velásquez R, Bancalari C. Development of an app for the dental care of Deaf people: *Odontoseñas*. *Univ Access Inf Soc* 2018.
19. Campos V. Barriers deaf patients face when receiving dental treatment. *J Oral Res* 2016;5:144-145.
20. Cardona M, Morales O, Marín E, Perdomo. Información sobre salud bucal de sordos Merideños. *Rev Venez Invest Odontol* 2015;3:28-47.
21. Cardoso AH, Rodrigues KG, Bachion MM. Perception of with severe or profound deafness about the communication process during health care. *Rev Lat Am Enferm* 2006;14:553-560.
22. Champion J, Holt R. Paediatric dentistry: Dental care for children and young people who have a hearing impairment. *Br Dent J* 2000;189: 155-159.
23. Chand BR, Kulkarni S, Swamy NK, Bafna Y. Dentition Status, Treatment Needs and Risk Predictors for Dental Caries among Institutionalised Disabled Individuals in Central India. *J Clin Diag Res* 2014;8:ZC56-59.
24. Chaveiro N, Barbosa ME, Porto CC, Munari DB, Madeiros M, Duarte SBR. Atendimento à pessoa surda que utiliza a língua de sinais, na perspectiva do profissional da saúde. *Cogitare Enfermagem* 2010;15: 639-645.
25. Ciger S, Akan S. Occlusal characteristics of deaf-mute individuals in the Turkish population. *Eur J Dent* 2010;4:128-136.
26. De Meulder M. The legal recognition of sign languages. *Sign Language Studies* 2015;15:498-506.

27. DeWalt DA, Boone RS, Pignone MP. Literacy and its relationship with self-efficacy, trust, and participation in medical decision making. *Am J Health Behav* 2007;31:S27–35.
28. Doichinova L, Peneva M. Motivational training programme for oral hygiene of deaf children. *Int J Sci Res* 2015;4:1124–1126.
29. Fernandes FSD, Fernandes JKB, Marques SG, da Silva RA. Effect of chlorhexidine gel containing saccharin or aspartame in deaf children highly infected with mutans streptococci. *Braz J Oral Sci* 2011;10:7–11.
30. Freitas D, Oliveira SL, Caldeira AP, Silveira MD. Odontologia Inclusiva. Percepções de indivíduos surdos sobre a comunicação com profissionais da Odontologia. *EFDeportes.com* 2011;16(155).
31. Gaçe E, Prifti H, Dulli R. Malocclusions and dental anomalies in Albanian children with disabilities. *Alban Med J* 2015;3:34–42.
32. Gaçe E, Kelmendi M, Fusha E. Oral Health Status of Children with Disability Living in Albania. *Mater Sociomed* 2014;26:392–394.
33. Garbin CAS, Garbin AJ, Sumida DH, do Prado RL. Evaluación del tratamiento personal recibido por pacientes sordos en Consultorio odontológico. *Acta Odontol Venez* 2008;46:446–450.
34. Genthner DJ, Frick KD, Chen D. Association of hearing loss with hospitalization and burden of disease in older adults. *JAMA* 2013;309:2322–2324.
35. Gupta E, Robinson PG, Marya CM, Baker SR. Oral health inequalities: relationships between environmental and individual factors. *J Dent Res* 2015;94:1362–1368.
36. Heuttel KL, Rothstein WG. HIV/AIDS knowledge and information sources among deaf and hearing college students. *Am Ann Deaf* 2001;146:280–286.
37. Humphries T, Humphries J. Deaf in the time of the cochlea. *J Deaf Stud Deaf Educ* 2010;16:153–163.
38. Jain M, Bharadwaj SP, Kaira LS, Bharadwaj SP, Chopra D, Prabu D. Oral health status and treatment need among institutionalised hearing-impaired and blind children and young adults in Udaipur, India. A comparative study. *Oral Health Dent Manag* 2013;12:41–49.
39. Jain M, Mathur A, Kumar S, Dagli RJ, Duraiswamy P, Kulkarni S. Dentition status and treatment needs among children with impaired hearing attending a special school for the deaf and mute in Udaipur, India. *J Oral Sci* 2008;50:161–165.
40. Jones T, Cumberbatch K. Sign language in dental education—A new nexus. *Eur J Dent Educ* 2017;Kuenburg A, Fellinger P, Fellinger J. Health care access among deaf people. *J Deaf Stud Deaf Educ* 2016;21:1–10.
41. Kuenburg A, Fellinger P, Fellinger J. Health care access among deaf people. *J Deaf Stud Deaf Educ* 2016;21(1):1–10.
42. Kumar S. Oral hygiene status in relation to sociodemographic factors of children and adults who are hearing impaired, attending a special school. *Spec Care Dentist* 2008;28:258–264.
43. Ladd P. *Deaf Culture: In Search of Deafhood*. Clevedon, England: Multilingual Matters, 2003.
44. Lock E. A workshop for medical students on deafness and hearing impairments. *Acad Med* 2003;8:1229–1234.
45. Old 46Margellos-Anast H, Estarziou M, Kaufman G. Cardiovascular disease knowledge among culturally Deaf patients in Chicago. *Prev Med* 2006;42:235–239.
46. Old 45Martínez NL. Dental caries experience in children with hearing impairment in two schools from the metropolitan area of Caracas, Venezuela 2001 in Spanish. *Acta Odontol Venez* 2003;41:30–35.
47. Mathews JL, Parkhill AL, Schlehofer DA, Starr MJ, Barnett S. Role-reversal exercise with deaf strong hospital to teach communication competency and cultural awareness. *Am J Pharm Educ* 2011;75:53.
48. McKee MM, Paasche-Orlow MK, Winters PC, Fiscella K, Zazove P, Sen A. Assessing health literacy in Deaf American Sign Language users. *J Health Commun* 2015;20(suppl 2):92–100.
49. McKee MM, Barnett S, Block R, Pearson T. Impact of communication on preventive services among deaf American Sign Language users. *Am J Prev Med* 2011;41:75–79.
50. McKee MM, McKee K, Winters P, Sutter E, Pearson T. Higher educational attainment but not higher income is protective for cardiovascular risk in Deaf American Sign Language (ASL) users. *Disabil Health J* 2014;7:49–55.
51. McKee MM, Moreland C, Atcherson SR, Zazove P. Hearing Loss: Communicating With the Patient Who Is Deaf or Hard of Hearing. *FP Essent* 2015;434:24–28.
52. McKee MM, Winters PC, Fiscella K. Low education as a risk factor for undiagnosed angina. *J Am Board Fam Med* 2012;25:416–421.
53. Mehta A, Gupta R, Mansoor S, Mansoori S. Assessment of oral health status of children with special needs in Delhi, India. *RSBO Revista Sul-Brasileira de Odontologia* 2015;12:239–246.
54. Merten JW, Pomeranz JL, King JL, Moorhouse M, Wynn RD. Barriers to cancer screening for people with disabilities: A literature review. *Disabil Health J* 2015;8:9–16.
55. Middleton A, Turner GH, Bitner-Glindzicz M, Lewis P, Richards M, Clarke A, et al. Preferences for communication in clinic from deaf people: A cross-sectional study. *J Eval Clin Pract* 2010;16:811–817.
56. Möller CC, Ibaldo LT, Tovo MF. Evaluation of the oral health conditions of deaf schoolchildren in the city of Porto Alegre, RS, Brazil in Portuguese. *Pesqui Bras Odontopediatria Clin Integr* 2010;10:195–200.
57. Möttus R, Johnson W, Murray C, Wolf MS, Starr JM, Deary IJ. Towards understanding the links between health literacy and physical health. *Health Psychol* 2014;33:164.
58. Nqobco CB, Yengopal V, Rudolph MJ, Thekiso M, Joosab Z. Dental caries prevalence in children attending special needs schools in Johannesburg, Gauteng Province, South Africa. *SADJ* 2012;67:308.
59. Onyeaso CO. Malocclusion pattern among handicapped children in Ibadan, Nigeria. *Nig J Clin Pract* 2004;5:57–60.
60. Oredugba FA. Oral health care knowledge and practices of a group of deaf adolescents in Lagos, Nigeria. *J Public Health Dent* 2004;64:118–120.
61. Padden C, Humphries T. *Inside Deaf Culture*. Cambridge, MA: Harvard University Press, 2005.
62. Pareek S, Nagaraj A, Yousuf A, Ganta S, Atri M, Singh K. Effectiveness of supervised oral health maintenance in hearing impaired and mute children—A parallel randomized controlled trial. *J Int Soc Prev Community Dent* 2015;5:176–182.
63. Peinkofer JR. HIV education for the deaf, a vulnerable minority. *Public Health Rep* 1994;109:390–396.
64. Rahmana NA, Yusoff A, Daud MK, Kamaruzaman FN. Salivary parameters, dental caries experience and treatment needs of hearing-impaired children in a special school for deaf in Kelantan, Malaysia. *Arch Orofac Sci* 2015;10:17–23.
65. Rao D, Amitha H, Munshi AK. Oral hygiene status of disabled children and adolescents attending special schools of South Canara, India. *Hong Kong Dent J* 2005;2:107–112.
66. Rawlani S, Motwani M, Bhowte R, Baheti R, Shivkuma S. Oral Health Status of Deaf and Mute Children Attending Special School in Anand-Wan, Warora, India. *J Korean Dent Sci* 2010;3:20–25.
67. Reddy VK, Chaurasia K, Bhambal A, Moon N, Reddy EK. A comparison of oral hygiene status and dental caries experience among institutionalized visually impaired and hearing impaired children of age between 7 and 17 years in central India. *J Indian Soc Pedod Prev Dent* 2013;31:141–145.
68. Rezaei M, Rashedi V, Morasae EK. Reading skills in Persian deaf children with cochlear implants and hearing aids. *Int J Pediatr Otorhinolaryngol* 2016;89:1–5.
69. Robey KL, Minihan PM, Long-Bellil LM, Hahn JE, Reiss JG, Eddy GE. Teaching health care students about disability within a cultural competency context. *Disabil Health J* 2013;6:271–279.
70. Rocha LL, de Lima Saintrain MV, Vieira-Meyer APGF. Access to dental public services by disabled persons. *BMC Oral Health* 2015;15:35.
71. Samnieng P. Dental care for patients who have a hearing impairment. *Int J Clin Prev Dent* 2014;10:215–218.
72. Sandeep V, Kumar M, Vinay C, Chandrasekhar R, Jyostna P. Oral health status and treatment needs of hearing impaired children attending a special school in Bhimavaram, India. *Ind J Dent Res* 2016;27:73–77.
73. Sandeep V, Vinay C, Madhuri V, Rao VV, Uloopi KS, Sekhar RC. Impact of visual instruction on oral hygiene status of children with hearing impairment. *J Indian Soc Pedod Prev Dent* 2014;32:39–43.
74. Sanjay V, Shetty SM, Shetty RG, Managoli NA, Gugawad SC, Hitesh D. Dental health status among sensory impaired and blind institutionalized children aged 6 to 20 years. *J Int Oral Health* 2014;6:55–58.
75. Santos Y, Novoa AM. Valoraciones de futuros estomatólogos sobre su formación para la atención al paciente sordo, La Habana, 2016. *Revista Habanera de Ciencias Médicas* 2017;16:280–294.
76. Sirch L, Salvador L, Palese A. Communication difficulties experienced by deaf male patients during their in-hospital stay: findings from a qualitative descriptive study. *Scand J Caring Sci* 2017;31:368–377.
77. Sharby N, Martire K, Iversen MD. Decreasing health disparities for people with disabilities through improved communication strategies and awareness. *Int J Environ Res Public Health* 2015;12:3301–3316.
78. Shearer AE, Hildebrand MS, Smith RJH. Hereditary Hearing Loss and Deafness Overview. In: Adam MP, Ardinger HH, Pagon RA, et al., eds. *Seattle: University of Washington, Seattle: GeneReviews [Internet]; 1993–2020:159–206.*

79. Shyama M, Al-Mutawa SA, Honkala S. Malocclusions and traumatic injuries in disabled schoolchildren and adolescents in Kuwait. *Spec Care Dentist* 2001;21:104–108.
80. Shyama M, Al-Mutawa SA, Morris RE, Sugathan T, Honkala E. Dental caries experience of disabled children and young adults in Kuwait. *Community Dent Health* 2001;18:181–186.
81. Simon EN, Matee MI, Scheutz F. Oral health status of handicapped primary school pupils in Dar es Salaam, Tanzania. *East Afr Med J* 2008; 85:113–117.
82. Singh A, Ashish Kumar A, Berwal V, Kaur M. Comparative study of oral hygiene status in blind and deaf children of Rajasthan. *Adv Med Dent Scie* 2014;2:26–31.
83. Sirch L, Salvador L, Palese A. Communication difficulties experienced by deaf male patients during their in-hospital stay: findings from a qualitative descriptive study. *Scand J Caring Sci* 2017;31:368–377.
84. Smith A, Shepherd A, Jepson R, Mackay S. The impact of a support centre for people with sensory impairment living in rural Scotland. *Prim Health Care Res Dev* 2016;17:138–148.
85. Steinberg AG, Barnett S, Meador HE, Wiggins EA, Zazove P. Health care system accessibility. *J Gen Intern Med* 2006;21:260–266.
86. Stevens G, Flaxman S, Brunskill E, Mascarenhas M, Mathers CD, Finucane M, et al. Global and regional hearing impairment prevalence: an analysis of 42 studies in 29 countries. *Eur J Public Health* 2013;23: 146–152.
87. Stewart MA. Effective physician-patient communication and health outcomes: a review. *CMAJ* 1995;152:1423–1433.
88. Stokoe WC. Sign language structure: An outline of the visual communication systems of the American deaf. *J Deaf Stud Deaf Educ* 2005; 10:3–37.
89. Suhani RD, Suhani MF, Badea ME. Dental anxiety and fear among a young population with hearing impairment. *Clujul Medical* 2016;89:143.
90. Suhani RD, Suhani MF, Muntean A, Mesaros M, Badea ME. Deleterious oral habits in children with hearing impairment. *Clujul Med* 2015;88: 403–407.
91. Suhani RD, Suhani MF, Muntean A, Mesaros M, Badea ME. Ethical dilemmas concerning the dental treatment of patients with hearing impairment. *Rev Romana Bioet* 2015;13.
92. Tamaskar P, Malia T, Stern C, Gorenflo D, Meador H, Zazove P. Preventive attitudes and beliefs of deaf and hard-of-hearing individuals. *Arch Family Med* 2000;9:518–526.
93. Thew D, Smith SR, Chang C, Starr M. The deaf strong hospital program: a model of diversity and inclusion training for first-year medical students. *Acad Med* 2012;87:1496.
94. Torres RE. The pervading role of language on health. *J Health Care Poor Underserved* 1998;9:S21–S25.
95. Traxler CB. The Stanford Achievement Test: National norming and performance standards for deaf and hard-of-hearing students. *J Deaf Stud Deaf Educ* 2000;5:337–348.
96. Ubido J, Huntington J, Warburton D. Inequalities in access to health-care faced by women who are deaf. *Health Soc Care Community* 2002; 10:247–253.
97. Utomi IL, Onyeano CO. Assessment of malocclusion treatment need in disabled children in Nigeria. *JDOH* 2007;8:3–8.
98. Van Winkle LJ, Fjortoft N, Hojat M. Impact of a workshop about aging on the empathy scores of pharmacy and medical students. *Am J Pharm Educ* 2012;76:9.
99. Vichayanrat T, Kositpumivate W. Oral health conditions and behaviours among hearing impaired and normal hearing college students at Ratchasuda College, Nakhon Pathom, Thailand. *Southeast Asian J Trop Med Public Health* 2014;45:1228–1235.
100. Wallhagen MI, Strawbridge WJ, Shema SJ. The relationship between hearing impairment and cognitive function: a 5-year longitudinal study. *Res Gerontol Nurs* 2008;1:80–86.
101. Webb MYL, Lederberg AR, Branum-Martin L, Connor CM. Evaluating the structure of early English literacy skills in deaf and hard-of-hearing children. *J Deaf Stud Deaf Educ* 2015;20: 343–355.
102. Wei H, Wang YL, Cong XN, Tang WQ, Wei PM. Survey and analysis of dental caries in students at a deaf-mute high school. *Res Dev Disabil* 2012;33:1279–1286.
103. Wollin J, Elder R. Mammograms and Pap smears for Australian deaf women. *Cancer nursing* 2003;26:405–409.
104. Woodroffe T, Gorenflo DW, Meador HE, Zazove P. Knowledge and attitudes about AIDS among deaf and hard of hearing persons. *AIDS Care* 1998;10:377–386.
105. World Health Organization. Disability and Health (Fact sheet N°352). Geneva: World Health Organization, 2015.
106. World Health Organization. Deafness and hearing loss (Fact sheet N°300). Geneva: World Health Organization, 2015.