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Review Article

Perceptual evaluation of velopharyngeal insufficiency in people with cleft palate: an integrative literature review

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ABSTRACT

Velopharyngeal Insufficiency (VPI) secondary to cleft palate refers to an incomplete closure of the velopharyngeal mechanism during speech, due to a lack of tissue in the soft palate or the walls of the pharynx, which generates a hypernasal resonance and nasal air emission when producing oral sounds. In this regard, there are various proposals in the literature for the perceptual evaluation of VPI. The objective of the present study is to describe the auditory-perceptual evaluation of velopharyngeal insufficiency, through an integrative literature review. To this end, in May 2020 a literature search was carried out using the electronic databases PUBMED, LILACS, SciELO, and Cochrane, using the keywords: "Velopharyngeal Sphincter", "Velopharyngeal Insufficiency", "Cleft Palate", "Speech Intelligibility", "Speech Production Measurement", "Speech Articulation Tests" and "Speech-Language Pathology", in English as well as Portuguese and Spanish. Original articles related to the topic were selected, and a specific protocol for data extraction was created. In total, 2,385 articles were found. Of these, 2,354 were excluded due to the title, 13 due to the abstract, and 3 after reading the full text. Finally, based on their methodology, 33 articles were used for this review. From the review, it is concluded that the parameters most used for the evaluation are hypernasality, nasal emission, and compensatory articulation associated with VPI. These parameters are evaluated mainly in sentences, spontaneous speech, and words, by an expert speech-language pathologist, in person and through audio recordings.

Keywords:
Velopharyngeal Insufficiency; Cleft Palate; Speech-Language Pathology; Speech Production Measurement

Evaluación perceptual de la insuficiencia velofaríngea en personas con fisura del paladar: una revisión integradora de literatura

RESUMEN

La insuficiencia velofaríngea (IVF) secundaria a fisura del paladar corresponde al cierre incompleto del mecanismo velofaríngeo durante el habla, debido a una falta de tejido en el paladar blando o las paredes de la faringe, lo cual genera una resonancia hipernasal y una emisión nasal de aire en los sonidos orales. Al respecto, en la literatura existen diversas propuestas para la evaluación perceptual de la IVF. Por esto, el objetivo del presente estudio es describir la evaluación perceptiva auditiva de la insuficiencia velofaríngea, mediante una revisión integradora de literatura. Para ello, en mayo de 2020 las bases de datos electrónicas PUBMED, LILACS, SciELO y Cochrane, fueron consultadas utilizando las palabras claves en inglés: "Velopharyngeal Sphincter", "Velopharyngeal Insufficiency", "Cleft Palate", "Speech Intelligibility", "Speech Production Measurement", "Speech Articulation Tests" y "Speech-Language Pathology" y sus respectivos equivalentes en portugués y español. Se seleccionaron artículos originales relacionados al tema, y se creó un protocolo específico para la extracción de los datos. En total se encontraron 2.385 artículos. De ellos, 2.354 fueron excluidos por el título, 13 por el resumen y 3 luego de la lectura del texto completo. Finalmente, a partir de la metodología desarrollada, en esta revisión fueron utilizados 33 artículos. A partir de la revisión realizada se concluye que los parámetros más utilizados en la evaluación son la hipernasalidad, la emisión nasal y la articulación compensatoria asociada a IVF. Estos parámetros son evaluados principalmente en oraciones, habla espontánea y palabras, por un fonoaudiólogo experto, en vivo y mediante grabaciones de audio.

Palabras clave:
Insuficiencia Velofaríngea; Fisura del Paladar; Patología del Habla y Lenguaje; Medición de la Producción del Habla

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INTRODUCTION

The velopharyngeal mechanism (VPM) or velopharyngeal sphincter is responsible for controlling the resonance balance between the nasal and oral cavity, thus controlling the air and acoustic pressures during speech. The sphincter remains closed during the production of oral sounds and opens for nasal sounds (Marrinan & Shprintzer, 2006; Moon, 2004; Smith & Kuehn, 2007). When the velopharyngeal closure does not occur appropriately during the emission of oral sounds, part of the voiced air stream is diverted towards the nasal cavity, compromising speech production in different ways (Kuehn & Moller, 2000). Thus, the excess of acoustic energy in the nasal cavity alters the balance of speech resonance and acoustics (Lam et al., 2007; Smith & Guyette, 2004).

Velopharyngeal insufficiency (VPI) is a term used to refer to the inappropriate closure of the VPM during speech. This may be due to anatomical velopharyngeal disturbances caused by structural deficits of the pharyngeal veil or walls, where there is not enough tissue to ensure an efficient closure of the VPM. A common cause of VPI is orofacial clefts affecting the palate (Morris & Ozanne, 2003; Trost-Cardamone, 1989). Cleft palate is a congenital malformation that is caused by incomplete or absent fusion of the maxillary processes during embryogenesis. In velopalatine clefts there is a compromise of the hard and soft palate; in velar clefts, the muscles and mucosa of the soft palate are affected; and in submucosal clefts, there is a disturbance of the velar musculature with continuity of the oral and nasal mucosa (Tresserra et al., 1997).

In patients with cleft palate, the primary surgical correction prioritizes the establishment of anatomical and functional conditions for an adequate velopharyngeal closure (Agrawal, 2009; Becker et al., 2000; Henningsson et al., 2008; Rosanowski & Eysholdt, 2002). However, 5% to 36% of patients with cleft palate still show VPI symptoms after primary surgery (Bicknell et al., 2002; Marrinan et al., 1998; Sommerlad, 2003).

The assessment of VPI is done using instrumental procedures and a clinical speech evaluation (*Ministerio de Salud* [Chilean Ministry of Health, MINSAL], 2015). As for the instrumental procedures, they can be used in both direct and indirect evaluations. Among direct methods of evaluation for the function of the VPS, we can find flexible video nasopharyngoscopy (VNP) and multiplane videofluoroscopy (VFS). On the other hand, the indirect method most used internationally is nasometry (Bettens et al., 2016; Conley et al., 1997). Meanwhile, the perceptual clinical evaluation of VPI performed by speech-language pathologists is considered the gold standard procedure for the assessment of functional disturbances of the VPM during speech (Chapman et al., 2016; Kuehn & Moller, 2000; Smith & Guyette, 2004).

Due to the above, it is important to have knowledge of the various parameters and procedures described for the perceptual assessment of velopharyngeal function during speech, after surgical, prosthetic, and functional interventions. Currently, the most widely used are the ones called universal parameters, described by Henningsson et al. (2008). These parameters were developed during a workshop held in Washington, DC, where a team of six people with experience in speech therapy and cleft palate developed a system of universal parameters to report speech outcomes in people with cleft palate (Henningsson et al., 2008). However, some studies describe other parameters and scoring scales for the evaluation of VPI by speech-language pathologists, which are used at a national and international level by multidisciplinary rehabilitation teams working with people with cleft palate (Álvarez et al., 2004; Henningsson et al., 2008; Kummer, 2011; MINSAL, 2015).

In recent years, there has been a growing development of literature reviews that allow providing a synthesis of knowledge concerning determined topics. Among these, the integrative literature review is a method that synthesizes research focused on clinical practice, with the aim to positively impact the quality of the services provided to patients (Souza et al., 2010). There have been several integrative reviews carried out concerning aspects of speech-language pathology assessments and interventions, but none on perceptual evaluation of VPI. Thus, an integrative literature review is proposed with the aim of describing the auditory-perceptual analysis' parameters and procedures used for the evaluation of velopharyngeal insufficiency in people with surgically intervened cleft palate.

MATERIAL AND METHOD

In this review the following stages were carried out: 1) Establishment of the research question. 2) Search or sampling of literature. 3) Data collection. 4) Evaluation and critical analysis of the included studies. 5) Interpretation and discussion of the results. 6) Synthesis of knowledge and presentation of the review (Mendes et al., 2008; Souza et al., 2010).

Search Strategy

The development of the search was based on the question: Which perceptual parameters and procedures are considered for the speech-language assessment of velopharyngeal insufficiency secondary to cleft palate?

In May 2020, an electronic search was carried out with no publication deadline, using the following databases: US National Library of Medicine National Institutes of Health (PUBMED), *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS), Scientific Electronic Library Online (SciELO), and Cochrane Library.

Terms in English were used for the article search that are available in the Medical Subject Headings (MeSH), as well as their equivalents in Spanish and Portuguese, obtained from *Descriptores en Ciencias de la Salud* (Descriptors in Health Sciences, DeCS). The terms were combined using the Boolean operator AND (Table 1). In addition, a cross-reference analysis was performed.

Table 1. Combination of descriptors used in the electronic search.

English (MeSH)	Spanish (DeCS)	Portuguese (DeCS)
Velopharyngeal Sphincter AND Speech Intelligibility	Esfínter Velofaríngeo AND Inteligibilidad del Habla	Esfíncter Velofaríngeo AND Inteligibilidade da Fala
Velopharyngeal Sphincter AND Speech Production Measurement	Esfínter Velofaríngeo AND Medición de la Producción del Habla	Esfíncter Velofaríngeo AND Medida da Produção da Fala
Velopharyngeal Sphincter AND Speech Articulation Tests	Esfínter Velofaríngeo AND Pruebas de Articulación del Habla	Esfíncter Velofaríngeo AND Testes de Articulação da Fala
Velopharyngeal Sphincter AND Speech-Language Pathology	Esfínter Velofaríngeo AND Patología del Habla y Lenguaje	Esfíncter Velofaríngeo AND Patologia da Fala e Linguagem
Velopharyngeal Insufficiency AND Speech Intelligibility	Insuficiencia Velofaríngea AND Inteligibilidad del Habla	Insuficiência Velofaríngea AND Inteligibilidade da Fala
Velopharyngeal Insufficiency AND Speech production measurement	Insuficiencia Velofaríngea AND Medición de la Producción del Habla	Insuficiência Velofaríngea AND Medida da Produção da Fala
Velopharyngeal Insufficiency AND Speech Articulation Tests	Insuficiencia Velofaríngea AND Pruebas de Articulación del Habla	Insuficiência Velofaríngea AND Testes de Articulação da Fala
Velopharyngeal Insufficiency AND Speech-Language Pathology	Insuficiencia Velofaríngea AND Patología del Habla y Lenguaje	Insuficiência Velofaríngea AND Patologia da Fala e Linguagem
Cleft Palate AND Speech Intelligibility	Fisura del Paladar AND Inteligibilidad del Habla	Fissura Palatina AND Inteligibilidade da Fala
Cleft Palate AND Speech production measurement	Fisura del Paladar AND Medición de la Producción del Habla	Fissura Palatina AND Medida da Produção da Fala
Cleft Palate AND Speech Articulation Tests	Fisura del Paladar AND Pruebas de Articulación del Habla	Fissura Palatina AND Testes de Articulação da Fala
Cleft Palate AND Speech-Language Pathology	Fisura del Paladar AND Patología del Habla y Lenguaje	Fissura Palatina AND Patologia da Fala e Linguagem

Selection Criteria and Data Analysis

The inclusion criteria for the selection of the studies were: a) Published in English, Spanish, and Portuguese; b) With access to the full text; c) Carried out on people with a surgically intervened cleft palate; d) Reporting and describing perceptual evaluation parameters for velopharyngeal insufficiency; e) With any of the following types of study: case series, cohort study, non-randomized and randomized clinical trial.

For the selection of the studies, the titles and abstracts of the publications found were read. Subsequently, the articles that met the inclusion criteria and responded to the research question were read. Each article was assessed by two of the authors and when in doubt, a consensus among all the authors was sought.

Case reports, literature reviews, conference presentations, dissertations, and book chapters were excluded. Furthermore, studies carried out in people with acquired velopharyngeal insufficiency due to trauma or tumor resection, velopharyngeal

incompetence due to neurological injury, or velopharyngeal mislearning due to a hearing deficit were also excluded.

A protocol was designed for data extraction which considered the following parameters: author, year, country, characteristics of the subjects with cleft palate (number of subjects, age, type of cleft, age in which the palate closure was performed, fistulas, and presence of compensatory articulation), characteristics of the control group (number and age), objective of the study, perceptual parameters for assessing VPI, type of speech sample used for the evaluation (spontaneous, automatic, retelling, syllables, words, sentences, etc.), type of evaluator (expert speech-language therapist; inexperienced therapist; non-trained listener), scale (Equal-Appearing Interval – EAI, Direct Magnitude Estimation-DME, or Visual Analog Scale-VAS), analysis (in person, audio, video), instrumental evaluation (video nasopharyngoscopy, videofluoroscopy, nasometry), and main results.

The results will be presented in tables, while the main findings are displayed in bar charts, designed using the software jamovi, version 1.1 (The jamovi project, 2019).

RESULTS

During the review, a total of 2,385 articles were found, of which 2,354 were excluded due to their title, 13 after reading the abstract, and 3 after reading the full text. In agreement with previously established methodological criteria and the cross-reference analysis, 33 articles were analyzed in this review (Figure 1).

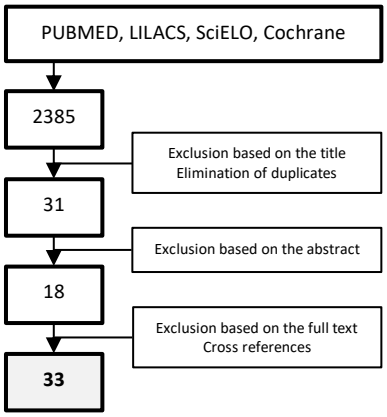

Figure 1. Stages of the literature review process.

Tables 2 and 3 summarize the studies selected for the description of perceptual parameters and procedures used in the evaluation of velopharyngeal insufficiency in people with surgically intervened cleft palate.

Table 2. Summary of the identification (year and country) and the participants of the studies.

Authors (year)	Country	Group of participants with cleft palate				Control Group	
		N	age	1º Sx (age)	Fistulas (yes, no)	N	age
Nellis et al. (1992)	EEUU	16	8-18 y	NR	NR	NR	NR
Williams et al. (1998)	Russia	112	4-10 y	2-4 a	yes	NR	NR
Keuning et al. (1999)	NL	15	10-13 y	NR	no	NR	NR
Sell et al. (2001)	UK	647	5-12 y	NR	NR	NR	NR
Keuning et al. (2002)	NL	43	4-83 y	NR	NR	NS	NS
Konst et al. (2003)	NL	54	2.5 - 3 y	12 m	NR	8	2
Kummer et al. (2003)	USA	173	3-12 y	NR	NR	NR	NR
Lewis et al. (2003)	USA	17	4.2 y 18.4 y	NR	NR	3	4.2-18.4 y
Álvarez et al. (2004)	Chile	46	3-29 y	NR	NR	NR	NR
Keuning et al. (2004)	NL	43	4-83 y	NR	NR	NR	NR
Paal et al. (2005)	Germany	12	9.5±0.5 y	NR	NR	NR	NR
John et al. (2006)	UK	10	5-10 y	NR	NR	1	NS
Sweeney & Sell (2008)	Ireland	50	4.10-15.10 y	NR	NR	NR	NR
Lee et al. (2009)	Ireland	20	21-65 y	NR	NR	2	23-35 y
Rullo et al. (2009)	Italy	68	5-8 y	8-12 m	NR	NR	NR
Lipira et al. (2011)	USA	88	2-24 y	NR	NR	NR	NR
Hubbard et al. (2013)	USA	18	3-19 y	3-12 m	NR	NR	NR

Paniagua et al. (2013)	Brazil	49	9-16 y	19.5 m	NR	NR	NR
Trindade et al. (2014)	Brazil	20	17-35 y	NR	NR	18	20-35 y
Nguyen et al. (2015)	USA	249	3 y	14-15 m	NR	NR	NR
Padilha et al. (2015)	Brazil	100	5-12 y	9-18 m	NR	NR	NR
Scarmagnani et al. (2015)	Brazil	100	6-47 y	NR	NR	NR	NR
Sell et al. (2015)	UK	248	5 y 12 y	NR	yes	NR	NR
Bettens et al. (2016)	Belgium	35	4-15 y	NR	NR	NR	NR
Chapman et al. (2016)	USA	10	5-7 y	NR	NR	NR	NR
Georgievska et al. (2016)	Macedonia	10	4-7 y	NR	NR	10	4-7 y
Larangeira et al. (2016)	Brazil	331	5-13 y	NR	NR	NR	NR
Medeiros et al. (2016)	Brazil	60	6-52 y	NR	NR	NR	NR
Oliveira et al. (2016)	Brazil	77	NR	NR	NR	NR	NR
Sinko et al. (2017)	Austria	36	8-27 y	NR	NR	NR	NR
Abdali & Yaribakht (2019)	Iran	24	13-41y	6 m	NR	NR	NR
Aparna et al. (2019)	India	25	5-7 y	18 m	NR	NR	NR
de Boer et al. (2020)	Canada	54	NR	NR	NR	NR	7.7±1.1 y

Abbreviations: NS = not specified (it is pointed out but not detailed); NR = not reported (not pointed out); N = number; y = years; m = months; CA = compensatory articulation; 1º Sx = age of primary palate surgery; NL = Netherlands; UK = United Kingdom; USA = United States of America

Regarding the year of publication, the first article included corresponds to Nellis's research, published in 1992. As can be seen in figure 2, the period with the highest scientific production is between 2003 and 2019. In relation to the countries of publication, as can be seen in figure 3 the three countries with the highest scientific production in this field are Brazil, the US, and the UK.

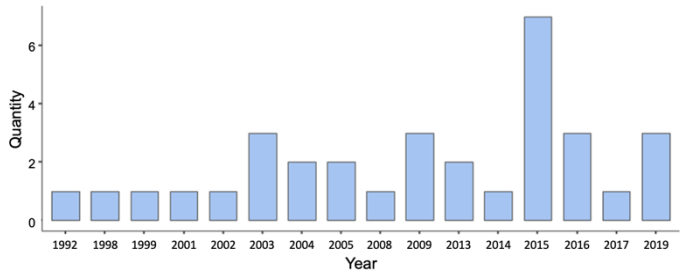

Figure 2. Year of publication.

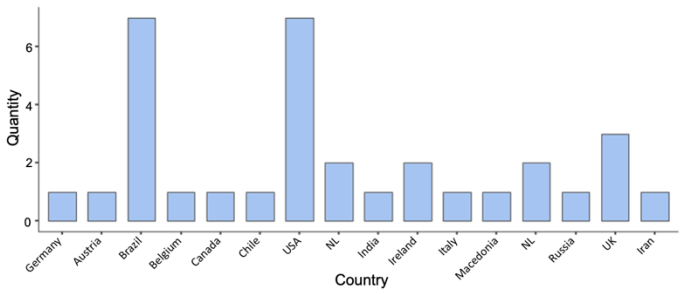

Figure 3. Countries of origin of the publications.

Concerning the participants with cleft palate, the average number of participants among all studies was 87 people, ranging from 10 to 647 people. The age range of the subjects is 2.5 to 83 years. As for the age of primary surgery, only 9 studies (27.3%) reported this information, indicating a range from 3 months to 4 years. The presence of fistulas was reported in only 2 studies (6%). Finally, concerning the control group, 6 of the investigations included participants without cleft palate, with an average of 7 subjects, and an age range from 2 to 35 years.

With regards to the perceptual parameters, figure 4 shows that the most evaluated parameter is hypernasality (N=31), followed by nasal emission (N=23), and compensatory articulation associated with VPI (N=9). On the other hand, the least evaluated parameters were mixed resonance (N=2), low intraoral pressure (N=2), severity level (N=2), point of articulation (N=2), visible nasal emission (N=2), and nasal fricative (N=2).

Table 3. Summary of the perceptual evaluation of velopharyngeal function during speech.

Authors (year)	**Objective of the study**	**Perceptual parameters evaluated**	**Scale: EAI; DME; VAS**	**Speech sample: spontaneous; automatic; sentences; words; syllables; sounds**	**Number and type of evaluator: Expert SLP; inexperienced SLP's; non-trained listener**	**Analysis: In-person; audio; video**	**Instrumental evaluation: VNP; VFS; nasometry**	**Main Results**
Nellis et al., (1992)	To relate nasalance values and perceptual judgment of nasality in individuals with pharyngeal flap.	- Hypernasality - Hyponasality	- EAI: 1-6 pts (absent, mild, mild-moderate, moderate, moderate-severe, or severe)	- Sentences	- 10 expert SLPs	- Audio	- Nasometry	The correlations between the perceptual judgment of hypernasality and nasalance were not significant.
Williams et al. (1998)	To evaluate the results of primary palatoplasty carried out using the method by Larisa Y. Frolova, M.D. (1971).	- Hypernasality - Hyponasality - Nasal Emission	- EAI: present or absent	- Words	- 2 expert SLPs	- In-person	NR	In the perceptual evaluation, 55.5% of the participants were classified as having a normal resonance. Meanwhile, 9.5% of the subjects presented hyponasality.
Keuning et al., (1999)	To evaluate the reliability of perceptual ratings for four types of speech samples.	- Hypernasality - Nasal Emission - CA	- VAS: 0-100 mm (normal to extremely deviated)	- Sentences	- 3 expert SLPs - 2 inexperienced SLPs - 1 non-trained listener (surgeon)	- Audio	NR	The perceptual evaluation judges differ significantly in the range used for rating. Furthermore, the level of experience of the expert speech therapists did not guarantee high reliability.
		- Hyponasality	- EAI: 1-3 pts (sometimes, always present or absent)					
Sell et al. (2001)	To describe the speech results in children with unilateral CLAP, interveined in the United Kingdom.	- Hypernasality - Hyponasality - Nasal Emission - Nasal turbulence	- EAI: 0-4 pts (absent, mild and occasional, mild and consistent, moderate and consistent, or severe and consistent)	- Automatic - Spontaneous	- 2 expert SLPs	- Audio - Video	NR	The perceptual evaluation findings suggest that primary surgeries for children with CLAP are producing poor speech outcomes and that Speech Therapy does not meet the children's needs.
		- Facial movement	- EAI: absent or present					
		- Intelligibility	- EAI: 0-5 pts (normal, to impossible to understand)					
Keuning et al. (2002)	To correlate nasalance values and perceptual evaluation of various	- Global severity level - Hypernasality - Nasal Emission	- VAS: 0-100 mm (normal to extremely deviated)	NS	- 6 expert SLPs	- Audio	- Nasometry	Low correlation between nasalance and perception of hypernasality. The general degree of severity seemed to be determined by intelligibility.

	aspects of speech in individuals with VPI.	- Intelligibility - CA						The experience showed a high correlation between instrumental measurement and perceptual evaluation.
		- Hyponasality	- EAI: absent, sometimes present, or always present					
		- Vocal quality	- EAI: good, moderate, or bad					
Konst et al. (2003)	To investigate the effect of child orthopedics used during the first year of life on speech characteristics in children with CLAP, through a perceptual evaluation.	- Articulation point - Hyperkinetic voice - Hypernasality - Nasal Emission - Nasal fricative - Nasal snort - Nasal realization - Correction of articulation - Intelligibility	- EAI: 1-7 pts	- Spontaneous	- 5 expert SLPs	- Audio	NR	The reliability and consistency of the perceptual evaluation scales were good. The intelligibility rating scale was the only speech characteristic that helped distinguish children with child orthopedics.
		- General impression	- EAI: 1-10 pts					
Kummer et al. (2003)	To examine the relationship between perceptual characteristics and size of the velopharyngeal gap.	- Hypernasality	- EAI: mild, moderate, or severe	- Sentences	- 1 expert SLP	NS	- VFS - VNP	Moderate and severe hypernasality was associated with a large velopharyngeal gap, while nasal turbulence was associated with a small gap.
		- Nasal Emission - Nasal turbulence	- EAI: absent or present					
Lewis et al. (2003)	To assess the level of agreement between the perceptual evaluation of nasality and nasalance scores, clinical experience of the listener, and academic training.	- Hypernasality	- EAI: 1-5 pts (normal resonance to severe hypernasality)	- Sentences	- 3 expert SLPs (lecturer and clinician) - 3 inexperienced SLPs (lecturer) - 3 inexperienced SLPs (student) - 3 non-trained listeners (surgeon)	- Audio	- Nasometry	The levels of agreement for perceptual evaluation were highest for speech therapists, followed by surgeons. Expert speech therapists and surgeons rated hypernasality as lower. The correlation coefficients between nasalance and perceptual evaluation were low to moderate.

Álvarez et al. (2004)	To evaluate the validity and reliability of an evaluation protocol for patients with CLAP.	- Nasal Emission	- EAI: 0-1 pts (absent or inconsistent)	- Syllables - Words - Sentences - Spontaneous	- 3 expert SLPs	- Audio - Video	- VNP	The assessment protocol was highly correlated with the gap observed in the VNP examination. A high perceptual score was associated with a high percentage of velopharyngeal sphincter gap. In the reliability analysis, no significant differences were found between the ratings of the listeners.
		- Consistent and visible nasal emission - Consistent audible nasal emission - Nasal turbulence - Low intraoral pressure - Facial movements - Hypernasality	- EAI: 1-3 pts (mild, moderate, or severe)					
		- Normal resonance/ Hyponasality	- EAI: present or absent					
		- Mixed resonance	- EAI: 1-2 pts (present or absent)					
		- CA	- EAI: present or absent					
Keuning et al. (2004)	To evaluate the potential clinical use of composite measures, derived from mean nasalance scores.	- Global level of severity - Hypernasality - Nasal Emission - Intelligibility - CA	- VAS: 0-100 mm (normal to extremely deviated)	- Sentences (paragraph)	- 6 expert SLPs	- Audio	- Nasometry	The normalization of the nasalance scores (composite measures) did not improve the correlation with the perception rates.
Paal et al. (2005)	To evaluate the reliability of VNP and auditory perception used for assessing speech in children with CLAP.	- Nasality - Articulation point - Articulatory tension - Interdental lisp	- EAI: 0-3 pts (non-perceivable auditory variation, to distinct auditory variation)	- Words	- 2 expert SLPs - 2 inexperienced SLPs	- Video	- VNP	The visual and perceptual findings of the experienced raters were highly reliable. Meanwhile, the relationship between VNP and the perception of hypernasality resulted in little correlation.
John et al. (2006)	To develop a tool called CAPS-A for the evaluation of speech in	- Hypernasality	- EAI: 0-4 pts (absent, minimal, mild, moderate, or severe)	- Automatic - Sentences - Spontaneous	- 7 expert SLPs	- Video	- Nasometry - VNP - VFS	CAPS-A is an acceptable, valid, and reliable tool for the perceptual evaluation of speech in people with CLAP.

	people with CLAP, intended for audit training between centers.	- Hyponasality	- EAI: 0-2 pts (absent, mild, or marked)					
		- Nasal Emission - Nasal turbulence	- EAI: 0-2 pts (absent, occasional or frequent)					
		- Facial Movement	- EAI: absent or present					
Sweeney & Sell (2008)	To evaluate the relationship between perceptual evaluation (Temple Street Scale) and nasalance scores, using controlled samples.	- Hypernasality	- EAI: 0-5 pts (absent to severe); consistent or inconsistent	- Words - Syllables - Sentences - Spontaneous - Automatic	- 1 expert SLP - 2 inexperienced SLPs	- In-person	- Nasometry	The Temple Street scale and the nasometer are valid clinical tools for the assessment of nasality when using a carefully constructed speech sample. The need to use Nasometry as a complement to perceptual assessment is highlighted.
		- Hyponasality	- EAI: 0-3 pts (absent to severe); consistent or inconsistent					
		- Cul-de-Sac resonance - Intranasal turbulence	- EAI: absent or present					
		- Nasal Emission - Nasal fricative - Nasal turbulence - Velopharyngeal fricative	- EAI: weak or strong, frequent or infrequent, consistent or inconsistent, or specific phoneme					
Lee et al. (2009)	To evaluate the effect of practice and feedback on the interjudge reliability for hypernasality.	- Hypernasality	- DME: a reference speech sample is presented (moderate hypernasality) to which the evaluator assigns a whole positive number that is later used as a reference for the perceptual evaluation	- Sentences	- 12 inexperienced SLPs (exposed student) - 12 inexperienced SLPs (intern without feedback) - 12 inexperienced SLPs (intern with feedback)	- Audio	NR	Both internship groups showed fair to good inter-judge reliability, that is, practice (with or without feedback) is useful for improving the reliability of perceptual scores for hypernasality.
Rullo et al. (2009)	To examine speech outcomes in a group of children with CLAP who	- Intelligibility - Hypernasality - Hyponasality - Nasal Emission	- EAI: 0-3 pts (severe and consistent, mild and occasional, or absent)	- Spontaneous	- 1 expert SLP	- In-person	NR	The perceptual evaluation showed that the phonetic and phonological development in children with CLAP is not only due to surgical strategies and the

	have been operated on by the same surgeon.	- Pharyngeal fricative - Glottal stop						surgeon's experience, but is also influenced by the collaboration of the patient and especially of the parents, the promptness of speech therapy intervention, and the child's abilities.
		- Facial movement	- EAI: 0-3 pts (facial movement, nasal movement, nasal dilation or absent)					
Lipira et al. (2011)	To compare the findings of lateral VFS, VNP, and perceptual evaluation of velopharyngeal dysfunction (modified PWSS).	- Nasal Emission	- EAI: 0-3 pts (absent, visible and inconsistent, visible and consistent or audible/turbulence)	- Spontaneous - Words - Sentences	- 1 expert SLP	NR	- VFS - VNP	Hypernasal resonance and facial movement are useful clinical indicators of a large velopharyngeal gap. Meanwhile, the velopharyngeal closure observed in VNP is more strongly correlated with the perceptual evaluation.
		- Facial movement	- EAI: 0-2 pts (absent or present)					
		- Hypernasality	- EAI: 0-4 pts (normal, mild, moderate, or severe)					
Hubbard et al. (2013)	To determine whether the contraction of the VPS following pharyngoplasty impacts velopharyngeal closure, nasal emission, and hypernasality.	- Hypernasality	- EAI: 0-3 pts (absent to severe)	- Sentences - Automatic - Spontaneous	- 1 expert SLP	NR	- VFS - VNP	The perceptual evaluation showed a continuous improvement of speech during the first year. In this regard, it is recommended to wait at least one year to decide to perform another surgical intervention for hypernasality or nasal emission.
		- Nasal Emission	- EAI: absent or present					
		- Intelligibility - Cul-de-Sac resonance - CA - Facial movement	NR					
Paniagua et al. (2013)	To compare findings between the perceptual evaluation and size of the gap observed in the VNP of people with CLAP.	- Hypernasality - Hyponasality	- EAI: mild, moderate, or severe	- Sentences - Automatic	- 1 expert SLP	- In-person	- VNP	Subjects with moderate and severe hypernasality had a more affected velopharyngeal closure, hence there is an association between VNP and perceptual evaluation.
		- CA - Obligatory speech disorders (weak intraoral pressure, facial movement, nasal emission, turbulence)	- EAI: present or absent					

Trindade et al. (2014)	To determine whether the acoustic rhinometry can identify the velopharyngeal activity's impairment in individuals with a diagnosis of VPI.	- Hypernasality - Nasal Emission	- EAI: 1-6 pts (absent, mild-moderate, moderate, moderate-severe, or severe)	- Words - Sentences - Spontaneous	- 2 expert SLPs	NR	- Acoustic Rhinomanometry	The perceptual evaluation showed that the analysis used in acoustic rhinometry has a good discriminatory power to identify velopharyngeal activity.
		- CA	- EAI: present or absent					
		- Velopharyngeal function	- EAI: 1-3 pts (adequate, borderline, or inadequate)					
Nguyen et al. (2015)	To compare the reports of perceptual evaluation of speech at 3 years old, between 4 primary palatoplasty protocols.	- Resonance - Nasal Emission - Nasal turbulence - Facial movement	- EAI: 0-3 pts (0 = normal resonance without nasal emission, nasal turbulence or facial movement; 1 = occasional mild hypernasality, nasal emission, turbulence, movement; 3 = severe hypernasality associated with anatomical anomalies)	NR	- 2 expert SLPs	- In-person	NR	The results of the perceptual evaluation determined that the maximum overlap and tension of the levator veli palatini muscle resulted in the best resonance of speech among the palatoplasty techniques evaluated.
Padilha et al. (2015)	To describe and compare the results of the perceptual evaluation of nasality of an in-person and recording analysis.	- Hypernasality	- EAI: 0-3 pts (absent, mild, moderate, or severe)	- Words - Sentences - Spontaneous	- 3 expert SLPs	- In-person	NR	In-person perceptual judgment can better detect the absence of speech hypernasality as well as mild hypernasality, compared to judgment performed by multiple judges using recorded samples.
				- Sentences	- 3 expert SLPs	- Audio	NR	
Scarmagnani et al. (2015)	To correlate the dimension of the velopharyngeal closure with the perceptual evaluation in individuals with an operated CLAP.	- Hypernasality	- EAI: 1-4 pts (absent/balanced resonance, mild, moderate, or severe)	- Sentences	- 3 expert SLPs	- Audio	- Aerodynamic assessment (flow-pressure technique)	The regression analysis showed that perceptual speech characteristics contributed significantly to predicting velopharyngeal closure. Hypernasality and nasal emission were significantly correlated with the velopharyngeal area. Meanwhile, nasal turbulence was negatively correlated with the velopharyngeal area.
		- Nasal Emission - Nasal turbulence	- EAI: present or absent					
Sell et al. (2015)	To describe the perceptual results of the Cleft Care UK study (CCUK) and	- Intelligibility - Hypernasality	- EAI: 0-4 pts (absent, minimal, mild, moderate, or severe)	NR	- 2 expert SLPs	- Audio - Video	NR	The perceptual findings obtained in the CCUK study showed strong evidence that

	compare them to the 1998 Clinical Standards Advisory Group audit (CSAG).	- Hyponasality - Nasal Emission - Nasal turbulence	- EAI: 0-2 pts (absent, mild, or marked)					the speech results were better than those observed in the CSAG.
		- CA	- EAI: 0-2 pts (absent CA, 1 or 2 CA, 3 or more CA)					
Bettens et al (2016)	To correlate the scores of the nasality severity index (NSI) 2.0 with the perceptual evaluation of hypernasality.	- Hypernasality - Nasal Emission - Intelligibility	- VAS: 0-100 mm (absent/normal to severely distorted/observed with frequency)	- Spontaneous - Sentences	- 4 expert SLPs	- Audio - Video	NR	Good to excellent reliability between inter- and intra-listeners was found for the perceptual rating. Meanwhile, the NSI 2.0 was significantly correlated with perceived hypernasality.
Chapman et al. (2016)	To describe the results of 2 reliability studies and estimate the impact of training on reliability scores among evaluators.	- Intelligibility/ Acceptability	- EAI: 0-4 pts	- Spontaneous	- 9 expert SLPs	- Audio	NR	The findings of this study suggested that improvements in interrater reliability could be achieved by following a systematic training program. However, the improvements were not uniform across all parameters. Acceptable levels of reliability were achieved for the most important parameters in the evaluation of velopharyngeal function.
		- Hypernasality	- EAI: 0-4 pts	- Automatic - Song - Sentences		- Audio - Video		
		- Hyponasality - Nasal Emission - Nasal turbulence - CA	- EAI: 0-2 pts					
		- Facial movement - Vocal quality	- EAI: 0-1 pts					
Georgivska et al. (2016)	To establish a link between nasal leak and perceptual symptoms, through auditory (PWSS) and visual (Czermak's mirror fogging) perceptual procedures.	- Visible nasal emission	- EAI: 0-3 pts (absent, small, medium, large)	- Sounds - Syllables - Words - Sentences	- 2 expert SLPs	- In-person	NR	The nasal leak observed with the Czermak mirror was strongly correlated with the perceptual assessment of velopharyngeal function during speech. Participants with greater nasal leak received a worse perceptual evaluation of velopharyngeal function.
		- Nasal Emission	- EAI: 0-3 pts (absent, visible and inconsistent, visible and consistent or audible/turbulence)					
		- Facial movement	- EAI: 0-2 pts (absent or present)					
		- Hypernasality	- EAI: 0-4 pts (normal, mild, moderate, or severe)					

		- Mixed resonance - Cul-de-Sac resonance	- EAI: 0-2 pts (absent or present)					
		- Hyponasality	- EAI: 0 (absent)					
		- Vocal quality	- EAI: 0-3 pts (normal, mild hoarseness, moderate hoarseness / reduced sonority or severe hoarseness/tension of the system)					
		- Articulation	- EAI: 0-23 pts					
Larangeira et al. (2016)	To describe and compare the nasality findings during speech, using 4 modalities: in-person perceptual judgment; based on recordings; hypernasality test (THYPER); and nasometry.	- Hypernasality	- EAI: 0-3 pts (absent, mild, moderate, or severe)	- Spontaneous - Words - Sentences	- 1 expert SLPs - 3 expert SLPs	- In-person - Audio	- Nasometry	The best results were obtained from the methods performed in person (in-person nasality judgment and THYPER).
		- THYPER: 2 repetitions, with and without obstructed nostrils	- 0-10 pts range	- 10 Words	NR	- In-person		
Medeiros et al. (2016)	To investigate the impact of the type of speech sample (spontaneous conversation or sentence repetition) on the perceptual judgment of hypernasality.	- Hypernasality	- EAI: 1-4 pts (absent/normal resonance, mild, moderate, or severe)	- Spontaneous - Sentences	- 3 expert SLPs	- Audio	NR	Sentence repetition improved the intra- and inter-rater reliability for the perceptual judgment of hypernasality.
Oliveira et al. (2016)	To investigate the impact of auditory training on the agreement between perceptual evaluations of different listeners.	- Hypernasality	- EAI: 1-4 pts (absent/normal resonance, mild, moderate, or severe)	- Automatic - Sentences	- 3 expert SLPs	- Audio	NR	The agreement between the 3 listeners for the degree of hypernasality was significantly higher after training than the one obtained before training.

Sinko et al. (2017)	To determine the possible differences between the perceptual and instrumental evaluation of nasalance.	- Hypernasality	- EAI: 0-3 pts (normal, mild, moderate, or severe)	- Sounds - Words - Sentences	- 2 expert SLPs	- Audio - Video	- Nasometry	Instrumental assessment cannot replace perceptual examination. However, once hypernasality has been diagnosed, it can detect objective changes in the follow-up evaluation.
Abdali & Yaribakht (2019)	To evaluate the results of VPI surgery (posterior pharyngeal wall augmentation), through perceptual judgment (CAPS-A), VNP, and lateral VFS.	- Hypernasality	- EAI: 0-4 pts (normal, borderline, mild, moderate, or severe)	NR	- 2 expert SLPs	- In-person	- VFS - VNP	The perceptual and instrumental evaluations showed that augmentation of the posterior pharyngeal wall with a graft is effective in improving hypernasality in patients with a moderate velopharyngeal gap.
		- Hyponasality	- EAI: 0-2 pts (normal, mild, or significant)					
		- Nasal Emission	- EAI: absent or present					
Aparna et al. (2019)	To investigate the velopharyngeal function and resonance parameters in children, following an early palate repair.	- Hypernasality	- EAI: 0-3 pts (normal, mild, moderate, severe)	- Syllables - Sentences	- 3 expert SLPs	- Audio - Video	- VFS	A good correlation was found between the closure percentage observed in the VFS and the perceptually assessed hypernasality. Analysis of the VFS images indicated that 48% of the children had a complete closure and 52% had a perceptually normal resonance.
		- Nasal Emission	- EAI: 0-1 pts (absent, or present frequently or inconsistently)					
de Boer et al. (2020)	To evaluate whether a nasalance-based pre-classification of oral-nasal balance disorders improves the agreement of listeners.	- Hypernasality	- EAI: 0-3 pts (absent, mild, moderate, or severe) - VAS	- Sentences	- 3 expert SLPs	- Audio	- Nasometry	Pre-classification of oral-nasal balance disorders based on nasalance scores can help listeners achieve better diagnostic accuracy and agreement. The agreement between perceptual evaluation and nasalance increased from 45.1 to 67.1%, while the inter-listener agreement increased from 36.7 to 85.4%.
		- Hyponasality	- EAI: 0-2 pts (absent, mild, moderate/severe) - VAS					

Abbreviations: NS = not specified (it is pointed out but not detailed); NR = not reported (it is not pointed out); pts = points; EAI = Equal-Appearing Interval; DME = direct magnitude estimation; VAS = visual analogue scale; VNP = video nasopharyngoscopy; VFS = video fluoroscopy; PWSS: Pittsburgh Weighted Speech Scale; VPI = velopharyngeal insufficiency; CA = compensatory articulation; CLAP = cleft lip, alveolus and palate.

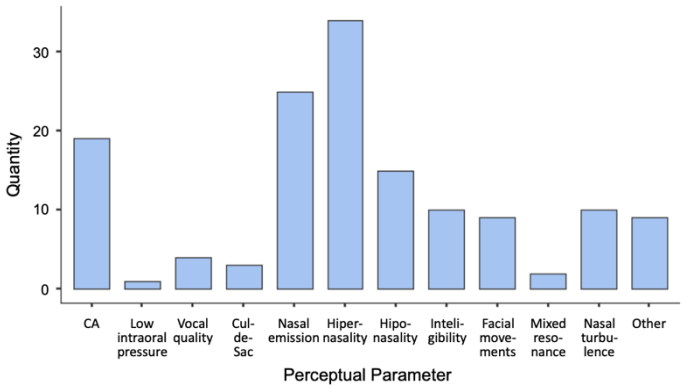

Figure 4. Perceptual Parameters.

On its part, as is observed in figure 5, the most used evaluation scale was the Equal-Appearing Interval – EAI (N=31), followed by the Visual Analog Scale-VAS (N=5). Meanwhile, there was only one study that used the Direct Magnitude Estimation-DME.

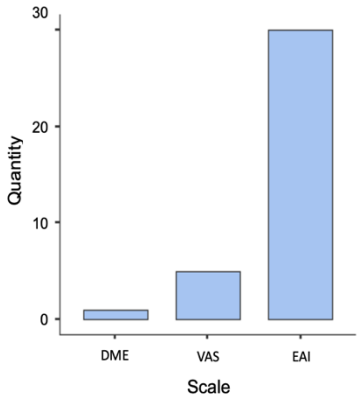

Figure 5. Evaluation Scale.

In figure 6 it can be observed that the most used type of speech sample was sentences (N=24), while other samples used were spontaneous speech (N=14), isolated words (N=8), and automatic speech (N=7). Some studies also included isolated sounds, syllables, and in one case, a song.

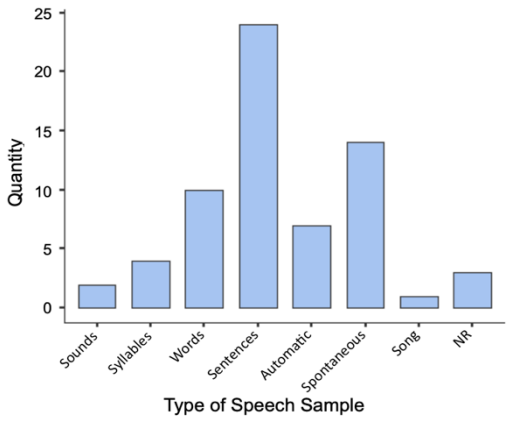

Figure 6. Speech Sample.

Concerning the type of evaluator, in the majority of the studies it was a trained or expert speech-language pathologist (N=33), while 5 studies included speech therapists without experience in the perceptual evaluation of people with cleft palate, and 2 studies used listeners without any training or education in the area of Speech-Language Therapy.

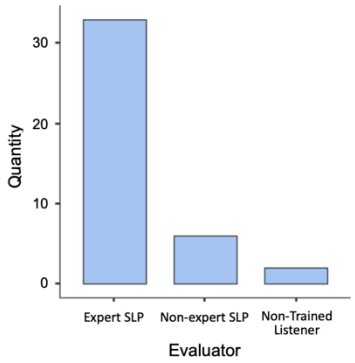

Figure 7. Type of evaluator.

In figure 8, the type of analysis performed can be observed. In this regard, the majority of the studies used audio recordings for the perceptual evaluation (N=20). However, an important number of studies carried out perceptual evaluations in person (N=9).

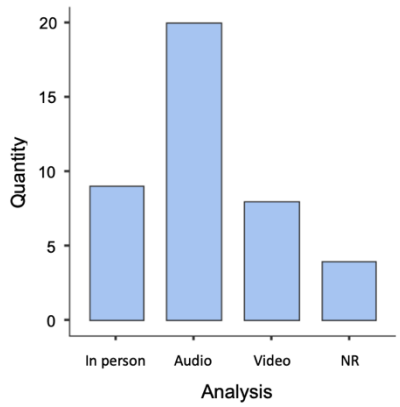

Figure 8. Type of analysis.

Lastly, the majority of the studies did not report the use of instrumental evaluations. The studies that did report an instrumental evaluation as a complement to the perceptual assessment, mainly employed nasometry (N=9), video nasopharyngoscopy (N=8), and videofluoroscopy (N=6).

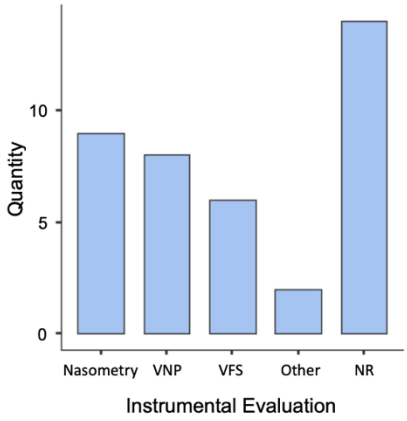

Figure 9. Instrumental evaluation.

DISCUSSION

An integrative literature review was carried out, with the aim of describing the parameters and procedures used during the perceptual evaluation of velopharyngeal insufficiency in people with cleft palate.

The perceptual parameters most used in the 33 studies correspond to (1) hypernasality, which is defined as "any abnormal increase in nasal resonance during speech production, that is more easily perceived in vowels and voiced consonants" (John et al., 2006), (2) nasal emission, defined as "an audible and abnormal or inappropriate nasal leak that accompanies the production of pressure consonants" (John et al., 2006), and (3) compensatory articulation (CA) associated with VPI, which corresponds to "maladaptive" articulatory disturbances caused initially by the cleft palate, that affect mainly the production of high-pressure sounds: plosives and fricatives. Concerning the latter, it is noteworthy that CA is not an obligatory consequence of VPI as are nasal emission and hypernasality. However, the presence of CA hinders the perceptual evaluation of VPI, since the velopharyngeal mechanism is not working properly. Hence, it is relevant to include its evaluation in the perceptual judgment of VPI in order to provide speech therapy for its correction (Palomares & Inostroza-Allende, 2019).

The three parameters previously mentioned are included within the universal parameters to report speech outcomes in people with cleft palate, described by Henningsson et al. (2008). Furthermore, Henningsson et al. (2008) consider hyponasality, voice disorders, nasal turbulence, speech intelligibility, and acceptability, which were also described in some of the studies included in this review (Abdali & Yaribakht, 2019; Álvarez et al., 2004; Bettens et al., 2016; Chapman et al., 2016; de Boer et al., 2020; Georgievska-Jancheska et al., 2016; Hubbard et al., 2013; John et al., 2006; Keuning et al., 1999, 2002, 2004; Konst et al., 2003; Kummer et al., 2003; Lipira et al., 2011; Nellis et al., 1992; Nguyen et al., 2015; Paniagua et al., 2013; Rullo et al., 2009; Scarmagnani et al., 2015; Sell et al., 2001, 2015; Sweeney & Sell, 2008; Williams et al., 1998).

Regarding the procedures, in this review the evaluation scales were classified as: Equal-Appearing Interval scale (EAI), in which the listeners divide the sensations into discrete categories; Direct Magnitude Estimation (DME), in which the listeners carry out a judgment by estimating ratios based on a reference; and Visual Analog Scale (VAS), where the listeners score their perception using a 100 mm line (Brancamp et al., 2010; Keuning et al., 2004). The findings of this review showed greater use of the EAI scale (close to 90% of the studies), which is also used by Henningsson et al. (2008) for reporting speech outcomes in people with cleft palate. Concerning this, a previous review described that 74% of the studies applied the EAI scale for perceptual speech evaluation in people with cleft palate (Lohmander & Olsson, 2004), inferior to what is observed in this study. Meanwhile, the VAS was used in only 5 of the 33 studies that were analyzed, despite having shown validity and reliability for the perceptual judgment in people with cleft palate. (Baylis et al., 2015; Whitehill et al., 2007). On its part, the DME was the

least used scale, which can be due to the difficulty in establishing a reference that allows evaluating each parameter.

Sentences were parameter most used, when analyzing the types of speech sample. According to Kummer (2016), this type of sample is considered one of the most useful ones, since it is a quicker and more direct way to assess the production and disturbances of specific sounds. On the other hand, Henningsson et al. (2008) consider isolated words and sentences for assessing hypernasality, audible nasal emission and/or nasal turbulence, and consonant production errors, while they only use sentences for hyponasality, and for voice disorders, intelligibility, and acceptability they use spontaneous speech samples. Concerning this, it is important to note that the perceptual evaluation in people with cleft palate should include words, sentences, and spontaneous speech samples that allow evaluating high-pressure sounds (/p/, /t/, /k/, /f/, /s/, and /t͡ʃ/), commonly affected in people with cleft palate (Palomares-Aguilera et al., 2021).

The evaluations were performed mainly by expert or trained speech-language pathologists. A limited number of studies included inexperienced speech-language pathologists and non-trained listeners (not speech therapists). The findings of this review show that in most of the studies, the experience of the judge is valued in the perceptual evaluation of VPI. The relevance of experience level has been reported previously in perceptual judgments related to vocal pathologies (Farías, 2016). Concerning this, Henningsson et al. (2008) also suggest that the assessment should be carried out by an expert speech-language pathologist. However, the need for more studies including inexperienced and untrained listeners is considered relevant, since this might reveal how velopharyngeal insufficiency might influence the judgment of laypersons. This provides information regarding intelligibility and acceptability of the message in real contexts, showing results that reflect the communicative competencies of people with VPI secondary to cleft palate (Brunnegård et al., 2009). On the other hand, it is important to consider factors related to the evaluator which could influence the perceptual judgment, such as individual differences due to experience, perceptual habits, biases, among others (Kreiman et al., 1993).

With regards to the type of analysis used for the perceptual judgment (in person, audio, and video), Padilha et al. (2015) mention that the most adequate analysis is in-person evaluation, since it allows observing the user's competencies in a functional communicative context, making it possible to observe facial movements associated with VPI, or other parameters such as compensatory articulation and speech sounds disorders (SSDs) of the articulatory type. However, in this review the majority of the studies used audio recordings. It is noteworthy that audio recordings present the advantage of being stored and reproduced repeatedly, which is useful when assessing inter- and intra-rater agreement (Álvarez et al., 2004; Aparna et al., 2019; Bettens et al., 2016; Chapman et al., 2016; de Boer et al., 2020; Keuning et al., 1999, 2002, 2004; Konst et al., 2003; Larangeira et al., 2016; Lee et al., 2009; Lewis et al., 2003; Medeiros et al., 2016; Nellis et al., 1992; Oliveira et al., 2016; Padilha et al., 2015; Scarmagnani et al., 2015; Sell et al., 2001, 2015; Sinko et al., 2017), and for comparing results following surgical and prosthetic interventions for VPI, or speech therapy for CA (Abdali & Yaribakht, 2019; Aparna et al., 2019; Konst et al., 2003; Rullo et al., 2009; Sell et al., 2001; Trindade et al., 2014). On the other hand, some studies included video analysis, which has the advantage of showing facial movements associated with VPI and participation of phono-articulatory organs during speech, allowing to identify CA and articulatory SSDs more easily (Álvarez et al., 2004; Aparna et al., 2019; Bettens et al., 2016; Chapman et al., 2016; John et al., 2006; Paal et al., 2005; Sell et al., 2015; Sinko et al., 2017). According to the above, it is suggested that multidisciplinary teams carry out in-person evaluations and that they complement them with good-quality audio and video recordings, since quality might also interfere with perceptual judgment (Padilha et al., 2015).

Perceptual judgment has been considered the gold standard procedure for the assessment of VPI (Larangeira et al., 2016; Sell, 2005). However, it is important to highlight instrumental evaluations such as videofluoroscopy and video nasopharyngoscopy which help characterize anatomical defects and carry out therapeutic or prosthetic plans for each patient (Abdali & Yaribakht, 2019; Álvarez et al., 2004; Aparna et al., 2019; Hubbard et al., 2013; John et al., 2006; Kummer et al., 2003; Lipira et al., 2011; Paal et al., 2005; Paniagua et al., 2013). Furthermore, nasometry allows quantifying speech nasality using a nasalance measure. This is the relative amount of acoustic energy produced by the nasal cavity during speech, which has been proven to have a high correlation with perceptual judgment (de Boer et al., 2020; Larangeira et al., 2016; Sinko et al., 2017; Sweeney & Sell, 2008). However, in this review a low number of studies complemented the perceptual evaluation with instrumental ones, which may be related to high costs and low collaborative work between SLPs, ENTs, radiologists, and surgeons, an issue that has been described in multidisciplinary teams from developing countries (Goldschmied et al., 2021).

It is necessary to note that the perceptual evaluation of VPI should be complemented with an anatomical and functional evaluation of the phono-articulatory organs, which is fundamental to identify

the presence of fistulas, undiagnosed submucous cleft palate, hyperplastic tonsils, lingual frenulum disturbances, and dento-maxillary anomalies, among others. In addition, a full characterization of the phonetic inventory should be done in order to identify speech sounds that are produced correctly and those which are substituted, omitted, distorted, and showing CA. Following this, the severity of the CA should be determined for each sound, using for example the scale of Pamplona et al. (2005). Moreover, the above should be complemented with the information provided by users, their parents/caregivers, or chaperones, using questionnaires such as VELO-Spanish, Intelligibility in Context Scale, among others (McLeod et al., 2012; Palomares-Aguilera et al., 2021; Skirko et al., 2018). These provide important information about the impact of VPI on the quality of life of people with cleft palate and their communicative performance in functional contexts, which is fundamental for the decision-making process for speech therapy and surgical treatments.

On the other hand, from a perspective of the International Classification of Functioning, Disability, and Health (ICF), the results obtained from this review show that function and structure are approached by the multidisciplinary team during the perceptual evaluation of speech and velopharyngeal function impairments. However, the evaluation does not seem to address activity and participation, or allow knowing the barriers and facilitators from the users' social environment. This poses a conflict, since there are facilitators controlled by the health care team, but there are also barriers that depend on each patient and their social context, which are fundamental for the development of people with cleft palate. As mentioned by Neumann & Romonath (2012) the prejudices surrounding people with VPI, who are in their majority children and adolescents, could be endured thanks to support networks available to parents/caregivers and users, such as foundations, self-help meetings, or patient organizations. In this regard, it is highlighted that VPI does not necessarily mean there is a compromised intelligibility, but rather a compromised speech acceptability, where the listeners' biases can influence their judgment of the severity of the speech impairment, as proposed by Henningsson et al., (2008).

In Chile, the multidisciplinary intervention of people with cleft lip, alveolus, and palate is described in the GES Guideline for Cleft Lip and Palate [*Guía GES de Fisura Labiopalatina*] (MINSAL, 2015). This guideline recommends carrying out speech therapy to prevent, evaluate, and treat speech, language, and voice disorders, considering the functional and anatomical deficiencies of the users; to achieve a normal speech, language, and velopharyngeal function; to prevent and treat bad oral habits and disturbed functions of the stomatognathic system. Concerning the evaluation of VPI, it recommends using the VPI evaluation protocol of *Fundación Gantz* [Gantz Foundation] (Álvarez et al., 2004), which includes the parameters most observed in this review. Nevertheless, several of the procedures described in this document can complement the perceptual evaluation currently performed.

A limitation of this research is that there was not an assessment of the biases present in the studies, despite following the PRISMA guideline for systematic reviews (Urrútia & Bonfill, 2010). Secondly, the selected articles were not classified according to the level of evidence, as it has been previously suggested for integrative reviews (Souza et al., 2010). Furthermore, the information obtained with regards to the parameters should have included the description of descriptors for each one, as it is described for hypernasality in the universal parameters proposed by Henningsson et al. (2008). Finally, in relation to the data analysis, one of the limitations is that the inter- and intrarater agreement and its relation to experience, training, and other aspects, were not evaluated directly, as well as the reliability and validity of perceptual judgments.

CONCLUSION

This integrative literature review focuses on the perceptual evaluation of velopharyngeal insufficiency in people with cleft palate. It is concluded that the most used perceptual parameters correspond to hypernasality, nasal emission, and compensatory articulation associated with VPI. Meanwhile, the most used procedures include the use of sentences as a speech sample, in addition to spontaneous speech and words, evaluated by an expert or trained speech-language pathologist and using mainly audio recordings, followed by in-person assessment. Few instrumental evaluations are included that agree with the perceptual evaluation.

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