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The prevalence of hearing loss in children in Colombia

Prevalencia de pérdidas auditivas de población infantil en Colombia

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| Summary |

Background. According to the Colombia National Statistics Administration (2005) in Colombia it is estimated that 17.3% of the registered population has permanent hearing limitations, of which 24 547 are under 10.

Objective. This study aimed to determine the national prevalence of hearing loss in the population under 10 years of age between 2009 and 2011, identifying the variations in rates by type of hearing loss, unilateral or bilateral loss, age, and sex.

Materials and methods. This descriptive, cross-sectional study, used data from the Individual Records of Health Procedures that was reported to the Colombian Ministry of Health during the period of observation and that was related to the diagnostic categories of hearing loss at discharge laid out in the ICD-10.

Results. The analysis identified a hearing loss rate of 4.3 cases per 1,000 individuals under 10 years of age. The rate of sensorineural hearing loss cases was 5.1, 2.4 for conductive hearing loss and 1.2 for mixed hearing loss. Rates of 5.7 for bilateral hearing loss and 0.6 for unilateral losses were identified. A higher rate was found in children aged 5 to 10 years (2.4), than in children of 0-4 years of age (1.9).

Conclusions. The evidence shows a high rate of hearing loss in children under 10 years of age. No significant differences between males and females are identified. Similar behavior was observed for both sexes in terms of sensorineural and conductive losses. However, there was a greater presence of mixed loss in females than in males.

Keywords: Prevalence; Hearing Loss; Child Health (MeSH).

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Resumen

Antecedentes. Según el Departamento Administrativo Nacional de Estadística (2005), en Colombia se estima que un 17,3% de la población censada tiene limitaciones permanentes para oír, de los cuales 24.547 son menores de 10 años.

Objetivo. El estudio se propuso determinar la prevalencia nacional de las pérdidas auditivas en población menor de 10 años entre 2009 y 2011, identificando las variaciones en las tasas según tipo de pérdida auditiva, uni o bilateralidad de la pérdida, edad y sexo.

Materiales y métodos. El estudio, de tipo descriptivo y transversal, empleó los datos del Registro Individual de Procedimientos en Salud reportados al Ministerio de Salud en el período de observación y relacionados con las categorías diagnósticas de egreso de pérdida auditiva en la CIE-10.

Resultados. El análisis identificó una tasa de pérdida auditiva de 4,3 casos por cada 1.000 en población menor de 10 años. La tasa de pérdidas neurosensoriales fue de 5,1 casos, 2,4 de conductivas y 1,2 de mixtas. Se identificó una tasa de 5,7 para pérdidas bilaterales y de 0,6 para unilaterales. Se presenta una tasa mayor en niños de 5 a 10 años con 2,4, que en niños de 0 a 4 años con 1,9.

Conclusiones. La evidencia muestra una alta tasa de pérdidas auditivas en niños menores de 10 años. No se identifican diferencias significativas entre hombres y mujeres, observándose un comportamiento similar por sexo en pérdidas neurosensoriales y conductivas y siendo mayor la presencia de pérdidas mixtas en mujeres que en hombres.

Palabras clave: Prevalencia; Pérdida Auditiva; Salud del niño (DeCS).

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Introduction

According to the 2005 general census carried out by the Colombian national statistics department (DANE), in Colombia it is estimated that 17.3% of the population, or 455 718 people, has permanent hearing limitations. This proportion can be seen especially well in the city of Bogotá, where 28 784 of its inhabitants have some kind of hearing problem. More specifically, among children under 10 years of age —a total population of 8 402 671 people across Colombia—, 24 547 have hearing limitations.

Although the DANE has been the entity trusted with maintaining a record of the population, something that it has done consistently, its efforts have not been sufficient; since demographic growth is very variable and rapid, national data regarding the prevalence of hearing impairment among children is not available. This information is fundamental for favoring the implementation of policies and actions surrounding health coverage in the country and for guaranteeing necessary and opportune care in these cases.

The reason for the lack of information lies in the fact that DANE statistics only identify the number of cases reported. This is what also happens in records surrounding the localization and characterization of individuals with disabilities. The DANE only reports the presence or absence of hearing problems in the population of different age groups. Furthermore, existent reports on prevalence in Colombia are restricted to the description of cases in specific population groups. For this reason, it is difficult to obtain information on prevalence, this without taking into account cases of late detection hearing loss or the lack of awareness of cases. These later cases can be inferred from the 2005 DANE report where a total of 180 622 children under 10 years of age appear with no record of either the presence or absence of hearing limitations. This generates a low level of certainty in the information provided.

Identifying the prevalence of hearing loss by using information provided by the state entity with the greatest collection of statistical health information —the Ministry of Health— favors the understanding of the current state of health of the Colombian population, and that of Colombian children in particular. Furthermore, identifying the conditions surrounding the types of hearing loss and the presence of bilateral and unilateral losses with relation to variables of age and sex allows us to have access to relevant and reliable information for decision-making and the health care of children. The objective of this study was to determine the national prevalence of hearing loss in the population under 10 years of age between 2009 and 2011 while identifying variations in the rates with regard to the type of hearing loss, bi- or unilaterality of the loss, and according to age and sex.

The prevalence, incidence, and distribution of diseases that affect human populations —and of the factors that cause or are associated with them— are epidemiological measures. Their purpose is to determine different forms of prevention and control of these illnesses, evaluate the care needs and the resources required to deal with them, and later to measure the efficacy of the measures taken (2). The main use and application of the results of epidemiological research are directly related to health care, especially due to the creation of knowledge that allows for the identification and control of health problems (3).

In the prevalence of hearing loss research field, at a Colombian level various studies can be found that, overall, are focused on the identification of cases in different groups of the population. This is the case of Alonso and cols., who determined the prevalence of hypoacusis in the population of children aged 0-5 years in the Colombian Institute of Family Welfare (Instituto Colombiano de Bienestar Familiar—ICBF) (4). The authors found a prevalence of infantile hypoacusis of 6.3% in the first evaluation and 2.3% in the second. They identified the type and degree of loss and the most prevalent environmental predictors.

Neira and Vargas (5), in their study on the prevalence of hearing loss in INSOR users, report a prevalence of hearing loss of 26.5% in children under 10 years of age in the right ear and of 23.5% in the left ear. They noted a prevalence of sensorineural hearing loss and found no significant differences between the sexes.

Talero-Gutiérrez et al, in their study, "Epidemiology of pre-lingual hearing impairment at a children's center in Bogotá, Colombia between 1997 and 2008", found that in 47.2% of cases evaluated in the CINDA Foundation, the etiological diagnosis was "unknown": 31 cases were identified as having

genetic causes and 38 were caused by STORCH infections (6). The research team determined that the origin of the hearing loss was perinatal factors in 52.5% of the cases, unknown in 40% of the cases, and hereditary in 7.5% of the cases. These findings allowed the investigators to conclude that adequate care and control during pregnancy would probably reduce in a large way the incidence of deafness in Colombia.

Carvajalino et al, estimated the prevalence of hearing impairments in high-risk baby population between 0 and 6 months of age in the city of Bogotá (7). The results showed a very high prevalence of bilateral hearing loss —at levels of 0.26%— in a population of 750 premature infants.

Elsewhere, Becerra et al, determined the total number of cases of hearing loss among children between 1 and 10 years of age in the period stretching from 2000 to 2009 from the review of 180 health records at 2 health service providing institutions in the city of Cali, Colombia (8). The results showed a prevalence of hypoacusis in children (in Colombia's contributive health regime) of 37%. Of these, 56.72% showed bilateral hearing loss and 43.28% showed unilateral loss. Low-grade conductive hypoacusis was the variety with the highest percentage found.

At the international level, according to a report from the Centers for Disease Control and Prevention of the United States, studies from North America and Europe have identified a uniform prevalence of approximately 0.1% of children with hearing loss of more than 40 decibels. These results were found from the analysis of health and/or educational reports. Other international studies that have used different criteria or methods —including hearing screening tests, questionnaires, or lower decibel thresholds— have reported higher prevalences. Thus, in Australia in 2007, the prevalence of hearing losses detected through hearing screening was 2.2% in 6 year olds in 1993, 1.1% in Israel in the period ranging from 1978-1991, 1% in Costa Rica in 1988 for eight-year-old children, 2.1% in Finland from 1972-1986 in children under 10 years of age, 3.3% in Gambia in children between 2 and 10 years of age, and 0.8% in the United Kingdom between 1977 and 1980 in children under 6 (9).

Data published by the Metropolitan Atlanta Developmental Disabilities Surveillance Program shows that, for the period 1988-1994, 14.9% of children and youth of between 6 and 19 years of age in the United States had high or low frequency hearing loss of at least 16 dB in one or both ears. In children between 3 and 10 years of age in the period stretching from 1991-1993, there were 1.3 cases per 1000 children with bilateral hearing loss of 40 decibels or more (10). In 2006, the prevalence of hearing loss of 40 decibels or more in children of 8 years of age was 1.3 cases per 1000 children. Of these, approximately 60% had sensorineural hearing loss.

With respect to newborns in 2007, a prevalence of 2.1% was found for children that did not pass the final or most recent test. For the group of children in this same year, approximately 1 to 3 in 1000 have hearing loss. Other studies have rates of between 2 and 5 in 1000, varying by age group and screening procedures. More recently, in 2009, of the newborns to which the initial hearing test was applied, 1.4 out of 1000 infants received the diagnosis of hearing loss (10).

In Chile, Schonhaut et al, studied the prevalence of hearing problems in the metropolitan area of the city of Santiago de Chile among preschool children with an average age of 4.4 years. They correlated this prevalence with educators' perceptions about hearing and language in the children (11). 15% presented audiological disorders, which corresponds to a hypoacusis rate of 11.6%. The high frequency of audiological problems found stands out here, and it was concluded that the educators' suspicion of hypoacusis alone is insufficient as a preselection method since they were able to identify only 50% of the affected children. These findings highlight the necessity to implement hearing screening goals for all children upon the initiation of their formal education.

In Uruguay, Ferreira et al, identified the prevalence of hypoacusis and risk factors in 3 741 newborns between May and October 2001. They found that 8% of the studied population showed risk factors for hypoacusis, several of them having different factors in coexistence. The most frequent were premature birth, low weight at birth, neonatal hypoxia, and suspicion of infection with the use of ototoxic drugs (12). In the first screening, 24% of candidates were set aside to be reevaluated according to the protocol proposed by the study.

The research reports mentioned above that are related to the study of the prevalence of hearing loss show an interest in different parts of Colombia for understanding risk characteristics, factors or markers that have determined the appearance of hearing loss in different groups. The same tendency can be seen at an international level, being especially relevant currently the detection of hypoacusis in newborns. As can be seen from the review of these investigative forerunners, the study of hypoacusis at a national level is relevant for the determination of prevalence rates of hearing loss while also allowing for an in-depth understanding of the characteristics of hearing loss in Colombia. From there, it is possible to project the most effective intervention measures in terms of the individual necessities of people or groups, and to influence health policies.

Stach (13) and Gallego and Sánchez (14) propose some general considerations for understanding hearing losses. Among these, the fact that hearing deterioration is the result of a variety of causes, and that it is usually characterized by type and degree of loss, is especially important. The types of hearing loss are related to the location in which the disorder of the hearing system can be found. The degree of loss refers to the extent that the disorder interferes with normal function. In this way, hearing deficiencies are of mainly 2 types: loss of sensitivity and disorders of the auditory nervous system. The loss of auditory sensitivity has 3 varieties: conductive, sensorineural, and mixed.

Variables identified in the study

Type of hearing loss

This can be observed in the relationship between the air conduction and bone conduction, which allows us to establish the type of loss by the location of the injury. In conductive hearing loss, where a bone/air gap can be observed, defects in bone conduction are slight or none when other complications do not exist (15). Sensorineural hearing loss refers to the absence of sensory or nerve cells, or of their connections within the cochlea, or when they are present but do not function correctly. Mixed hearing loss occurs when the structures of the cochlea and the conductive mechanism are both dysfunctional.

Unilaterality or Bilaterality

In addition, hearing loss can be described by the number of ears involved. It is unilateral when only one ear is affected, and bilateral when the hearing loss relates to both ears (13).

As acoustic and psychoacoustic factors, Kochkin (16) proposed the following with regard to the uni- or bilaterality of the processing of acoustic signals: the sum of binaural sonority, which refers to the fact that the intensity of a sound is greater if it is perceived in both ears simultaneously and not in only one (this is the case both for hearing individuals and for those with hearing problems); difference in the level of masking, related to the intelligibility of speech in noisy situations; the capacity to localize the source of a sound, which varies among people with hypoacusis, possibly because of an elevation of the threshold in each ear and a retrograde degeneration of the potential of neurons related to binaural tasks; and finally, the "head shadow" effect that is produced by the reduction of sounds when they travel from one side of the head to another, and that has a significant impact on the recognition and identification of consonants.

Age

This variable is an obligatory variable in studies of prevalence. It refers to the number of years of life of the evaluated patients, and brings auditory conditions by age group. The analysis of this information was made by age ranges.

Sex

This variable is also obligatory in studies of prevalence. It refers to if the patient is male or female. It contributes to the recognition of auditory conditions in the population in relation to anatomical and physiological conditions that are used to categorize human beings.

Materials and methods

The present study is descriptive since it analyzed information held in the Individual Records of Health Procedures (Registro Individual de Procedimientos en Salud - RIPS) during a specific time of 3 years, between 2009 and 2011. After the information was approached, its characteristics were described in terms of type of hearing loss and demographic conditions.

This research used a cross-section type design, given that it selected a specific time-window for observation in order to determine the prevalence of a particular phenomenon that was to be measured. This type of research describes the health conditions of a population group at a certain point in time while taking into account the conditions of the population and the particularities of each group, and quantifying the number of cases.

The units of analysis of the information for determining the number of cases with hearing loss in children under 10 years of age were all the RIPS data reported to the Ministry of Health and accessed through Colombia's integral information system on social protection (SISPRO) from 2009 to 2011. Once the data was collected, it was analyzed in terms of type of hearing loss and it's uni- or bilaterality and under the diagnostic categories used by the International Classification of Diseases (ICD) version 10 (17) in the discharge diagnosis. The following diagnoses were found:

H900 – Conductive hearing loss, bilateral

H901 – Conductive hearing loss, unilateral with unrestricted hearing on the contralateral side

H902 – Conductive hearing loss, unspecified

H903 – Sensorineural hearing loss, bilateral

H904 – Sensorineural hearing loss, unilateral with unrestricted hearing on the contralateral side

H905 – Sensorineural hearing loss, unspecified

H906 – Mixed conductive and sensorineural hearing loss, bilateral

H907 – Mixed conductive and sensorineural hearing loss, unilateral with unrestricted hearing on the contralateral side

H908 – Mixed conductive and sensorineural hearing loss, unspecified

H910 – Ototoxic hearing loss

H912 – Sudden idiopathic hearing loss

H913 – Deaf mutism, not elsewhere classified

H918 – Other specified hearing loss

H919 – Hearing loss, unspecified

For the set up of the epidemiological profile of hearing loss, dynamic information tables were created in Excel. In these tables, the data necessary for the study was compiled from data recorded in SISPRO. For the analysis of this data, Excel's statistical tools were used since the statistical information of prevalence does not require robust systems information processing systems.

Results

This project describes the variations in hearing loss rates recorded in SISPRO through reports made by Colombian health providing institutions to the Ministry of Health and Social Protection in the Individual Records of Health Procedures between 2009 and 2011. The data was selected by filtering the information to find the number of patients attended with ICD-10 codes at discharge related to hearing loss and who were also under 10 years of age. This information was then filtered by age ranges in such a way as to visualize year-to-year specific data in those under 5 years of age and in another general group of 5 to 10 year-olds. The information was grouped in this way while taking into account the evaluation procedures and the diagnostic categories that differed in the 2 groups (0-5 years and 5-10 years).

In addition, the information collected was from data from the years 2009-2011. Data from 2012 was not included in this investigation because an overall report from the system was not available at the date of analysis. This means that there is a possibility of continuing the analysis of the information year by year as the SISPRO data become available. This will allow for the advancement of the identification of the prevalences of hearing losses with systematic data that is comparable in the long term. Such a process would generate valuable information for the recognition of the state of auditory health among children in Colombia.

According to the DANE (1), Colombia's population in 2011 amounted to an estimated 46 044 601 people. In SISPRO, it is reported that 17 to 18 million of these citizens were attended to per year, as shown in Table 1.

Table 1. Number of patients receiving medical attention in the Colombian health care system between 2009 and 2011.

Year	2009	2010	2011
Number of patients attended	17 184 030	17 769 075	18 490 943

Source: (1).

Of the population that received medical attention each year, the number of children between 0 and 10 years of age are shown in Table 2.

Table 2. Number of children between 0 and 10 years of age receiving medical attention between 2009 and 2011.

Years Reported				
Age	2009	2010	2011	Overall Total
0 to before 1 year	575 593	538 631	485 995	1 600 219
1 to 2 years	908 822	905 334	826 454	2 640 610
3 to 4 years	799 815	826 519	794 443	2 420 777
5 to 10 years	2061 741	2 013 310	2 002 859	6 077 910
Overall Total	**4 283 794**	**4 283 794**	**4 109 751**	**12 739 516**

When we examine the number of patients receiving attention with between 0 and 10 years of age with a diagnosis of hypoacusis, we find that the number of diagnosed cases is very low in different years, increasing with age, as shown in Table 3. This can be related to diagnostic procedures, late access to health services, or to the children's entry into educational

institutions. Here, the incidence of the flu increases, an illness that produces the greatest number of conductive hearing losses due to obstructions of the upper airways. Also, communicative and behavioral conditions are often detected in the children in this school context.

Table 3. Number of cases with diagnosis of hypoacusis at discharge in children from 0 to 10 years of age.

Age /Diagnostic code	2009	2010	2011	Overall Total
0 to before 1 year	**1**	**0**	**1**	**2**
H918 – Other specified hearing loss			1	1
H919 – Hearing loss, unspecified	1			1
1 to 2 years	**3**	**0**	**4**	**7**
H900 – Conductive hearing loss, bilateral	1			1
H903 – Sensorineural hearing loss, bilateral			1	1
H905 – Sensorineural hearing loss, unspecified	1			1
H918 – Other specified hearing loss	1		1	2
H919 – Hearing loss, unspecified			2	2
3 to 4 years	**2**	**6**	**2**	**10**
H902 – Conductive hearing loss, unspecified		1		1
H903 - Sensorineural hearing loss, bilateral	1	3		4
H904 - Sensorineural hearing loss, unilateral with unrestricted hearing on the contralateral side			1	1
H905 – Sensorineural hearing loss, unspecified			1	1
H906 – Mixed conductive and sensorineural hearing loss, bilateral	1			1
5 to 10 years	**5**	**3**	**16**	**24**
H900 – Conductive hearing loss, bilateral	1		3	4
H901 – Conductive hearing loss, unilateral with unrestricted hearing on the contralateral side			1	1
H902 – Conductive hearing loss, unspecified			1	1
H903 – Sensorineural hearing loss, bilateral	3	1	4	8
H905 – Sensorineural hearing loss, unspecified	1			1
H908 – Mixed conductive and sensorineural hearing loss, unspecified			3	3
H918 – Other specified hearing loss			1	1
H919 – Hearing loss, unspecified		2	3	5
1 to 2 years	**3**	**0**	**4**	**7**

Firstly, the diagnostic procedures used in the pediatric population vary by age. In children over 5 years of age, there are assessment batteries similar to those for the assessment of adults, which are suited to the abilities of the children to respond to behavioral tests in an objective way and to be in structured situations with specific demands of conditioned response to auditory stimuli. In children between 2 and 5 years of age, another kind of battery is available that includes conditioning through play (COR), observable behavioral responses to sound stimuli associated to visual stimuli (VRA), combined with analysis objective middle ear evaluation procedures in acoustic immittance. In children under 2 years, there is the possibility of behavioral observation audiometry (BOA). This is an assessment that requires greater preparation from the personnel and special stimulation in which environmental, instrumental, and verbal sounds are used in specific stimulation conditions. To this are added objective evaluation procedures like automated auditory evoked potentials and middle-ear acoustic immittance testing. All of these procedures require special equipment and environmental conditions.

That said, late access to the health system can be related to the lack of affiliation to it, difficulty with referrals to phonoaudiology professionals and audiology specialists, and difficulty with the identification of risk conditions by child caretakers.

While hearing screening is guaranteed at around 5 years of age when the children enter school —something which favors the detection of hearing difficulties—, there is greater emphasis on the linguistic development of the children that is sometimes affected by deteriorations in the auditory system. Here, the presence of hearing loss is more clearly identified. From the total of cases diagnosed, the types of hearing loss are identified in the information presented below (Table 4).

Table 4. Distribution by type of hearing loss.

Type of loss	Number of cases
Conductive	8
Sensorineural	17
Mixed	4

According to the reports, the largest category is sensorineural hearing loss, followed by conductive loss, and finally, as the smallest category, mixed loss. When it comes to the laterality of the losses, 2 cases of unilateral hearing loss and 19 cases of bilateral hearing loss were identified. Among the other diagnoses are 4 reported cases of other specified hearing loss, and 10 cases of unspecified hearing loss. Other diagnoses that were searched for included ototoxic hearing loss, sudden idiopathic hearing loss, and deaf mutism. However, no cases of these conditions were reported between 2009 and 2011.

Our analysis does not take into account diagnoses like otorrhea, otalgia, otorrhagia, tinnitus, neuritis, presbycusis, and cholesteatoma since they are categorized as other ear disorders. These disorders are not related to possible diagnoses given by specialists in audiologists or for the age of observation. Nor are they necessarily related to the presence of hearing loss. With regard to the year-to-year variations in the rate of prevalence of hearing losses, Table 5 shows the greatest prevalence of cases in 2011 and a sudden increase in the number of diagnosed cases with respect to age.

Table 5. Rates of hearing loss by age and year of observation.

Age groups	Population standard	Prevalence rates				Number of standardized cases*			
		2009	2010	2011	Total	2009	2010	2011	Total
0 to before 1 year	1 600 219	0.0000625	0.0000000	0.0000625	0.0001250	0.1	0.0	0.1	0.2
1 to 2 years	2 640 610	0.0001136	0.0000000	0.0001515	0.0002651	0.3	0.0	0.4	0.7
3 to 4 years	2 420 777	0.0000826	0.0002479	0.0000826	0.0004131	0.2	0.6	0.2	1.0
5 to 10 years	6 077 910	0.0000823	0.0000494	0.0002632	0.0003949	0.5	0.3	1.6	2.4
Total	**12 739 5**	**0.0000863**	**0.0000706**	**0.0001805**	**0.0003375**	**1.1**	**0.9**	**2.3**	**4.3**

Etween 0 and 10 years of age in 2009 corresponds to 1.1 cases in 1000, to 0.9 cases per 1000 in 2010, and in 2011 to 2.3 pero 1000. For the period 2009-2011, a rate of 4.3 cases per 1000 children was found.

With regard to the type of loss and its laterality, the data presented in Table 6 is found. A rate of 2.4 cases of conductive loss per every 1000 cases evaluated. This represents close to half the rate of sensorineural hearing loss (5.1 cases). Mixed loss makes up an even lower number of cases per 1000 evaluated (1.2 cases). There is a higher rate of bilateral hearing losses than unilateral ones, as well as a high rate of unspecified hearing losses.

Table 6. Rates of hearing loss by type.

Age groups	Population standard (PS)			Prevalence rates (PR)				Number of standardized cases*			
	2009	2010	2011	2009	2010	2011	Total	2009	2010	2011	Total
Conductive	4 345 97	4 283 79	4 1090 751	0.000046	0.000023	0.000121	0.000191	0.2	0.1	0.5	2.4
Sensorineural				0.000138	0.000093	0.000170	0.000401	0.6	0.4	0.7	5.1
Mixed				0.000023	0	0.000073	0.000096	0.1	0.0	0.3	1.2
Unilateral				0	0	0.000048	0.000048	0.0	0.0	0.2	0.6
Bilateral				0.000161	0.000093	0.000194	0.000449	0.7	0.4	0.8	5.7
Other specified				0.000023	0.000000	0.000073	0.000096	0.1	0.0	0.3	1.2
Unspecified				0.00002	0.000093	0.000121	0.000238	0.1	0.4	0.5	3.0

Note: SP values correspond to the number of cases reported in SISPRO for all categories during the year. PR is the prevalence of hearing losses in each diagnostic category during the year. Standardized cases refer to the prevalence rate per 1000 individuals per year and diagnostic category, and over 3 years of observation.

The results for the number of cases by the sex of the user who received medical attention can be seen below in Table 7.

Table 7. Distribution of hearing loss by sex and year.

Row descriptors	Female			Total Female	Male			Total Male
	2009	2010	2011		2009	2010	2011	
0 to before 1 year	**1**			**1**			**1**	**1**
H918 – Other specified hearing loss							1	1
H919 – Hearing loss, unspecified	1			1				
1 to 2 years	**2**			**2**	**1**		**4**	**5**
H900 – Conductive hearing loss, bilateral	1			1				
H903 – Sensorineural hearing loss, bilateral							1	1
H905 – Sensorineural hearing loss, unspecified					1			1
H918 – Other specified hearing loss	1			1			1	1
H919 – Hearing loss, unspecified							2	2
3 to 4 years	**2**	**2**	**2**	**6**		**4**		**4**
H902 – Conductive hearing loss, unspecified						1		1
H903 – Sensorineural hearing loss, bilateral	1	1		2		2		2
H904 – Sensorineural hearing loss, unilateral with unrestricted hearing on the contralateral			1	1				
H905 – Sensorineural hearing loss, unspecified			1	1				
H906 – Mixed conductive and sensorineural hearing loss, bilateral	1			1				
H919 – Hearing loss, unspecified		1		1		1		1
5 to 10 years		**3**	**9**	**12**	**5**		**7**	**12**
H900 – Conductive hearing loss, bilateral			2	2	1		1	2
H901 – Conductive hearing loss, unilateral with unrestricted hearing on the contralateral side							1	1
H902 – Conductive hearing loss, unspecified							1	1
H903 – Sensorineural hearing loss, bilateral		1	3	4	3		1	4
H905 – Neurosensorial hearing loss, unspecified					1			1
H908 – Mixed conductive and sensorineural hearing loss, unspecified			3	3				
H918 – Other specified hearing loss.							1	1
H919 – Hearing loss, unspecified		2	1	3			2	2
Overall Total	**5**	**5**	**11**	**21**	**6**	**4**	**12**	**22**

Note: Number of cases reported in SISPRO by ICD-10 code.

The evidence shows that there are not significant differences between males and females in the distribution of diagnoses. In terms of type of hearing loss, a similar distribution can be seen for sensorineural and conductive losses, while mixed hearing loss is more frequent in females. Previous studies show similar results (18).

Discussion

The Individual Records of Health Procedures constitute a valuable source of information for understanding the health conditions of the population starting in 2009. Having an up-to-date and systematic information system allows different professions to understand the panorama, plan and support their actions and procedures according to the needs of the country, and respond to these needs in an adequate fashion. Furthermore, it allows for verifying existing conditions for the provision of health services and for projecting for the optimization of equipment purchases and personnel training.

This study showed that in the population under 10 years of age, there is a prevalence of hearing loss as discharge diagnosis

of 0.0003375, representing a rate of 4.3 cases in 1000. The highest rate was in 2011. The recorded data regarding the number of people who received care in the health system as reported in SISPRO can be interpreted as a sub-registry of information since, of 12 739 516 children between 0 and 10 years of age, 43 had a discharge diagnosis of some type of hypoacusis, equivalent to 0.0034% of the population. When this number is put up against international statistics, we see a very low prevalence compared to Australia, Israel, Costa Rica, Finland, Gambia and the United Kingdom, according to the data presented earlier (9).

In the same way, when we compare our results to those of Colombian studies, we can see that Alonso et al. reported a prevalence of 2.3% in children of 0-5 years of age (4). Carvajalino et al. estimated the prevalence of hearing alterations in the high-risk infant population under 6 months of age in the city of Bogotá at 0.26% (they showed a very high prevalence of bilateral hearing loss) (7). Becerra et al, determined the total number of cases of hearing loss in children between 1 and 10 years of age with a prevalence of 37% in 2 health care institutions in Cali (8).

In Atlanta, similar results were found, since in children of 3 to 10 years of age in the period of 1991-1993, 1.3 children per 1000 were found to have bilateral hearing loss of 40 decibels of more (10) and other studies show rates of between 2 and 5 cases per 1000 children.

With respect to the type of hearing loss, we find a rate of 5.1 cases per 1000 children of sensorineural hearing loss, followed by 2.4 per 1000 for conductive loss, and 1.2 per 1000 for mixed losses. The prevalence was greater in 2011 for all kinds of hearing loss. With regard to uni- or bilaterality, we found a rate of 5.7 for bilateral losses and 0.6 for unilateral losses.

With respect to age, a higher rate was found for children of between 5 and 10 years of age —2.4 per 1000 children—, while in children of between 0 and 4 years of age it is lower at 1.9. This shows that the rate of hearing loss increases with age. Significant differences were not found between males and females in terms of the prevalence of hearing loss. This was true over the different years of observation, and the rate of hearing loss was similar for both sexes with respect to sensorineural and conductive losses. Nevertheless, the presence of mixed hearing loss is greater in females than in males.

The diagnoses used for this analysis came from the ICD-10 (17). These correspond to 11 categories of discharge diagnoses related to hearing loss. The classification does not allow for establishing levels of severity of the diagnosis or detriments to communication, nor does it ensure that the diagnosis is clearly identified within the correct category. This is especially the case for the categories of "other specified" hearing loss, and "unspecified" hearing loss that are not exclusive of the other diagnostic categories and that are not clearly defined.

Conclusions

The results presented allow us to prove that there is an important need for auditory health attention for the pediatric population, for continuous screening starting in the first years of life, and for creating programs that put early detection and priority care policies into effect at all care levels. The increase in the quantity of cases with the age of the patients that the results also show leads us to infer that there is a need to continue performing assessments systematically each year to identify cases that may pass unperceived in early childhood, or that may appear in subsequent years due to childhood health conditions.

The study also leads us to suggest the standardization of the information records, the unification of the diagnostic terminology and categories for the clinical records of the assessments, and the design of record protocols. While the national RIPS system and the codes available from the ICD-10 are regularly used in patient care, these codes should be reviewed and adjusted to the needs of national statistics in such a way that they will allow professionals and state entities to identify the true conditions and auditory care needs in the country.

With the focus of generating data that allow for diverse directions of analysis for the characterization of the prevalence of hearing loss among Colombian children, it is necessary to collect national level information through research processes that promote the attainment of data from primary sources and from national-level epidemiological analyses in order to back up political strategies in the areas including the promotion, prevention, diagnosis and intervention of impairments when it comes to auditory health.

There is a need for creating inter-institutional and inter-sector alliances so as to influence the education of human talent at the different levels of care for hearing impairment. This will aid these professionals to provide complete and accurate epidemiological information in health records.

Future studies should aim to characterize hearing impairment according to the life cycles in which it appears, and by its risks and effects. The natural history of the many diseases that lead to hearing loss should be described. For epidemiological descriptions, it is important to identify the

most frequent problems among newborns, in early childhood, and at school age. The causes and evolution of these diseases should be studied in order to identify critical points in which prevention, diagnosis, or intervention can be performed to stop, eradicate or mitigate the disability. With data from the Individual Records of Health Procedures (RIPS) alone, this information is impossible to ascertain. For this reason, it is necessary to search for information directly from descriptive audiological diagnoses that are made in daily clinical practice. The categories with which the diagnoses are recorded in SISPRO should also be reformulated.

Finally, all professionals that provide hearing health care to the population must make their reports to the Secretariat of Health in an oportune manner so as to avoid under-recording of information. This will provide a clear panorama of the hearing conditions of the Colombian population, something that will provide a foundation for the professional practice of phonoaudiologists and audiology specialists.

Conflict of interest

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