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Demographic and audiological characteristics of a pediatric population in a hearing health care center in São Paulo

Características demográficas e audiológicas da população pediátrica de um centro de referência em saúde auditiva de São Paulo

Características demográficas y audiológicas de la población pediátrica de un centro de referencia en salud auditiva de Sao Paulo

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Abstract

Introduction: The creation of public policies regulating actions in primary care to promote hearing health care, prevention and identification of hearing loss, ensures rehabilitation, providing support and protection of persons with disabilities, in addition to health. **Objective:** To characterize demographic and audiological data of users of a hearing health care center, in São Paulo City. **Method:** This is a descriptive and retrospective observational study developed at the Hearing in Children Center (CeAC). There were analyzed 857 patients' recordings of those who concluded the audiological assessment, from August 2010 to June 2015. The following data were extracted from the recordings: gender, date of birth, dwelling area, newborn hearing screening (NHS) tests performed, risk indicators for hearing loss in the children's history, origin of the referral, age at the first visit, age at diagnosis, and results for hearing status. **Results:** 64.2% of the children live in the South region of São Paulo city; 2 months old was the mean age at the beginning of the diagnosis; 54,8% of the complaints were of hearing loss followed by refers

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Authors' contributions:
SNF – article elaboration.
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after NHS (29.6%); 57.8% of the children performed NHS; 50,2% of children completed the diagnosis in the age group over one year old; auditory status was found to be 22,4% for bilaterally sensorial hearing loss, 17,7% for conductive hearing loss. **Conclusion:** The principal reason for searching diagnosis was hearing loss, and not because of refers after NHS. The center assists specially the children who live in the area for which the center is responsible, according to the hearing health policies.

Keywords: Hearing loss; Child; Public policy; Early diagnosis; Tracking programs.

Resumo

Introdução: A criação de políticas públicas regulamentando ações na atenção básica de promoção à saúde auditiva, prevenção e identificação de problemas auditivos, garante a reabilitação, dando proteção às pessoas com deficiência. **Objetivo:** Caracterizar os dados demográficos e audiológicos dos usuários de um centro de referência em saúde auditiva, do município de São Paulo. **Método:** Trata-se de estudo de caráter descritivo e retrospectivo, desenvolvido no Centro Audição na Criança (CeAC/DERDIC/PUCSP). Foram analisados 857 prontuários de pacientes que compareceram para avaliação audiológica e concluíram o diagnóstico, entre agosto/2010 e junho/2015. Foram extraídos os seguintes dados dos prontuários: sexo, data de nascimento, zona de moradia, realização da triagem auditiva neonatal (TAN), indicadores de risco para deficiência auditiva na história da criança, origem do encaminhamento, idade na primeira consulta, idade na finalização do diagnóstico audiológico e resultado do mesmo. **Resultados:** 64,2% das crianças atendidas residem na região Sul de São Paulo; 2 meses foi a idade média no início do diagnóstico; 54,8% das queixas foi suspeita de perdas auditivas seguida da necessidade de diagnóstico por falha na TAN (29,6%); 57,8% das crianças realizaram a TAN; 50,2% finalizaram o diagnóstico com idade superior a um ano, seguida pelas crianças de 0 à 3 meses (18,4%); o diagnóstico encontrado nas crianças foi de 22,4% de perdas auditivas sensórioneurais bilateralmente, 17,7% de perdas condutivas. **Conclusão:** A maioria da população atendida se origina em queixas de perdas auditivas e não pela demanda proveniente das maternidades que realizam a TAN. Nota-se ainda que o referido centro atende a população de sua área de referência.

Palavras-chave: Perda auditiva; Criança; Políticas públicas; Diagnóstico precoce; Programas de rastreamento.

Resumen

Introducción: La creación de políticas públicas regulando acciones en la atención básica de promoción a la salud auditiva, prevención e identificación de problemas auditivos, garantiza la rehabilitación, dando amparo a las personas con discapacidad. Objetivo: Caracterizar los datos demográficos y audiológicos de los usuarios de un centro de referencia en salud auditiva. Método: Se trata de un estudio de carácter descriptivo y retrospectivo, desarrollado en el Centro AudicióndelNiño (CeAC/DERDIC/PUCSP). Se analizaron 857 prontuarios de pacientes que comparecieron para evaluación audiológica y concluyeron el diagnóstico, entre agosto/2010 a junio/2015. Se tomaron los siguientes datos: sexo, fecha de nacimiento, zona de vivienda, realización de lo rastreo auditivo neonatal(TAN), indicadores de riesgo para deficiencia auditivaen la historia del niño, origen del encaminamiento, edad en la primera consulta, edad en la finalización del diagnóstico audiológico y su resultado. Resultados: 64,2% de los niños atendidos residen en la región Sur de São Paulo; 2 meses fue el promedio de edad al inicio del diagnóstico; 54,8% de las quejas fue sospecha de pérdida auditiva, seguida de la necesidad de diagnóstico por fallo en el rastreo (29,6%); 57,8% de los niños realizaron rastreo; 50,2% finalizó el diagnóstico con edad superior a un año, seguido por niños de 0 a 3 meses 18,4%; el diagnostico encontrado fue de 22,4% de pérdidas auditivas sensorioneuronales bilaterales, 17,7% de pérdidas conductivas. Conclusión: La mayoría de la población atendida se origina a partir de quejas de pérdidas auditivas y no por demanda proveniente de las maternidades que realizan el rastreo. Se observa además que el referido centro atiende a la población de su área de referencia.

Palabras claves: Pérdida de la audición; Niño; Políticas públicas; Diagnóstico precoz; programas de rastreo.

Introduction

The integrity of the auditory system is key to child's development considering the fact that hearing is the means to acquire language and speech skills, which enable the child to organize and understand the universe, communicate, understand others, and interact with the world and learn[1]. Children who have hearing disorders may have their language, speech, learning, social and emotional development affected[2]. Thus, measures should be taken to identify hearing disorders as early as possible, aiming at rapid and accurate diagnosis, and a therapeutic intervention with the child and the family, minimizing the effects of this sensory deprivation and taking advantage of brain plasticity[2,3].

With the purpose of allowing early diagnosis, it is important to have public health policies in place, especially those aimed at hearing health, which guarantee the right to identification, diagnosis, intervention and (re-)habilitation of the child with hearing impairment, following guidelines for the organization and implementation of Regionalized Hearing Healthcare Networks[4].

In our country, there are set guidelines under Decree MS/GM number 835, of April 25, 2012[5] and under Decree MS/GM number 1,278, of October 20, 1999[6] that advocate actions ranging from the early identification, through the Universal Neonatal Hearing Screening (UNHS), and diagnosis to intervention measures, through adaptation of Individual Sound Amplification Device (ISAD), and even Cochlear Implant (CI). For all children with hearing loss that can affect their language development or is considered disabling, the speech-language therapy is also recommended[5,6].

Therefore, since hearing is an essential factor in language acquisition and development, and early detection of hearing loss is extremely important in the prognosis of rehabilitation, UNHS is recommended for up to the first month of life, and the establishment of diagnosis not later than the third month of life[8], as it minimizes the effects of hearing impairment on the individual[7]. It is also recommended to immediately initiate clinical intervention after the positive result for hearing loss has been confirmed, with use of electronic devices, speech,language therapy, and guidance to parents and caregivers[7,8].

The Multiprofessional Hearing Health Committee (COMUSA) created in 2010 in Brazil refers to actions aimed at hearing health in all age groups, with recommendations on good practices related to UNHS, diagnosis and early intervention, as well as guidelines on the need for improving the processes involved in the hearing health program[9].

On August 2, 2010, Law number 12303 was signed. In the law's content, its author brings forward the neonatal hearing screening (NHS) and settled the otoacoustic emissions test (OAE) as mandatory for all newborns nationwide[10].

In 2012, the Hearing Health instructive document was published, pointing out guidelines for treatment, rehabilitation and/or habilitation of people with hearing, physical, intellectual and visual impairments. It also regulates general operating rules for Specialized Rehabilitation Centers (SRC), with physical facilities, opening hours and human and material resources. Within the guidelines for hearing-impaired individuals, the hearing rehabilitation/habilitation service is also available in the program, as well as the criteria for Diagnostic Evaluation, hearing aid indication, and speech-language therapy[11].

A study conducted at two clinics specialized in deafness in Campinas, Brazil, investigated 320 medical records of patients diagnosed with prelingual deafness and identified that even with the approval of draft laws endorsing NHS, the programs for early identification of hearing loss have not reached the entire population[12]. In this study, the average age of children's first consultation was 3 years and 6 months old and parents suspected hearing loss when children were between 1 and 9 months old.

In São Paulo, a study analyzed the implementation of actions in hearing health by searching the main documents related to hearing health through information system, regional forums and interviews with professionals from three high complexity centers. It was possible to identify two major milestones: the implementation of the Brazilian Hearing Healthcare Policy (PNASA) and "Plano Viver sem Limite" (literally, "Living Without Limit Plan"). The data also showed a growth in the concession of individual sound amplification devices and cochlear implants, as well as the performance of procedures to identify hearing loss. The numbers for follow-up and therapy were lower than expected, though. The study suggested an opportunity for

change, appropriate for discussion, requiring efforts and dialogue among all involved to facilitate processes and access to a healthier and fairer life for those with disabilities[13].

Nonetheless, PNASA enabled a greater organization in the care of the hearing impaired population and improvement of actions in hearing health, since it proposes a hierarchical, regionalized and integrated network, from basic to high-complexity care, thus trying to guarantee the needed rehabilitation and access to services. Therewith, PNASA once again plays a key role in the organization and access to the identification, diagnosis and rehabilitation services, facilitating access to services and structuring a network of care, according to different levels of complexity[14].

Another nationwide study sought to evaluate PNASA from the coverage of specialized services and medium- and high-complexity hearing health diagnostic procedures, per region and across Brazil. Data from the Department of Informatics of the Unified Health System (DATASUS) were used between 2004 and 2011. It has been identified an increase of 113% in service coverage and 61% in the number of medium and high-complexity hearing health diagnostic procedures across the country. The Northern region of the country showed a 78% increase in the number of procedures. However, a proportionally larger number of procedures is performed in the Southeast region. It has also been identified a significant increase in otoacoustic emissions test (OAE) for hearing screening, transient OAE and distortion-product studies, as well as diagnostic reassessment tests for hearing impairment in patients older than three years of age. It is concluded that there has been a significant increase in services and actions in hearing healthcare in Brazil since the implementation of PNASA, but there are still important regional inequalities in the provision of services[15].

Based on PNASA and national and municipal guidelines, this article aims to characterize the users' demographic and audiological data of a reference center in hearing health in the city of São Paulo.

Method

The study was implemented at the Child Hearing Center of the Division of Education and Rehabilitation of Communication Disorders (CeAC-DERDIC / PUCSP), an accredited unit of the Hearing Healthcare Network in São Paulo.

At first, the Scheduling System was used to search for patients scheduled at CeAC between August 2010 and June 2015. This system is a general computer-based program of the institution used to store patient and schedule information. After this survey within the institution files, we identified 857 records of patients that were attended during the study period and had an audiological diagnosis and hearing status established. In order to help data collection, a clinical record form with the required data for the research was elaborated and inserted into an Excel spreadsheet for later statistical analysis. The following information was extracted from each medical record: date of birth, age at first consultation, region of residence, origin and reason for referral, presence of risk indicators for hearing loss (RIHL), age at the diagnosis completion, and hearing status after establishment of diagnosis (results). The medical records were analyzed through anamnesis forms, medical and speech-language therapy evolution sheets, and records of the carried out diagnosis tests: Evoked Otoacoustic Emissions (EOE), Brainstem Evoked Response Audiometry (BERA), Visual Reinforcement Audiometry (VRA) or Conditioned Play Audiometry (CPA) and immitanciometry. The hearing impairment risk indicators (RIHL) considered were those specified by the Multiprofessional Hearing Health Committee (COMUSA) and the Joint Committee on Infant Hearing (JCIH)[7,9].

A descriptive analysis of the data was carried out as following: demographic analysis characterizing the child's gender and age at the first consultation; child's age at the establishment of diagnosis; origin (city, State and current city of residence); origin of referral (services that performed the referral for diagnosis); whether or not the UNHS test was performed and where it was performed; audiological characterization as per RIHL presence and audiological result after evaluation. An inferential analysis was performed based on the cross-checking of the following data: UNHS accomplished according to the child's age at the first consultation and at the establishment of diagnosis; origin of referral as per the child's at the establishment of diagnosis; UNHS result according to the diagnosis result.

Results

We have found 857 records of patients that underwent the audiological diagnosis at CeAC between August 2010 and June 2015.

Thus, the following results will be presented: distribution of medical records/patients surveyed, age at first consultation, region of residence, referral reason for audiological diagnosis, RIHL presence, child's age at diagnosis and hearing status.

The descriptive summary of the child's age in months, at the first consultation, is shown in Table 1. It can be noted that in all years there were children whose first consultation took place before one month of age. However, most attended children were 12 months of age or older.

Table 1. Distributions of frequency and percentages of the age group in the first consultation per year in which it occurred

Year of the first consultation	Age group at the first consultation				Total
	0a3 months	4a6 months	7a12 months	more than 12 months	
2010	25	8	13	35	81
	30.9%	9.9%	16.0%	43.2%	100.0%
2011	33	15	25	68	141
	23.4%	10.6%	17.7%	48.2%	100.0%
2012	24	9	39	92	164
	14.6%	5.5%	23.8%	56.1%	100.0%
2013	47	30	25	84	186
	25.3%	16.1%	13.4%	45.2%	100.0%
2014	48	22	35	85	190
	25.3%	11.6%	18.4%	44.7%	100.0%
2015	21	8	21	45	95
	22.1%	8.4%	22.1%	47.4%	100.0%
Total	198	92	158	409	857
	23.1%	10.7%	18.4%	**47.7%**	100.0%

Most attended children lived in the South and North Regions, and this result is due to the fact the institution is a reference for such regions.

With regard to the origin of referrals, it should be noted that Maternity Centers and Specialized Rehabilitation Centers (SRC) are at the top of the list as the origin of referrals. From the implementation of UNHS tests in the county, there was an increase in the number of referrals for diagnosis after a failure in UNHS, deriving from the hospitals that performed them.

Most children underwent UNHS tests. However, it is worth mentioning that the percentages of children who underwent UNHS tests refer to the years 2013 to 2015, which shows higher percentage when they are compared to the period between 2010 and 2012. This shows, therefore, an evolution in the number of children over the years.

Table 2. Distributions of frequency and percentages of the region of residence per year in which the first consultation occurred

Region of residence	Year of the first consultation						Total
	2010	2011	2012	2013	2014	2015	
North	16	29	24	49	45	22	185
	19.8%	20.6%	14.6%	26.3%	23.7%	23.2%	**21.6%**
South	47	87	119	119	113	65	550
	58.0%	61.7%	72.6%	64.0%	59.5%	68.4%	**64.2%**
East	7	15	10	15	21	6	74
	8.6%	10.6%	6.1%	8.1%	11.1%	6.3%	8.6%
West	9	8	5	2	5	1	30
	11.1%	5.7%	3.0%	1.1%	2.6%	1.1%	3.5%
Central	1	0	0	0	5	1	7
	1.2%	0.0%	0.0%	0.0%	2.6%	1.1%	0.8%
Metropolitan/Seaside	1	2	6	1	1	0	10
	1.2%	1.4%	3.6%	0.5%	0.5%	0.0%	1.2%
Total	81	141	164	186	190	95	857
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3. Distributions of frequency and percentages of the origin of the referral by year in which the first consultation occurred

Referral	Year of the first consultation						Total
	2010	2011	2012	2013	2014	2015	
Institutions	3	4	4	5	6	4	28
	3.70%	2.80%	2.40%	2.70%	3.10%	4.30%	3.30%
AE/AMA/AME	9	13	7	5	9	2	46
	12.30%	9.20%	4.20%	2.70%	4.80%	2.20%	5.40%
CAPS/CER/NISA/NIR/ UBS	18	40	62	74	88	55	360
	22.20%	28.40%	49.90%	40.80%	45.80%	58.10%	**41.90%**
Spontaneous complaint	4	3	4	5	2	1	19
	4.90%	2.10%	2.40%	2.70%	1.10%	1.10%	2.20%
School	1	1	0	1	1	0	4
	1.20%	0.70%	0.00%	0.50%	0.50%	0.00%	0.50%
Hospital	4	10	9	5	4	1	33
	4.90%	7.10%	5.50%	2.70%	2.10%	1.10%	3.90%
Maternity	27	38	31	62	59	21	238
	33.30%	27.00%	18.90%	33.30%	31.10%	22.10%	**27.80%**
Others	13	32	27	26	21	11	129
	16.0%	22.7%	16.5%	13.4%	11.1%	11.6%	**15.1%**
Total	81	141	164	186	190	95	857
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Key: INSTITUTIONS – APAE (Associação de Pais e Amigos dos Excepcionais - Association of Parents and Friends of Exceptional Children), AACD (Associação de Apoio a Criança Deficiente – Assistance Association for Children with a Disability) and CEMA (Centro de Medicina Avançado – Center of Advanced Medicine); AE (ambulatório de especialidades – Specialty Outpatient Clinic); AMA (Assistência Médica Ambulatorial – Ambulatory Medical Care); AME (Ambulatório Médico de Especialidades – Specialist Medical Ambulatory); CAPS (Centro de Atenção Psicossocial – Center for Psychosocial Care); CER (Centro Especializado em Reabilitação – SRC - Specialized Rehabilitation Center); NIR (Núcleo Integrado em Reabilitação – Integrated Nucleous in Rehabilitation); NISA (Núcleo Integrado em Saúde Auditiva – Integrated Center for Hearing Health); UBS (Unidade Básica de Saúde – Basic Health Center)Reabilitação); NIR (Núcleo Integrado em Reabilitação); NISA (Núcleo Integrado em Saúde Auditiva); UBS (Unidade Básica de Saúde)

The main complaint for the diagnosis was failure in UNHS at maternities and the suspicion of hearing losses in early childhood.

It is also worth noting that, in all the years, most attended children had some kind of RIHL. These children are more likely to have a hearing impairment, and are more likely to be observed in their development because of parents' and health professionals' concerns.

The age group at diagnosis, prevalent in all years, was over 12 months of age, followed by children up to 3 months of age.

Table 4. Distributions of frequency and percentages of the answers to "have you undergone unhs" per year in which the first consultation occurred

Year of the first consultation	Have undergone UNHS			Total
	N	Y	ND	
2010	15	41	25	81
	18.5%	50.6%	30.9%	100.0%
2011	15	75	51	141
	10.6%	53.2%	36.2%	100.0%
2012	17	85	62	164
	10.4%	51.8%	37.8%	100.0%
2013	13	116	57	186
	7.0%	62.4%	30.6%	100.0%
2014	11	122	57	190
	5.8%	64.2%	30.0%	100.0%
2015	6	56	33	95
	6.3%	58.9%	34.7%	100.0%
Total	77	**495**	285	857
	9.0%	57.8%	33.3%	100.0%

Key: N = No; Y = Yes; ND = No data

Table 5. Distributions of frequency and percentages of the reason to search for audiological tests, per year in which the first consultation occurred

Year of the first consultation	Reason for referral					Total
	Hearing	ND	Speech/lgg	prosthesis	screening	
2010	45	0	6	0	30	81
	55.60%	0.00%	7.40%	0.00%	**37.00%**	100.00%
2011	93	3	11	1	33	141
	66.00%	2.10%	7.80%	0.70%	**23.40%**	100.00%
2012	104	1	24	0	35	164
	63.40%	0.60%	14.60%	0.00%	**21.30%**	100.00%
2013	98	1	25	0	62	186
	52.70%	50.00%	13.40%	0.00%	**33.30%**	100.00%
2014	81	5	33	8	63	190
	42.60%	2.60%	17.40%	4.20%	**33.20%**	100.00%
2015	49	3	11	1	31	95
	51.60%	3.20%	11.60%	1.10%	**33.60%**	100.00%
TOTAL	470	13	110	10	254	857
	54.80%	1.50%	12.80%	1.20%	**29.60%**	100.00%

Key: ND = Neuropsychomotor Development; Lgg = language

Table 6. Distributions of frequency and percentages of children with rihl per year in which the first consultation occurred

Year of the first consultation	RIHL			Total
	N	Y	ND	
2010	25	55	1	81
	30.9%	67.9%	1.2%	100.0%
2011	50	90	1	141
	35.5%	63.8%	0.7%	100.0%
2012	54	110	0	164
	32.9%	67.1%	0.0%	100.0%
2013	63	123	0	186
	33.9%	66.1%	0.0%	100.0%
2014	62	126	2	190
	32.6%	66.3%	1.1%	100.0%
2015	37	57	1	95
	38.9%	60.0%	1.1%	100.0%
Total	291	561	5	857
	34.0%	**65.5%**	0.6%	100.0%

Key: RIHL risk indicators for hearing loss; N = No; Y = Yes; ND = No data

Table 7. Distributions of frequency and percentages of the age group of diagnosis per year.

Year of the first consultation	Age group at diagnosis				Total
	0 a 3 months	4 a 6 months	7 a 12 months	more than 12 months	
2010	23	8	13	37	81
	28.40%	9.90%	16.00%	**45.70%**	100.00%
2011	23	22	24	72	141
	16.30%	15.60%	17.00%	**51.10%**	100.00%
2012	19	10	40	95	164
	11.60%	6.10%	24.40%	**57.90%**	100.00%
2013	37	34	26	89	186
	19.90%	18.30%	14.00%	**47.80%**	100.00%
2014	39	25	39	87	190
	20.50%	13.20%	20.50%	**45.80%**	100.00%
2015	17	9	19	50	95
	17.90%	9.50%	20.00%	**52.60%**	100.00%
TOTAL	158	108	161	430	857
	18.40%	12.60%	18.80%	**50.20%**	100.00%

The diagnosis time period varied between 2 and 6 months.

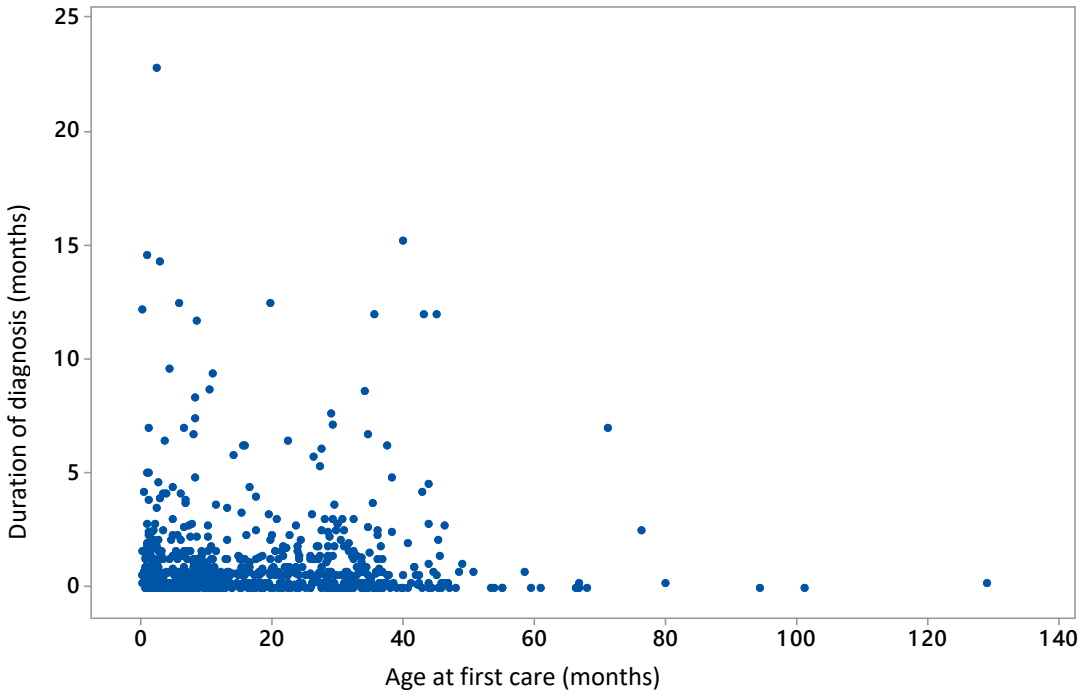

Figure 1. Diagram of dispersion of time duration of the diagnosis and the age at the first consultation

With the exception of years 2012 and 2015, the number of children who underwent UNHS tests and had their diagnosis established by the age of 3 months was higher than the other age groups. As for the results of UNHS and diagnosis, it can be observed that the failure in UNHS during screening were confirmed in the diagnosis, showing the efficiency of these procedures to identify hearing losses at an age considered ideal to start rehabilitation. Once again, it is shown the importance of this simple, fast and inexpensive procedure for early start of the necessary intervention. [The importance of this simple, fast and inexpensive procedure for the necessary intervention early start is shown once again].

There was a match between the types of loss in the two ears in most children, that is, the audiological characterization shows symmetry between the ears, regarding hearing loss.

In addition, the relationship between the age at diagnosis and RIHL is shown, indicating that children with RIHL are more likely to have hearing losses and are monitored closely by being referred earlier to reference centers.

Table 8. Distributions of frequency and percentages on the answer to "have you undergone UNHS" in each diagnosis combination for both ears

Diagnosis LE/RE	Have undergone UNHS			Total
	N	S	SD	
normal/normal	44	198	146	388
	11.3%	**51.0%**	**37.6%**	100.0%
normal/conductive	2	17	12	31
	6.5%	**54.8%**	38.7%	100.0%
normal/mixed	1	1	0	2
	50.0%	50.0%	0.0%	100.0%
normal/ neurosensorial	0	8	2	10
	0.0%	**80.0%**	20.0%	100.0%
conductive/conductive	14	100	38	152
	9.2%	**65.8%**	25.0%	100.0%
conductive/mixed	0	2	0	2
	0.0%	**100.0%**	0.0%	100.0%
conductive/normal	6	34	7	47
	12.8%	**72.3%**	14.9%	100.0%
conductive/ neurosensorial	0	1	1	2
	0.0%	50.0%	50.0%	100.0%
mixed/mixed	0	11	5	16
	0.0%	**68.8%**	31.3%	100.0%
mixed/normal	0	1	0	1
	0.0%	**100.0%**	0.0%	100.0%
mixed/ neurosensorial	0	1	0	1
	0.0%	**100.0%**	0.0%	100.0%
neurosensorial /conductive	0	3	0	3
	0.0%	**100.0%**	0.0%	100.0%
neurosensorial /normal	1	7	2	10
	10.0%	**70.0%**	20.0%	100.0%
neurosensorial/neurosensorial	9	111	72	192
	4.7%	**57.8%**	37.5%	100.0%
Total	77	495	285	857
	9.0%	**57.8%**	33.3%	100.0%

Key: LE/RE left ear/right ear

Table 9. Distributions of joint and marginal frequency and percentages of the type of hearing loss by year

Type of loss RE	Type of loss LE				Total
	Normal	conductive	mixed	sensorineural	
Normal	388	31	2	10	431
	45.3%	3.6%	0.2%	1.2%	50.3%
conductive	47	152	2	2	203
	5.5%	17.7%	0.2%	0.2%	23.7%
mixed	1	0	16	1	18
	0.1%	0.0%	1.9%	0.1%	2.1%
sensorineural	10	3	0	192	205
	1.2%	0.4%	0.0%	22.4%	23.9%
Total	446	186	20	205	857
	52.0%	21.7%	2.3%	23.9%	100.0%

Key: LE=left ear; RE=right ear

Table 10. Distributions of frequency and percentages of the age group of the diagnosis in relation to have RIHL per year in which the first consultation occurred

		Age of diagnosis				
Year of the first consultation	**RIHL**	**0 a 3 months**	**4 a 6 months**	**7 a 12 months**	**+ 12 months**	**Total**
2010	N	8	3	1	13	25
		32.0%	12.0%	4.0%	**52.0%**	100.0%
	Y	15	5	12	23	55
		27.3%	9.1%	21.8%	41.8%	100.0%
	Total	23	8	13	36	80
		28.7%	10.0%	16.3%	**45.0%**	100.0%
2011	N	11	7	8	24	50
		22.0%	14.0%	16.0%	**48.0%**	100.0%
	Y	12	15	16	47	90
		13.3%	16.7%	17.8%	**52.2%**	100.0%
	Total	23	22	24	71	140
		16.4%	15.7%	**17.1%**	**50.7%**	100.0%
2012	N	8	3	10	33	54
		14.8%	5.6%	**18.5%**	**61.1%**	100.0%
	Y	11	7	30	62	110
		10.0%	6.4%	27.3%	56.4%	100.0%
	Total	19	10	40	95	164
		11.6%	6.1%	24.4%	57.9%	100.0%
2013	N	14	9	6	34	63
		22.2%	14.3%	9.5%	**54.0%**	100.0%
	Y	23	25	20	55	123
		18.7%	20.3%	16.3%	44.7%	100.0%
	Total	37	34	26	89	186
		19.9%	18.3%	14.0%	47.8%	100.0%
2014	N	15	5	17	25	62
		24.2%	8.1%	27.4%	40.3%	100.0%
	Y	24	19	22	61	126
		19.0%	15.1%	17.5%	**48.4%**	100.0%
	Total	39	24	39	86	188
		20.7%	12.8%	20.7%	45.7%	100.0%
2015	N	7	2	9	19	37
		18.9%	5.4%	**24.3%**	**51.4%**	100.0%
	Y	10	6	10	31	57
		17.5%	10.5%	17.5%	54.4%	100.0%
	Total	17	8	19	50	94
		18.1%	8.5%	20.2%	53.2%	100.0%

Key: RIHL risk indicators for hearing loss; N = No; Y = Yes

Discussion

The results shown in Table 1 indicate that the age at first consultation, mostly, occurred when the child was at about 12 months of age.

The literature recommends the diagnosis to be completed by the third month of life, which does not occur in most of the children included in the present study[5,6,7]. These recommendations are confirmed by studies that report that the maturation process of the peripheral part of the auditory pathway to the brainstem occurs still in the intrauterine phase, and after birth, with auditory pathway myelination, completing this initial process around the 18 months of life. It is known, however, that sensory deprivation can impair the maturation of these pathways, interfering in the neural network formation and their connections with the auditory cortex. Therefore, the early diagnosis, in the child's first months of life, is necessary for a better use of the auditory residue and the neuronal plasticity, and consequently, a good development of the language[1,2,3,4,8,9,16].

The prevalent age group, according to Table 1, was of children older than 12 months. Only 23.1% of children belonged to the age group under

3 months of age. In 2010, as UNHS procedures became mandatory across the country, by means of federal law, it was expected a decrease in the age group that would look for a diagnosis, after the failure in UNHS procedures had been solved. The present study, accomplished between 2010 and 2015, may have shown results that were influenced by the strength of the law published in 2010, but without all the desired effects for early diagnosis, after 5 years of implementation of UNHS procedures in the county. Thus, most of children considered in the present study began their audiological diagnosis process after completing 12 months of age. Despite the mandatory nature of UNHS, it is known that not all maternity units in the county perform it in compliance with national and international recommendations and that , mainly, it is questioned whether the health system is structured enough to refer all children who did not undergo a UNHS procedure to specialized diagnosis. The latter is not efficiently carried out in all maternity units, being a quality indicator to be studied[10,17].

The South region (64.2%), followed by the North (21.6%), identified as the dwelling regions, were predominant in the referral for the diagnosis (Table 2). This is due to the principle of regionalization in the Brazilian Unified Health System (SUS). CeAC is accredited as a reference service in Hearing Health, prepared to offer audiological diagnosis to children of any age group, and referred as a Specialized Rehabilitation Center (SRCII) in two modalities: auditory and intellectual. The institution where this study was carried out is the reference for the two regions in question. Regionalization is the principle of SUS, as a way of organizing services and facilitating access to Brazilian citizens. It is important that access to care be the closest to the patient's home, helping in early detection, diagnosis, treatment and rehabilitation[11,12,18].

The referrals that stood out were those from maternity units, followed by other SRCs and the Integrated Center for Hearing Health (NISA) (Table 3). SRC and NISA are part of the county's Hearing Healthcare Network, and when they cannot meet all patients' demands, they refer them to more complex unit services such as CeAC. Therefore, such result shows that the hearing health service network is functioning as recommended by SUS, that is, in a regionalized and hierarchical way[11].

Although hearing healthcare centers are still not providing early enough diagnostic and/or intervention services for the children, the large number in the follow-up shows a more effective rehabilitation process. In Table 1 we can see that from 2012 to 2014 the number of children who started the diagnosis before 3 months of age doubled, although this group age is still smaller than that of children 12 months or older. It shows that, as UNHS procedures became mandatory as of August 2010, there was an improvement in the early identification of hearing loss and, subsequently, in early rehabilitation, thus reducing the effects of hearing impairment on the child[8,10,18].

These data corroborate with the findings of a study carried out in Italy in which the authors identified that the average age of diagnosis at the Audiology and Phoniatrics Center in Turin was 20.5 months of age, but, when they only considered the group of children who underwent UNHS procedures, this age decreased to 6.8 months, demonstrating that the UNHS strategy leads to an early diagnosis of hearing disorders[19].

Most children who attended a healthcare unit for audiological evaluation underwent UNHS procedures (57.8%). However, this number should be 100% of children screened, since UNHS has been made mandatory by law since 2010 across the country, and includes children with or without RIHL (Table 4). Therewith, it can be inferred that there are still places that do not comply with the law, undermining early diagnosis and intervention. It is important to make parents and those in charge of children aware as well as clarify the civil society regarding the requirement and promotion of UNHS procedures[10,20,21]. It is worth mentioning that a national policy that regulates the UNHS implementation and its subsequent processes of diagnosis and intervention has not yet been published by the Brazilian Department of Health. Some authors also mention factors that may delay the diagnosis of hearing disorders, such as the low socioeconomic level of the population and the poor knowledge of the symptoms and ways of rehabilitating hearing loss[22].

A study carried out in Turkey, with a retrospective analysis of 199 medical records between 1999 and 2004, and 156 medical records between 1991 and 1994, shows that the age of suspicion, identification and intervention was statistically lower in the group from 1999 to 2004 when compared to the group of previous years. Despite this, only 8.5% of cases were identified before 6 months of age,

and only 1% of children underwent intervention not older than 6 months of age. They concluded that UNHS procedures should be implanted to decrease the age of identification and intervention of hearing disorders[22].

The children's age at diagnosis was on average 12 months of age, and the referral reasons for these children were due to suspicion of hearing disorders or speech and language delay[19,23].

In Brazil, in a study carried out in a center in Jundiaí, 313 children's medical records were retrospectively analyzed. Also in this study, it was observed that the age at diagnosis, intervention and recommendation of hearing amplification devices was lower when the children were referred after the failure in UNHS procedures had been solved. There was an advantage of 40.7 months in the diagnosis, 45.8 months in the intervention and 54.9 months in the recommendation of hearing amplification devices when compared to children who came from other professionals/sites than of those maternity units that offer UNHS. Furthermore, they analyzed that the delay in establishing the diagnosis of some children coming from UNHS procedures was due to non-inclusion of families that failed to attend medical appointments, besides difficulties in the accurate conclusion of the audiological diagnosis. This assessment in neonates and infants requires specific procedures, such as BERA with Specific Frequency (BERA-SF), both by air and bone pathways. Such tests require experienced and qualified professionals to perform them[24].

The children who underwent the diagnosis after the failure in UNHS procedures had been solved (Table 8) had their hearing loss diagnosis completed earlier, around the 3rd month of age. Even in developed countries, the average age for hearing loss diagnosis is still considered high, with studies indicating an average age of 5.4 years.

The present study reveals that 65.5% of children presented some type of RIHL (Table 6). Some studies mention the correlation between hearing loss and RIHL, showing a greater incidence of hearing disorders among the group that has one or more RIHL[,26,27,28].

In a study in Brazil, it was found that 0.6% of children who did not undergo UNHS procedures had one or more RIHL. The incidence of UNHS failure was smaller in children with up to one RIHL when compared to other children with a greater number of hearing impairment indicators. There was a statistically significant association between the incidence of UNHS failure and the number of RIHL. They also showed that the rate of the UNHS procedures in preterm and very low-birth-weight infants was higher than in term and preterm birth infants weighing more than 1500 gr. This fact reveals that children in the first group are more vulnerable to being hospitalized in a Neonatal Intensive Care Unit (NICU) and more likely to receive ototoxic medications, as well as being exposed to mechanical ventilation. Of children who did not undergo UNHS procedures, 0.5% presented hearing disorders, and the frequency of Hearing Impairment (HI) was higher in preterm infants when compared to term infants; and higher among very low-birth-weight preterm infants when compared to preterm infants weighing more than 1500 gr at birth. There was also a greater incidence of HI in children with one or more RIHL. However, there is a report of an HI case in a child without RIHL, which reinforces the importance of UNHS, that is, in all children and not only those with a history that indicates RIHL[28].

The relationship between RIHL and diagnosis (Table 10) shows that most children have RIHL (65.5%). The most frequent risk indicator was NICU stay, for more than 5 days, followed by family history of hearing loss. Some studies point out to this correlation between hearing loss and RIHL, revealing the highest occurrence among the group that has one or more risk indicators. They emphasize NICU stay as a frequent risk factor among the studied population[21,23,28,29,30,31].

Regarding RIHLs, some authors report that there is a higher incidence of HI in developing countries due to worse health and socioeconomic conditions, high infant mortality rate, lack of adequate prenatal care. They estimate that the incidence should be 6 for 1000 babies. They say that diseases, such as measles, meningitis, mumps and rubella, should be prevented by means of vaccines in basic healthcare actions. They also indicate that better obstetric, neonatal and childcare practices should be put into place to minimize neonatal anoxia, infant prematurity, and low-birth-weight infants. It proposes the inclusion of actions in basic healthcare, promotion of maternal and child health, health education actions and awareness in regard to diseases such as cytomegalus virus, toxoplasmosis, herpes and syphilis, as well as taking care of the

pregnant woman, identifying and treating syphilis and gestational toxoplasmosis[32].

Normal hearing in both ears was the diagnosis obtained in the present study in most children. However, mixed and neurosensorial losses accounted for 26% in the right ear and 26.2% in the left ear (Table 9). Studies of hearing-loss prevalence report that conductive hearing loss appears in great number, followed by neurosensorial and mixed losses. This figure is considered high when compared to developed countries, which suggests more studies and investments in health promotion and deafness prevention[25,29].

It must be observed that there was a predominance of early diagnosis for children older than 12 months. This shows how important it is to have a hearing health policy in place so that these children undergo as early as possible an early diagnosis, thus, not missing an essential time for their language development. Unfortunately, the implementation of Brazilian Hearing Healthcare Policy (PNASA) is not consistent across the country. Therefore, the totality and universality of human rights are not yet guaranteed to everyone[11,13,14,15].

Conclusion

From this study, which was carried out with the data available in the CeAC between August 2010 to June 2015, the conclusion drawn was that the regionalization of the health service has been achieved, due to the fact that the regions of the reference area are the ones that most refer patients for diagnosis, the hearing complaints are the ones that have more occurrence in the search for audiological tests, especially for children with RIHL in their history; throughout the studied years, there have been children who arrived for the first consultation under one month of age, a reduced number, however; the prevailing age group for the first consultation was above 12 months of age, which shows that, so far, early diagnosis has not been reached at its most; the neurosensorial hearing loss was the most prevailing one, maybe due to the greater visibility among parents and health professionals; UNHS public policies should be published and implemented more systematically so that early diagnosis and intervention can be achieved.

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