

Spatial distribution of hearing aids users from a hearing health service

Distribuição espacial de usuários de AASI de um serviço de saúde auditiva

Distribución espacial de usuarios de audífonos de un servicio de salud auditiva

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Abstract

Objective: To analyze the spatial distribution of users at a Microregional Auditory Health Center, according to sociodemographic, clinical and care aspects. **Method:** This is a cross-sectional descriptive observational study using geoprocessing techniques to describe the distribution of individuals attended at the hearing health service of a Microregional Auditory Health Center. The data collect was obtained through analysis of medical records of users served from May 2009 to May 2013. For the analysis and presentation of the data, thematic maps were elaborated from a cartographic base of the Territorial Division of the Regionals of the city of Betim (MG). **Results:** Of the sample of 745 individuals, 699 (94%) belonged to Betim residents and 46 (6%) from four other cities belonging to the service coverage region. Users residing in Betim were visually distributed on the city map according to the region that resides to analyze socio-demographic, clinical and care aspects according to the regions of the city. **Conclusion:** The geoprocessing technique allowed a more detailed observation of the service, with information relevant to management, which can serve as a work strategy for the development of actions to promote hearing health.

Keywords: Hearing Aids; Hearing Loss; Spatial Analysis; Unified Health System; Speech therapy.

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MTP: data collection and analysis, writing and formatting of the article.

DSPJ: conception, design, collection and analysis of data and revision of the manuscript.

FJM: conception, design, data analysis and revision of the manuscript.

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Resumo

Objetivo: Analisar a distribuição espacial de usuários atendidos em uma Junta de Saúde Auditiva Microrregional, segundo aspectos sociodemográficos, clínicos e assistenciais. **Métodos:** Trata-se de estudo observacional descritivo transversal utilizando técnicas de geoprocessamento para descrever a distribuição de indivíduos atendidos no serviço de saúde auditiva de uma Junta de Saúde Auditiva Microrregional. A coleta foi obtida via análise de prontuários de usuários atendidos no período de maio de 2009 a maio de 2013. Para análise e apresentação dos dados, elaborou-se mapas temáticos a partir de base cartográfica da Divisão Territorial das Regionais do município de Betim (MG). **Resultados:** Da amostra de 745 indivíduos, 699 (94%) pertenciam a residentes de Betim e 46 (6%) de outros quatro municípios pertencentes à região de cobertura do serviço. Os usuários residentes em Betim foram distribuídos visualmente no mapa da cidade de acordo com a região que reside para análise dos aspectos sociodemográficos, clínicos e assistenciais segundo as regiões do município. **Conclusão:** A técnica de geoprocessamento possibilitou uma observação mais detalhada do serviço, com informações relevantes à gestão, o que pode servir de estratégia de trabalho para o desenvolvimento de ações de promoção de saúde auditiva.

Palavras-chave: Auxiliares de audição; Perda Auditiva; Análise Espacial; Sistema Único de Saúde; Fonoaudiologia.

Resumen

Objetivo: analizar la distribución espacial de los usuarios asistidos en una Junta de Salud Auditiva Microregional, de acuerdo con aspectos sociodemográficos, clínicos y asistenciales. **Métodos:** Este es un estudio observacional descriptivo de corte transversal que utiliza técnicas de mapas geográficos para describir la distribución de las personas tratadas en el servicio de salud auditiva de una Junta de Salud Auditiva Microregional. La colección se obtuvo a través del análisis de registros médicos de usuarios atendidos desde mayo de 2009 hasta mayo de 2013. Para el análisis y la presentación de datos, se prepararon mapas temáticos a partir de la base cartográfica de la División Territorial Regional de Betim (MG). **Resultados:** De la muestra de 745 individuos, 699 (94%) pertenecían a residentes de Betim y 46 (6%) de otros cuatro municipios pertenecientes a la región de cobertura de servicios. Los usuarios que residen en Betim se distribuyeron visualmente en el mapa de la ciudad de acuerdo con su región de residencia para el análisis de aspectos sociodemográficos, clínicos y de atención de acuerdo con las regiones del municipio. **Conclusión:** La técnica de distribución en mapas geográficos permitió una observación más detallada del servicio, con información relevante para la gestión, que puede servir como estrategia de trabajo para el desarrollo de acciones de promoción de la salud auditiva.

Palabras clave: Audífonos; Pérdida de audición; Análisis Espacial; Sistema Único de Salud; Logopedia.

Introduction

The Brazilian Institute of Geography and Statistics (IBGE) describes through the National Health Survey (PNS) that 1.1% of the Brazilian population has hearing loss, being 0.9% acquired due to illness or accident and 0.2% by congenital acquisition¹. Among the disabilities, hearing loss is classified as severely disabling and with the greatest restriction on participation in relation to the individual's social life since it interferes directly in interpersonal communication and in the learning process^{2,3}.

Actions to ensure care for hearing impaired people are diverse and the most prevalent is the use of the individual hearing aid. The hearing aid is a device with proven efficiency for the treatment of great part of hearing losses which allows the recovery of the speech perception and environmental sound, promoting the improvement of communication skills and therefore minimizing the problems caused by sensory deprivation^{2,4,5}.

A limiting factor in the rehabilitation process of the person with hearing loss was the difficulty of access to hearing aid concession services by the *Unified Health System* (SUS). Accessibility, in this case, is more in-depth than a simple availability of resources such as the hearing aid offer⁶. The access to the service expresses the characteristics of the offer that intervene in the relationship between the characteristics of the individuals and the use of the service, including the adequacy of professionals and the technological resources used for the health needs of the patients⁶.

In 2004, the National Policy for Hearing Health Care – PNASA (Ordinance MH 2073, year 2004) was instituted and proposed the organization of a hierarchical regionalized and integrated network between primary health care services, specialized and high-level complexity components⁷.

In this context, the distribution of services, profile of users served and the relation between territory and health needs are fundamental factors for the planning and evaluation of the care organization.

The understanding of distribution of health services using georeferencing techniques becomes important as a way of mapping and characterizing the population according to space. It is believed that describing the characteristics of users in face of the present conditions, the services with great-

est demand from the population, the flow of this service and the areas of greatest vulnerability can provide major knowledge about the condition and inequalities in health⁸. Such information is fundamental for the improvement of the service at national and regional level seeking a specific performance in each area covered.

In addition, the spatial distribution can provide data that permit directing the measures and actions of prevention and health promotion according to the specificities of population in the territories, enabling greater efficiency in the use of the public resources available to the entire region of coverage and prioritizing the practice areas⁹.

The objective of the present study was to analyze the spatial distribution of users at a Micro regional Hearing Health Board according to sociodemographic, clinical and assistance care aspects.

Methods

This is a cross-sectional descriptive observational study using geoprocessing techniques to describe the distribution of individuals in attendance at the hearing health service of the municipality of Betim. The study scenario was the Micro regional Hearing Health Board of Betim (JSAM).

The JSAM is responsible for monitoring the hearing rehabilitation demand in the Health Region (cities as Igarapé, São Joaquim de Bicas, Esmeraldas, Juatuba, Mateus Leme, Mário Campos, Piedade dos Gerais, Bonfim, Crucilândia, Florestal, Brumadinho and Rio Manso) and scheduling the users to reference services in Hearing Health in Betim. It also performs the speech therapy reception service, audiological evaluation and rehabilitation of the user after the adaptation of the hearing aid, in the municipalities agreed in the Regional Intergovernmental Commission (CIR) that do not have a speech and language therapist.

The present study analyzed the assistance data only from the municipalities that refer users for speech and language assessment in Betim.

The estimated population of the municipality of Betim for 2017 was 427,146 inhabitants consisting of 34.2% of children and young people, 58.7% adults and 7.1% elderly. According to the 2010 census, 99.3% of the population lives in an urban area. The elderly population, composed of individuals aged 60 years or over, showed an in-

crease in relation to the last census and is composed predominantly by female individuals⁷.

The information collected for the present study was taken from the protocol for evaluation and authorization of the concession of the hearing aid, proposed by the Regulatory Board of the Care Network for People with Disabilities – PBH. The data collection was conducted through the analysis of medical records of users seen at JSAM Betim from May 2009 to May 2013. The medical records are available in the institution's file room and were requested by the speech- language and hearing pathologist responsible for the hearing health service.

The medical records of users who underwent evaluation to adapt hearing aids from May 2009 to May 2013 were included, and the medical record that presented more than 20% of incomplete information, or those that were not found in the unit's file were excluded. The study sample consisted of 745 medical records.

The data collected from medical records were related to sociodemographic, clinical and assistance aspects. For the present study, the following variables were used: age group, sex, degree and probable etiology of hearing loss, use of hearing aids before admission to the service, speech and language therapy and waiting time for initial assistance and adaptation of hearing aids.

The user's waiting time was divided in two stages: T1 that refers to the Time waited by the user for the first contact at JSAM for evaluation for the grant of hearing aid, and T2 for the time between the first evaluation (T1) and the authorization of adaptation and scheduling at the Hearing Health Care Service (SASA).

For the analysis and presentation of data, thematic maps were elaborated from the cartographic base of the Territorial Division of the Regionals of the municipality of Betim (state of Minas Gerais): Alterosas, Centro, Citrolândia, Imbiruçu, Norte, PTB, Teresópolis e Vianópolis. On this base, the variable "Population" was represented using zonal cartographic symbology, which observes data from

IBGE (Population Estimative) with reference date on July 1, 2016 (IBGE. Research Directory – DPE – Coordination of Population and Social Indicators-COPIS). The "Population" variable was comprised of class intervals defined by the natural breaks distribution that elaborates the boundaries of the intervals based on real breaks in the histogram, as seen by the researchers.

After the representation of the variable "Population" a specific cartographic representation was established in an aggregate form with proportionality graphic resources. The represented phenomena were:

- a. Users with hearing loss treated at Betim service by age group;
- b. Users with hearing loss treated at Betim service by sex group;
- c. Identification of the degree by ear of the hearing loss of users with hearing impairment treated at the Betim service;
- d. Users with hearing loss treated at the Betim service according to the etiology of the loss;
- e. Users with hearing loss treated at the Betim service who have or have not used hearing aids;
- f. Users with hearing loss treated at the Betim service who did or did not attend speech- language therapy;
- g. Waiting time between the first contact at JSAM and the authorization, scheduling and completion of the hearing aid adaptation in compliance with the region and the population distribution of the Municipality.

Results

From the sample of 745 individuals, 699 (94%) were residents of Betim and 46 (6%) were from four other municipalities belonging to the region covered by the service. The distribution of users according to the city and region of the municipality are described in Table 1. Only the municipality of Betim has territorial division into regions.

Table 1. Distribution of patients treated by a JSAM of Betim in the period of May 2009 to may 2013 for assessment and concession of hearing aid (n=745).

User's municipality	Municipality region	Number of individuals assessed for hearing aid	% of individuals
Betim	Alterosas	164	22.0%
	Centro	117	15.7%
	Citrolândia	58	7.8%
	Imbiruçu	123	16.5%
	Norte	66	8.8%
	PTB	62	8.3%
	Teresópolis	85	11.4%
	Vianópolis	22	2.9%
Crucilândia	---	02	0.3%
Mário Campos	---	03	0.4%
Mateus Leme	---	06	0.8%
		37	5.0%

From the users treated by JSAM residing in Betim, 699 (94%), were distributed visually on the city map according to the region in which each individual resides and characterized according to the established aspects: age group, sex, degree of hearing loss, etiology of hearing loss, previous use of hearing aid, speech- language therapy and time waiting for the concession of the hearing aid.

Figure 1 shows spatial distribution of users according to the sex and group age, also considering the population by region of the municipality.

There was a predominance of elderly users aged 60 years or over, in all regions of the municipality. The most populous region, Alterosas, has the lowest proportion of elderly users compared to the others, but still comprises at least 50% of the individuals served in the period.

The spatial distribution of users according to sex was composed mostly of men due to the population density in the regions. Women were the majority in the regions with the lowest population density: Vianópolis and Citrolândia (Figure 1).

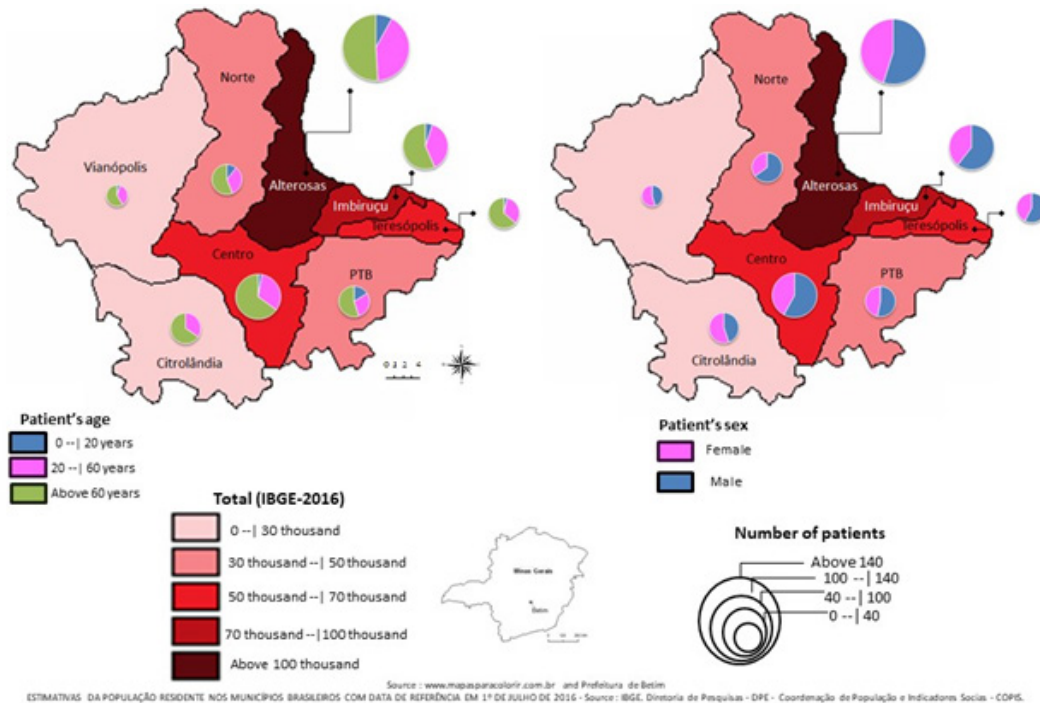


Figure 1. Users with hearing loss treated by age group (left) and sex group (right), in observance to the region and population distribution of the municipality.

Regarding the degree of the hearing loss analyzed by ear in the individual it was noted that for the most users there was a predominance of mild to moderate degree in the best ear. Regarding the degree of hearing loss in the worst ear there was a higher occurrence of severe degree of anacusis.

The expressive occurrence of a mild degree stands out for both ears. It was also observed that the distribution of the degree of hearing loss occurred in a similar way in all the analyzed regions as shown in Figure 2.

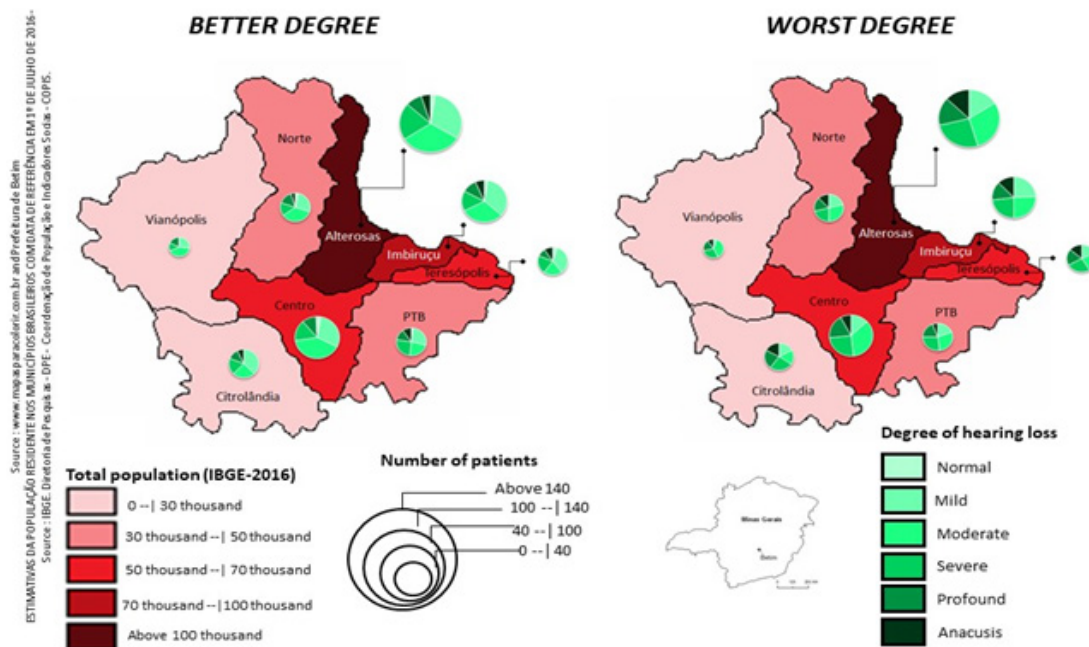


Figure 2. Spatial distribution of the best and worst degree of hearing accuracy by prevalence found in users with hearing loss, in observance to the region and population distribution of the municipality.

As for the spatial distribution of etiology of hearing loss, it was found that the acquired type was the most frequent in all regions with the exception of Citrolândia, which had a higher occurrence of users with hereditary hearing loss (figure 3 – left). In other municipalities, hereditary hearing losses reached the second position and congenital hearing losses were more prominent in the most populous region of the municipality: Alterosas.

Regarding the previous use of hearing aids, it was noted that most users had not previously used the device before joining the service (figure 3 – right). It was also observed that regions with lower demographic density had a lower proportion of users who had previously used hearing aids compared to regions with higher demographic density as Alterosas, Imbiruçu and Teresópolis.

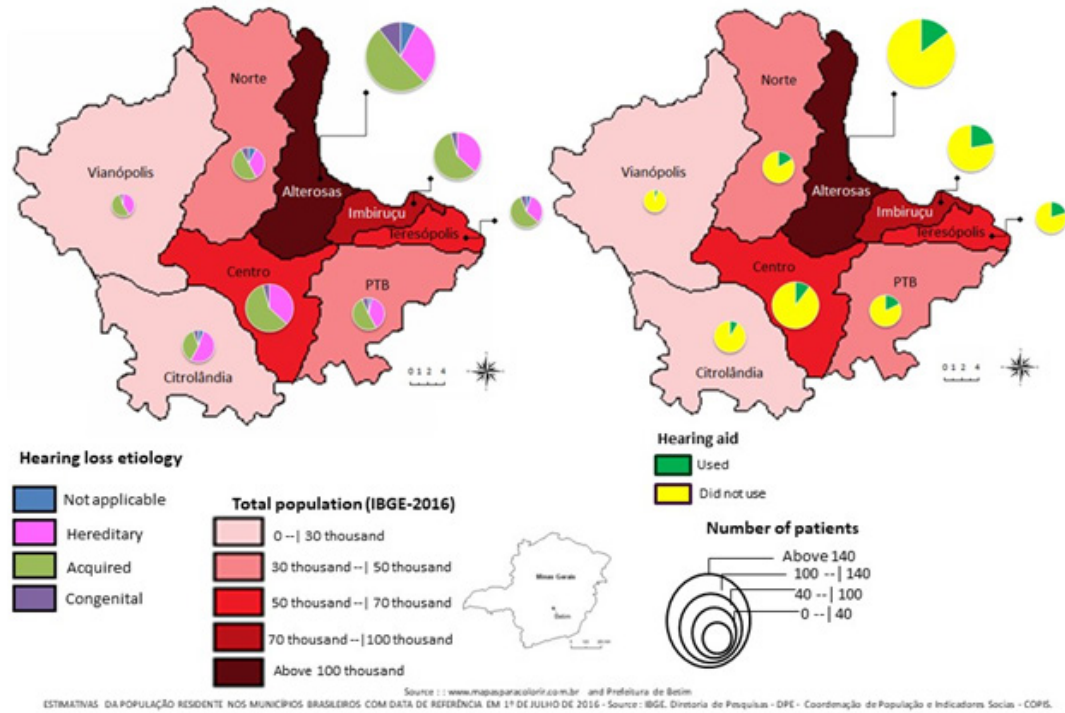


Figure 3. Users with hearing loss treated at the service in Betim according to etiology of loss (left) and previous use of hearing aid (right) in observance to the region and distribution of the municipality.

Speech and language therapy was performed in a small number of users as shown in Figure 4. It was observed that the proportion of users who underwent speech and language therapy was higher in the

most populous region of Betim. In less populated regions, all users of the service never underwent speech and language therapy.

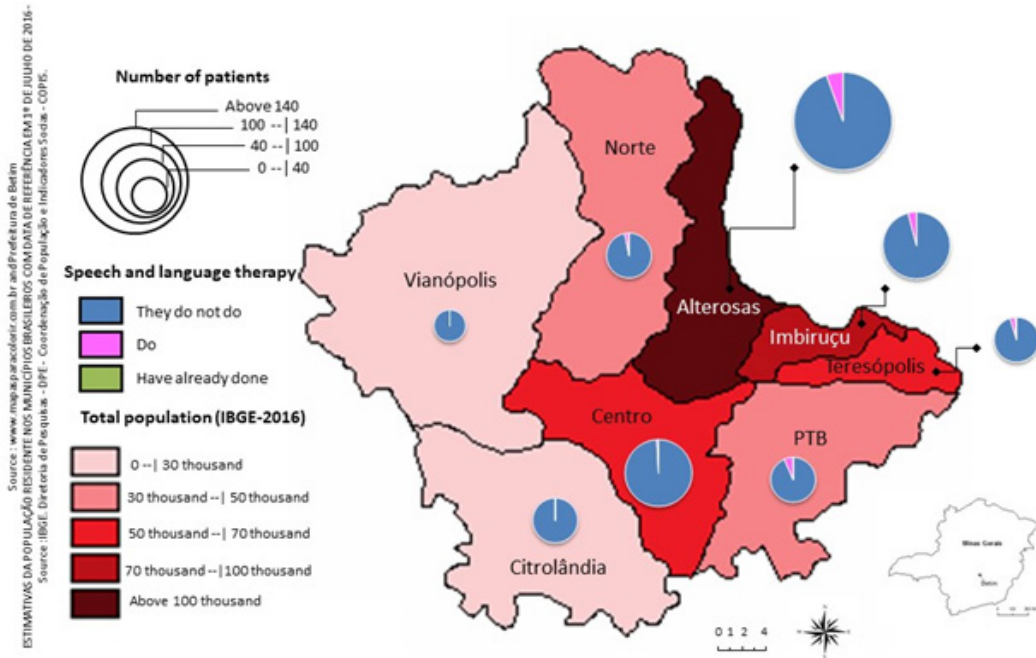


Figure 4. Users with hearing loss treated in the Betim service that have or not attended speech and language therapy, in observance of the region and population distribution of the municipality.

The user’s waiting time was divided into two stages: T1 that refers to the time waited by the user for the first contact at JSAM for evaluation for the concession of the hearing aid, and T2 for the time between the first evaluation (T1) and authorization for adaptation and scheduling at SASA. Regarding

the spatial distribution of waiting time, less time was observed in T1 compared to T2, with T1 equal to or less than three months, and T2 between three and six months of waiting. It was verified that there was no variation between the waiting times and the population density of the region (Figure 5).

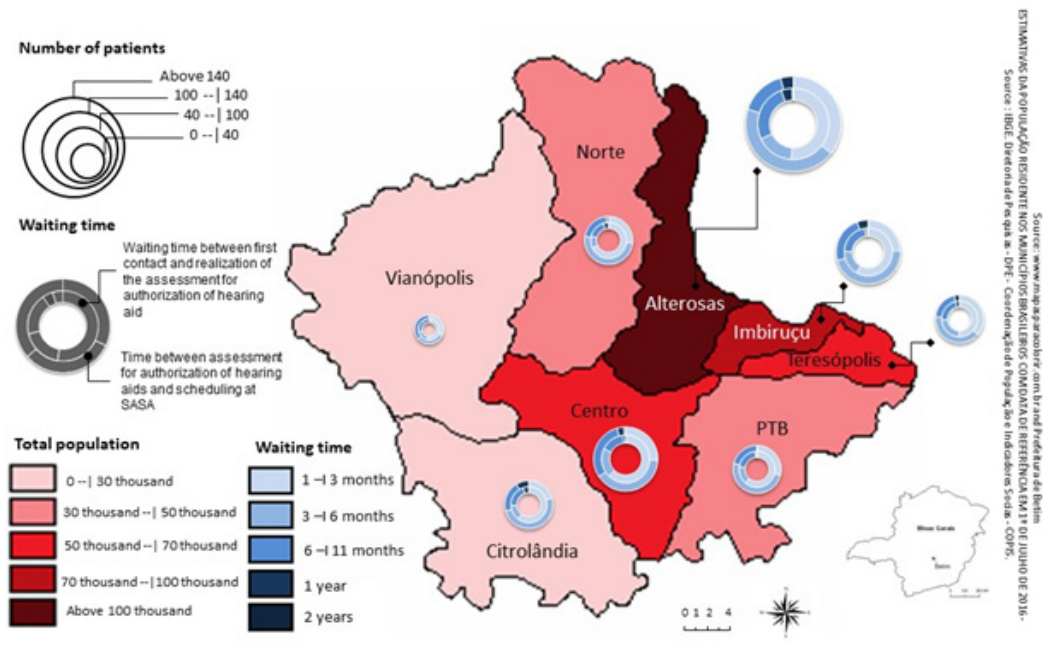


Figure 5. Waiting time between the first contact and the evaluation for authorization of the hearing aid concession and between the evaluation for authorization of the hearing aid concession and scheduling in SASA service at Betim, in observance of the region and population distribution of the municipality.

Discussion

The number of residents in Betim (94%) treated at JSAM and referred to SASA is significant in view of the number of users from other locations (6%). The population of the other six municipalities estimated for 2018 totalizes 70.236 inhabitants, which corresponds to approximately 20% of the total population (502.811 inhabitants) of the seven municipalities referred to JSAM. Thus, a greater number of individuals residing in Betim were expected to be treated at the service, however, in a smaller proportion than what was found.

The elderly population represents the higher percentage of users evaluated in the study which confirms the greater consumption of health services resulting from the greater number of diseases that affect this population⁸. It is also known that the probability of using the health services increases with age¹⁰. A study conducted in Brazil¹¹ found that hearing loss was self-reported by 30,4% of population of all ages and both sexes. However, it is noteworthy that some data may be underestimated,

since presbycusis presents a slow and gradual onset, being reported by the elderly only in more advanced stages of hearing loss¹¹.

The male gender represented the largest number of individuals in the sample, which did not corroborate a study that indicates that women are in greater demand for the health service^{10, 12, 13}. However, literature points out that the level of education influences health conditions and people with lower levels of education tend to fall ill more frequently¹⁴. The predominance of illiteracy and the lowest education level was attributed to the female sex¹⁴ who had predominantly domestic work as a labor activity years ago.

The higher prevalence of male individuals can also be associated with greater exposure to noise and leisure activities compared to females¹⁴. It is also known that workers in noisy environments report a greater auditory handicap the older their age¹⁶ and that the noise-induced hearing loss induced by high sound pressure levels (NIHL) may be due to prolonged exposure to noise. Therefore, a possible explanation may be the economic characteristic of the municipality with a strong industrial

vocation. Thus, if the elderly in the study were workers exposed to intense noise or engaged in leisure activities in places with high exposure to noise, the proportion found in the study is justified.

It is also noteworthy the higher percentage of female individuals in the less populated regions, Citrolândia e Vianópolis and with a greater predominance of elderly. This finding corroborates the fact that women live on average eight years longer than men¹⁷.

It is known that the industrial concentration of the municipality is located in the PTB region, which justifies a greater demographic density of the nearest regions and the greater number of individuals treated at the service. In comparison to the more distant and less populated regions, Vianópolis and Citrolândia, there was also a lower prevalence of male individuals treated at SASA.

The high prevalence of individuals with mild hearing loss in both ears of worse or better degree highlights the need for a public service aimed at preventing the increase in hearing loss such as through the provision of hearing aids¹⁸. The predominance between different degrees in the best and worst ear may be due to NIHL, one of the possible causes of hearing loss suggested in the study¹⁸.

There was a predominance of acquired hearing loss in the sample. It is known that presbycusis and NIHL are of acquired etiology, the first being a change in auditory acuity that occurs with the aging process and the second due to prolonged exposure to noise and of an irreversible character^{9,19}. Thus, the etiology of hearing loss can be associated with age and work performed by the users. Associated with acquired etiology, the reduced previous use of hearing aids in the study population can be justified by the greater prevalence of this type of loss in the population and the greater number of elderly individuals.

Previous use of hearing aids can be associated with low user access to SASA and the high value of the device for private purchase. According to the 2010 IBGE Census the per capita income of more than 50% of the population is up to one minimum wage and less than 20% has per capita income above two minimum wages²⁰. Considering the high monetary value of the hearing aid for private acquisition, it is clear that the device was not viable for the majority of the population before being granted by SUS. It is believed that social variations in the use of health services show that unfavorable

social conditions tend to reduce the possibilities of using the service²¹.

It is also observed that the highest prevalence of previous use of hearing aids occurs in regions with a higher percentage of male individuals attended at the service and close to the industrial center of the municipality. As workers who are exposed to noise need frequent hearing evaluation, the greater demand for the service and the higher prevalence of previous use of hearing aids in regions closer to the industrial regions can be associated with the early diagnosis of individuals. It is noteworthy that although the Citrolândia region has a prevalence of hereditary hearing loss there is no greater use of previous hearing aids in this region.

The low number of individuals who were in speech and language therapy at the assessment date for the grant of hearing aids can be related to the lack of clarification from the user regarding the process of adapting the hearing aids or difficulty of accessing the service¹¹. A study¹⁶ highlights the great demand for the speech and language therapy service due to the number of monthly hearing aid adaptations, which results in overcrowding of the service and the need of prioritization. Thus, the children have priority for speech and language therapy once they require the rehabilitation of oral language¹⁶.

Comparing the performance of speech and language therapy (Figure 4) with the age group of the public treated in each region (Figure 1 – left), it was noted that the Alterosas region had a higher proportion of individuals who underwent speech and language therapy and the higher prevalence of children treated at the service.

There was a predominance of waiting time between one to three months in T1 and three to six months in T2, regardless of the region where the user resides. It appears that regardless of the distance from the residence to the SASA service location, or the specificities of the municipality, the user is treated equally. It is verified that the waiting period is shorter than the time reported for the acquisition of other types of devices for rehabilitation²².

The present study demonstrates an advance in the data analysis of a hearing health service. It is worth mentioning that the geoprocessing technique enabled a more detailed observation of the service provided in the municipality with relevant informa-

tion to management, especially for the development of joint actions of specialized and basic care.

It is highlighted that research on the use of health services focuses on the demand present in the service, not considering people who do not seek the service, which compromises real knowledge at the population level⁽¹⁰⁾. Thus, it is essential to differentiate equity in health from equity in the use of health service since the determinants of inequalities in falling ill differ from inequalities in the consumption of health services²¹. In the study realized, there are data on people with hearing impairments who used the service and not on the entire population with hearing impairments in the seven municipalities referred for hearing assessment in Betim.

Conclusion

The user's distribution treated at JSAM Betim and referred to Hearing Health Care Services covered all regions of the main municipality of study, but there is still lack of service coverage in other locations that are part of the JSAM service. There are several factors that can influence such distribution, such as ease of access for the user and the total population of each municipality. It is necessary to investigate the factors that can contribute to the entry of all municipalities contemplated in the service.

As for the regional distribution of the sample and the proposed study axes, it was observed as to the sociodemographic aspects, referring to the age and sex, prevalence of the elderly population in the regions of Centro and Citrolândia and of women only in the regions of Vianópolis and Citrolândia. Regarding the characteristics of hearing loss, there was a predominance of acquired hearing loss in almost the entire city with the exception of Citrolândia, which has a higher prevalence of hereditary hearing loss.

Regarding the care aspects – referring to the previous use of hearing aids, speech and language therapy and waiting time for the assessment and concession of hearing aids – there was greater access by the population of regions closer to the Centro and the industrial center in terms of the first two aspects. There was no difference between the regions regarding the waiting time.

It is believed that this study serves as a work strategy for actions to promote hearing health in

the Family Health Care Centers of Betim, in the areas demonstrated in geoprocessing.

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