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Assistive technologies for visual and hearing impairments offered to medical students in Brazil

Tecnologias assistivas para deficiência visual e auditiva ofertadas aos estudantes de medicina no Brasil

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ABSTRACT

Introduction: Assistive technologies (AT) are products, equipment, devices, resources, methodologies and strategies that can be used in education to promote autonomous learning and academic success for students who have some type of disability.

Objective: The objective was to analyze the AT available in medical courses in Brazil to support medical students with hearing and/or visual impairment.

Methods: This is a descriptive study that used data from undergraduate medical courses participating in the Higher Education Census coordinated by Anísio Teixeira National Institute of Educational Studies and Research (Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira, INEP), in 2018. AT for students with hearing and/or visual impairment that were available in medical courses were evaluated considering the characteristics of the institution, such as the type of administration (public versus private), location (capital versus interior) and the year the course started (from the year 2000 versus before year 2000).

Results: In 2018, there were 323 active medical courses in Brazil. Most of them (90%) confirmed the offer of at least one type of AT. The discipline of Brazilian Sign Language (LIBRAS, Linguagem Brasileira de Sinais) was the most frequently offered AT (80%) and tactile material was the least offered AT (32%). There was greater comprehensiveness of AT supply for medical students in courses with a private administration, compared to the public ones. The location and the year the course started did not influence the provision of AT in Brazil. The courses showed better AT comprehensiveness to support students with hearing impairment than those with visual impairment.

Conclusion: Most medical courses supply AT for people with visual and/or hearing impairments who are medical students, but incompletely. Although the location of the course and the length of time that the course has been active did not influence AT provision, the study revealed inequalities. Medical students with visual and/or hearing impairments have access to assistive technologies especially in courses with private administration, adding more barriers to their financial possibilities, which are already sufficiently affected by the fact that they have to meet the essential needs common to people living with disabilities.

Keywords: Assistive Technologies; Person with Disability; Mainstreaming Education; Public Policy; Medical Students.

RESUMO

Introdução: *As tecnologias assistivas (TA) são produtos, equipamentos, dispositivos, recursos, metodologias e estratégias que podem ser usados na educação para promover o aprendizado com autonomia e o sucesso acadêmico de estudantes que têm algum tipo de deficiência.*

Objetivo: *O objetivo foi analisar as TA disponibilizadas nos cursos de medicina no Brasil para apoiar os estudantes com diminuição de audição e/ou visão.*

Métodos: *Este é um estudo descritivo que usou dados de cursos de graduação em medicina que participaram do Censo do Ensino Superior coordenado pelo Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep), em 2018. As TA para estudantes com deficiência auditiva e/ou visual que eram disponibilizadas nos cursos de medicina foram avaliadas considerando as características da instituição, como a categoria administrativa (pública versus privada), a localização (capital versus interior) e o ano de abertura do curso (a partir do ano 2000 versus antes do ano 2000).*

Resultados: *Em 2018, havia 323 cursos de medicina funcionando no Brasil. A maioria deles (90%) confirmou a oferta de pelo menos um tipo de TA. A disciplina de Língua Brasileira de Sinais foi a TA mais frequentemente ofertada (80%), e o material tátil foi a TA menos ofertada (32%). Houve maior completude de oferta de TA para estudantes de medicina nos cursos de administração privada quando se compararam aos públicos. A localização e o ano de abertura do curso não influenciaram a oferta de TA no Brasil. Os cursos apresentaram melhor completude de TA para apoiar estudantes com deficiência auditiva do que com deficiência visual.*

Conclusão: *A maioria dos cursos de medicina oferta TA para os estudantes com deficiência visual e/ou auditiva, mas de modo incompleto. Apesar de a localização do curso e o tempo em que ele está em funcionamento não terem influenciado a oferta, o estudo revelou desigualdades. Estudantes de medicina com deficiência visual e/ou auditiva encontram TA sobretudo nos cursos de administração privada, adicionando mais barreiras às suas possibilidades financeiras, que já são suficientemente comprometidas pelo fato de terem que suprir as necessidades essenciais comuns às pessoas vivendo com deficiência.*

Palavras-chave: *Tecnologia Assistiva; Pessoas com Deficiência; Inclusão Escolar; Política Pública; Estudantes de Medicina.*

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INTRODUCTION

Assistive technologies (AT) are products, equipment, devices, resources, methodologies, strategies, practices and services used to promote functionality and increase autonomy, independence, quality of life and social inclusion of people with disabilities (PWD)[1]. The use of AT in education is essential for the development and academic success of students who are PWD, particularly in relation to meeting their needs in the school environment and promoting empowerment and equal opportunities[2].

Health professionals have little training to address health issues of PWD[3]. For Meeks et. al.[3], AT are important to remove the barriers that challenge the training of more experienced doctors in this field, who know more intimately the difficulties faced by PWD and who have a greater understanding of social and biomedical problems related to disabilities.

In Brazil, several inclusive public policies have been developed for PWD, increasing access to regular education and providing a beneficial effect of increasing the number of PWD in higher education[4]. In the United States, considering only medical students, there was a 2.7% to 4.9% increase in PWD students enrolled in US medical schools from 2016 to 2019[5]. The growth trend in PWD enrollment in medical schools is a scenario that demands adaptation of educational institutions to the needs of the students.

Regarding physicians with disabilities, a national campaign conducted by the Federal Council of Medicine (CFM, *Conselho Federal de Medicina*) sought to estimate their number and establish the need for adjustments to the work environment[6]. In the first five months, the institution received 247 records and the physicians stated they had hearing impairment (18%), visual impairment (17%), and some did not specify the type (11%), whereas 23% of the total number reported that the disability was of congenital origin[6].

Physicians who are PWD can influence the quality of care for other PWD, who are also patients, not only by experiencing and understanding the problems and barriers faced by both[7] but, above all, by symbolizing the reality of these people, which can therefore be experienced by their colleagues[8]. However, there is little information on the provision and comprehensiveness of medical courses regarding the supply of technical help to medical students who have some type of disability in Brazil. To increase the understanding of the scenario that involves the training of physicians who are PWD, the present study aimed to analyze the AT supply to support medical students with hearing and/or visual impairment available in medical courses in Brazil.

METHODS

This is a descriptive study that used data from the Higher Education Census in Brazil, which are managed by Anísio Teixeira National Institute of Educational Studies and Research (*Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*, INEP)[9], a federal agency linked to the Ministry of Education. The microdata used in the study can be obtained via web by consulting the Inep website (https://www.gov.br/inep/pt-br), following <*Pesquisas, Estatísticas e Indicadores Educacionais*> (Research, Statistics and Educational Indicators), <*Censo da Educação Superior*> (Higher Education Census), <*Resultados*> (Results) and <*Microdados*> (microdata). In the icon '*Orientações*' (guidelines), in the same electronic address, Inep provides the questionnaires related to each of the investigation modules (Higher Education Institution – HEI, Student, Course and Teacher) and data collection used in the HEI, detailing the variables that comprise the Higher Education Census System (Censup, *Censo da Educação Superior*) and other information concerning the data collection process.

The AT offered by the courses are routinely evaluated through an annual consultation made by INEP to all Higher Education Institutions (HEIs) in Brazil, based on the collection of data from the Higher Education Census, in the course module. The present study focused on assistive technologies that aim to increase the autonomy, independence and inclusion of people with disabilities, particularly those with visual and/or hearing impairment, as specified in the Inep manual[10] and detailed below:

- *AT aimed at people with visual impairment, as specified by Inep:*
    1. Accessible digital teaching material (meaning material with audio reproduction and synchronization of selected excerpts that allow reading through enlarged characters, annotations and export for printing in Braille).
    2. Didatic material in printed format using enlarged characters (meaning printed material with characters larger than usual).
    3. Tactile pedagogical material (these are pedagogical resources that allow or facilitate the learning for people with visual impairment).
    4. Didactic material in accessible printed format (meaning material prepared using certain characteristics such as font, body, number of characters, space between the lines, space between words, letters, colors, type of paper and illustrations that promote autonomy for people with low visual capacity).
    5. Audio material (meaning material recorded using a human voice that allow blind or low visual capacity individuals to access various contents).

6. Material in Braille (material prepared using the Braille System that allows reading and writing of contents).

- *AT aimed at people with sensory hearing loss:*
  1. Teaching material in Brazilian Sign Language (material produced using the Brazilian Sign Language (LIBRAS -– *Linguagem Brasileira de Sinais*) aimed at teaching the deaf)
  2. Inclusion of the Brazilian Sign Language subject in the course (Brazilian Sign Language subject offered to the students of the course).
  3. Translator and interpreter of the Brazilian Sign Language (offer of a professional specialized in translating, interpreting and transmitting information between deaf and normal-hearing people).

- *AT aimed at people with sensory hearing and/or visual impairment:*

1. Guide-interpreter (professional trained in forms of communication used by people with deafblindness, who can interpret or transliterate).
2. Communication accessibility resources (these are resources that eliminate barriers in the communication of people with disabilities, regardless of the limitation, increasing access to the content, to the presentation of information and therefore to knowledge).
3. Accessible computer resources (these are resources that allow adaptations and increased interaction with computer use).

Data collection and variables of interest

Data collection focused on information from the course module, corresponding to the year 2018, which was available online, selecting only the courses identified by Inep as 'MEDICAL COURSE'. In addition to information on assistive technologies, data were collected on the HEI type of administration (public *versus* private), place where the course was offered (capital or interior) and year when the course started (from the year 2000 and before the year 2000).

The comprehensiveness of the ATs supply was investigated considering the type of sensory impairment that the ATs is intended for (for visual impairment, for hearing impairment, and for both) and the number of AT offered (all, at least one, none).

Data analysis

The study included a descriptive analysis and presentation of absolute and relative frequencies. Statistical analysis was performed by comparing proportions and applying the chi-square statistical test, considering an alpha error of 5%.

Ethical aspects

The study follows the recommendations for research involving human beings and was conducted with data publicly available via web, without any identification of the research subjects. The protocol was approved by the Research Ethics Committee of the Higher Education Institution that hosted the study, under Opinion n. 3,490,540, dated of 08/07/2019.

RESULTS

The Higher Education Census synthesized data from 323 medical courses offered in Brazil, in 2018. Most of them were from the Southeast region (41.80%) followed by the Northeast (24.15%), South (17.03%), Midwest (8.67%) and North (8.36%) regions. Most courses confirmed the provision of technologies for students with disabilities (yes: 90.09% *versus* no: 9.91%). The AT that was most frequently (261/323) offered in medical courses was 'the 'Libras' subject in (80.80% *versus* 19.20%) and the least offered one (106/323) was 'tactile material' (32.82% *versus* 67.18%).

When analyzing the frequency of courses that offer AT (n=291) per Federation Unit, 19.00% (55/291) are located in São Paulo, 15.50% (45/291) in Minas Gerais; 6.5% (19/252) of them are located equally in the states of Bahia, Rio de Janeiro, Paraná and Rio Grande do Sul, with the remainder distributed in smaller proportions in the other Federative Units. The states of Acre, Rio Grande do Norte and Santa Catarina make all AT available in more than 50% of their medical courses. Figure 1 summarizes the provision of AT in medical courses according to the Federative Unit.

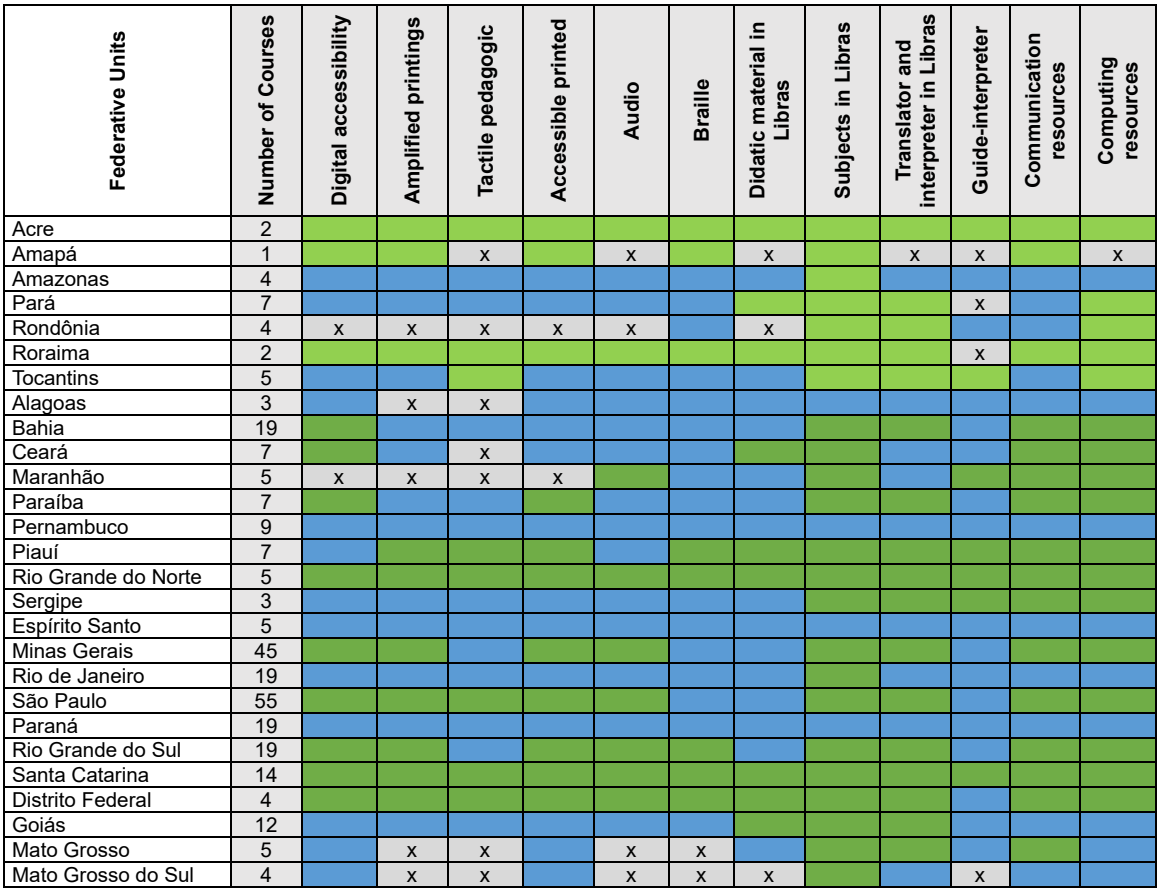
In Brazil as a whole, the frequency of AT supply was higher in private courses compared to public ones, with a statistically significant difference in the four different sets of comprehensiveness of AT supply analyzed. The worst scenario was the lack of technologies for visual impairment only in almost 50% of public courses in the country. The comparison of the frequencies of AT supply by macroregion reproduces the pattern of lack of supply prevalent in public courses (Table 1).

The location of the course in the capital or in the interior of the state did not influence the offer of ATs in the country. Exceptions were found only in the Southeast Region (all AT) and in the Midwest Region (AT for visual impairment) (Table 2).

The most recent authorization (from the year 2000) for the beginning of a medical course operation, compared to the

older courses, showed no association regarding the provision of AT in Brazil and in the North and Midwest regions. However, in the Northeast and Southeast, the proportion of older courses (before the year 2000) that do not offer any AT to support both visual and hearing impairment was twice that found in newer courses (Table 3).

Figure 1. Distribution of the provision of assistive technologies in medical courses, per Federation Unit, according to data from the Higher Education Census, 2018.



Source: Created by the authors based on data from the Higher Education Census, Inep, 2018.

Table 1. Distribution of assistive technologies in public and private medical courses, in Brazil and in the macroregions, 2018.

	Brazil		North		Northeast		Southeast		South		Midwest	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	128 (39.6)	**195 (60.4)**	**14 (51.8)**	**13 (48.2)**	**41 (52.6)**	**37 (47.4)**	**36 (26.7)**	**99 (73.3)**	**19 (34.5)**	**36 (65.5)**	**18 (64.3)**	**10 (35.7)**
AT[a] (all)												
all	14 (10.9)	36 (18.5)	0 (0.0)	1 (7.7)	5 (12.2)	2 (5.4)	4 (11.1)	22 (22.2)	2 (10.5)	9 (25.0)	3 (16.7)	2 (20.0)
some	92 (71.9)	149 (76.4)	12 (85.7)	12 (92.3)	25 (61.0)	33 (89.2)	26 (72.2)	72 (72.7)	17 (89.5)	24 (66.7)	12 (66.6)	8 (80.0)
none	22 (17.2)	10 (5.1)	2 (14.3)	0 (0.0)	11 (26.8)	2 (5.4)	6 (16.7)	5 (5.1)	0 (0.0)	3 (8.3)	3 (16.7)	0 (0.0)
p value[b]	< 0.001		0.226		0.014		0.048		0.153		0.393	
AT[a] (visual impairment))												
all	26 (20.3)	46 (23.6)	1 (7.1)	1 (7.7)	6 (14.6)	4 (10.8)	10 (27.8)	27 (27.3)	6 (31.6)	12 (33.3)	3 (16.7)	2 (20.0)
some	39 (30.5)	101 (51.8)	4 (28.6)	8 (61.5)	16 (39.0)	22 (59.5)	11 (30.6)	49 (49.5)	8 (42.1)	18 (50.0)	0 (0.0)	4 (40.0)
none	63 (49.2)	48 (24.6)	9 (64.3)	4 (30.8)	19 (46.3)	11 (29.7)	15 (41.6)	23 (23.2)	5 (26.3)	6 (16.7)	15 (83.3)	4 (40.0)
p value[b]	< 0.001		0.199		0.193		0.069		0.685		0.011	

Continue...

Table 1. (Continuaton) Distribution of assistive technologies in public and private medical courses, in Brazil and in the macroregions, 2018.

	Brazil		North		Northeast		Southeast		South		Midwest	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	128 (39.6)	**195 (60.4)**	**14 (51.8)**	**13 (48.2)**	**41 (52.6)**	**37 (47.4)**	**36 (26.7)**	**99 (73.3)**	**19 (34.5)**	**36 (65.5)**	**18 (64.3)**	**10 (35.7)**
AT[a] (hearing impairment)												
all	35 (27.3)	73 (37.4)	4 (28.6)	2 (15.4)	9 (21.9)	11 (29.7)	9 (25.0)	40 (40.4)	7 (36.8)	17 (47.2)	6 (33.3)	3 (30.0)
some	64 (50.0)	107 (54.9)	8 (57.1)	11 (84.2)	19 (46.3)	23 (62.2)	18 (50.0)	51 (51.5)	10 (52.6)	15 (41.7)	9 (50.0)	7 (70.0)
none	29 (22.7)	15 (7.7)	2 (14.3)	0 (0.)	13 (31.7)	3 (8.1)	9 (25.0)	8 (8.1)	2 (10.5)	4 (11.1)	3 (16.7)	0 (0.0)
p value[b]	< 0.001		0.211		0.036		0.020		0.726		0.343	
AT[a] (both)												
all	26 (20.3)	75 (38.5)	0 (0.0)	3 (23.1)	13 (31.7)	10 (27.0)	8 (22.2)	39 (39.4)	2 (10.5)	21 (58.3)	3 (16.7)	2 (20.0)
some	44 (34.4)	94 (48.2)	8 (57.1)	9 (69.2)	5 (12.2)	23 (62.2)	14 (38.9)	47 (47.5)	14 (73.7)	9 (25.0)	3 (16.7)	6 (60.0)
none	58 (45.3)	26 (13.3)	6 (42.9)	1 (7.7)	23 (56.1)	4 (10.8)	14 (38.9)	13 (13.1)	3 (15.8)	6 (16.7)	12 (66.6)	2 (20.0)
p value[b]	< 0.001		0.036		< 0.001		0.003		< 0.001		0.036	

[a] Assistive technologies. [b] Chi-square test and 5% alpha error
Source: Created by the authors based on data from the Higher Education Census, Inep, 2018.

Table 2. Distribution of assistive technologies in medical courses in the capitals and interior, in Brazil and in the macroregions, 2018.

	Brazil		North		Northeast		Southeast		South		Midwest	
	Capital	Interior	Capital	Interior	Capital	Interior	Capital	Interior	Capital	Interior	Capital	Interior
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	98 (30.3)	**225 (69.7)**	**18 (66.7)**	**9 (33.3)**	**32 (41.0)**	**46 (59.0)**	**27 (20.0)**	**108 (80.0)**	**9 (16.4)**	**46 (83.6)**	**12 (42.9)**	**16 (57.1)**
AT[a] (all)												
all	10 (10.2)	40 (17.8)	1 (5.6)	0 (0.0)	4 (12.5)	3 (6.5)	2 (7.4)	24 (22.2)	0 (0.0)	11 (23.9)	3 (25.0)	2 (12.5)
some	75 (76.5)	166 (73.8)	15 (83.3)	9 (100.0)	24 (75.0)	34 (73.9)	20 (74.1)	78 (72.2)	9 (100.0)	32 (69.6)	7 (58.3)	13 (81.3)
none	13 (13.3)	19 (8.4)	2 (11.1)	0 (0.0)	4 (12.5)	9 (19.6)	5 (18.5)	6 (5.6)	0 (0.0)	3 (6.5)	2 (16.7)	1 (6.2)
p value[b]	0.122		0.430		0.516		0.031		0.159		0.406	
AT[a] (visual impairment)												
all	15 (15.3)	57 (25.3)	2 (11.1)	0 (0.0)	4 (12.5)	6 (13.0)	4 (14.8)	33 (30.6)	2 (22.2)	16 (34.8)	3 (25.0)	2 (12.5)
some	45 (45.9)	95 (42.2)	8 (44.4)	4 (44.4)	16 (50.0)	22 (47.8)	13 (48.2)	47 (43.5)	4 (44.4)	22 (47.8)	4 (33.3)	0 (0.0)
none	38 (38.8	73 (32.4)	8 (44.4)	5 (55.6)	12 (37.5)	18 (39.1)	10 (37.0)	28 (25.9)	3 (33.3)	8 (17.4)	5 (41.7)	14 (87.5)
p value[b]	0.129		0.561		0.982		0.222		0.512		0.017	
AT[a] (hearing impairment)												
all	27 (27.6)	81 (36.0)	3 (16.7)	3 (33.3)	11 (34.4)	9 (19.6)	6 (22.2)	43 (39.8)	3 (33.3)	21 (45.7)	4 (33.3)	5 (31.2)
some	55 (56.1)	116 (51.6)	13 (72.2)	6 (66.7)	15 (46.9)	27 (58.7)	15 (55.6)	54 (50.0)	6 (66.7)	19 (41.3)	6 (50.0)	10 (62.5)
none	16 (16.3)	28 (12.4)	2 (11.1)	0 (0.0)	6 (18.7)	10 (21.7)	6 (22.2)	11 (10.2)	0 (0.0)	6 (13.0)	2 (16.7)	1 (6.3)
p value[b]	0.289		0.411		0.335		0.107		0.286		0.640	
AT[a] (both)												
all	27 (27.6)	74 (32.9)	2 (11.1)	1 (11.1)	11 (34.4)	12 (26.1)	8 (29.6)	39 (36.1)	3 (33.3)	20 (43.5)	3 (25.0)	2 (12.5)
some	42 (42.9)	96 (42.7)	11 (61.1)	6 (66.7)	10 (31.2)	18 (39.1)	11 (40.7)	50 (46.3)	5 (55.6)	18 (39.1)	5 (41.7)	4 (25.0)
none	29 (29.6)	55 (24.4)	5 (27.8)	2 (22.2)	11 34.4)	16 (34.8)	8 (29.6)	19 (17.6)	1 (11.1)	8 (17.4)	4 (33.3)	10 (62.5)
p value[b]	0.517		0.950		0.681		0.372		0.653		0.307	

[a] Assistive technologies. [b] Chi-square test and 5% alpha error.
Source: Created by the authors based on data from the Higher Education Census, Inep, 2018.

Table 3. Distribution of assistive technologies in medical courses that started their operations before and after the year 2000, in Brazil and in the macroregions, 2018.

	Brazil		North		Northeast		Southeast		South		Midwest	
	New	Old	New	Old	New	Old	New	Old	New	Old	New	Old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	222 (69.8)	**96 (30.2)**	**19 (79.2)**	**5 (20.8)**	**64 (82.1)**	**14 (17.9)**	**82 (61.7)**	**51 (38.3)**	**34 (61.8)**	**21 (38.2)**	**23 (82.1)**	**5 (17.9)**
AT[a] (all)												
all	32 (14.4)	17 (17.7)	1 (5.3)	0 (0.0)	5 (7.8)	2 (14.3)	18 (21.9)	7 (13.7)	5 (14.7)	6 (28.6)	3 (13.0)	2 (40.0)
some	168 (75.7)	69 (71.9)	16 (84.2)	5 (100.0)	50 (78.1)	8 (57.1)	59 (71.9)	38 (74.5)	26 (76.5)	15 (71.4)	17 (73.9)	3 (60.0)
none	22 (9.9)	10 (10.4)	2 (10.5)	0 (0.0)	9 (14.1)	4 (28.6)	5 (6.1)	6 (11.8)	3 (8.8)	0 (0.0)	3 (13.0)	0 (0.0)
p value[b]	0.733		0.636		0.263		0.304		0.207		0.296	
AT[a] (visual impairment)												
all	43 (19.4)	28 (29.2)	1 (5.2)	1 (20.0)	8 (12.5)	2 (14.3)	24 (29.3)	12 (23.5)	7 (20.6)	11 (52.4)	3 (13.0)	2 (40.0)
some	105 (47.3)	33 (34.4)	9 (47.4)	2 (40.0)	33 (51.6)	5 (35.7)	40 (48.8)	19 (37.3)	20 (58.8)	6 (28.6)	3 (13.0)	1 (20.0)
none	74 (33.3)	35 (36.5)	9 (47.4)	2 (40.0)	23 (35.9)	7 (50.0)	18 (21.9)	20 (39.2)	7 (20.6)	4 (19.0)	17 (73.9)	2 (40.0)
p value[b]	0.059		0.569		0.545		0.1		0.038		0.285	
AT[a] (hearing impairment)												
all	73 (32.9)	33 (34.4)	3 (15.8)	2 (40.0)	16 (25.0)	4 (28.6)	33 (40.2)	15 (29.4)	14 (41.2)	10 (47.6)	7 (30.4)	2 (40.0)
some	120 (54.1)	48 (50.0)	14 (73.7)	3 (60.0)	37 (57.8)	5 (35.7)	41 (50.0)	27 (52.9)	15 (44.1)	10 (47.6)	13 (56.5)	3 (60.0)
none	29 (13.1)	15 (15.6)	2 (10.5)	0 (0.0)	11 (17.2)	5 (35.7)	8 (9.8)	9 (17.7)	5 (14.7)	1 (4.8)	3 (13.0)	0 (0.0)
p value[b]	0.751		0.418		0.220		0.271		0.512		0.677	
AT[a] (both)												
all	71 (32.0)	29 (30.2)	2 (10.5)	1 (20.0)	18 (28.1)	5 (35.7)	35 (42.7)	11 (21.6)	13 (38.2)	10 (47.6)	3 (13.0)	2 (40.0)
some	99 (44.6)	37 (38.5)	13 (68.4)	3 (60.0)	28 (43.8)	0 (0.0)	35 (42.7)	25 (49.0)	15 (44.1)	8 (38.1)	8 (34.8)	1 (20.0)
none	52 (23.4)	30 (31.2)	4 (21.1)	1 (20.0)	18 (28.1)	9 (64.3)	12 (14.6)	15 (29.4)	6 (17.7)	3 (14.3)	12 (52.2	2 (40.0)
p value[b]	0.327		0.848		0.004		0.021		0.788		0.354	

[a] Assistive technologies. [b] Chi-square test and 5% alpha error.
Source: Created by the authors based on data from the Higher Education Census, Inep, 2018.

DISCUSSION

This study focused on AT used in higher education in Brazil and showed that most medical courses supply AT for people with visual and/or hearing impairments who attend these courses in the country. Although the location and time since the beginning of the course operation did not influence the provision of AT, the study revealed some inequalities. Medical students with visual and/or hearing impairment find support AT especially in the private courses, adding more barriers to their financial possibilities, which are already sufficiently affected by the fact that they have to meet the essential needs common to people living with disabilities.

The predominance of AT in private medical schools raises the suspicion that the same may be being experienced in other higher education courses in the country. In fact, the findings that were found in medical courses reinforces the scenario of exclusion experienced by PWD and has implications for the gains that PWD could attain with the affirmative policies that have been implemented in Brazil. A global analysis of data from 2018 showed that the number of students with disabilities enrolled in private HEI was almost two-fold those who studied in public HEI in Brazil[11]. This picture constitutes an environment of inequality that penalizes students with disabilities, who in addition to having to overcome, throughout their lifetime, several factors that limit access to higher education, add financial commitments that need to be paid for in order to acquire professional training. Considering this context of difficulties, education loses part of its democratizing and inclusive function, since the existence of obstacles, such as obtaining funds to pay for tuition is not a simple option but almost an obligation for these people.

In light of the ATs evaluated by Inep, the states of Santa Catarina, Rio Grande do Norte, and Acre show greater supply wholeness, since all the different AT are present in more than 50% of the courses in these Federative Units. Overall, the courses seem better equipped to accommodate students with reduced hearing or deafness than those with reduced vision or blindness. In India, an analysis involving 250 students and investigating 42 different types of AT to improve vision showed that sound/touch-based technologies (talking watch, Braille

typewriter, audio format) and vision-based technologies (optical magnifiers, electronic magnifiers, large keyboard for computer) were the ones most often requested by the students[12]. The most common access barriers found in India were the lack of availability of AT in schools and the lack of financial resources to purchase AT by the students themselves.

The AT from information and communication technology groups are the most sophisticated ones and continue to evolve rapidly[13]. This group includes hardware and software, modified keyboards, special monitors, Braille printers and Braille lines[13]. Although they are AT that facilitate the simultaneous digital inclusion of students who have visual and/or hearing impairments, their distribution in public medical schools in Brazil is far from meeting academic needs and adapting to affirmative inclusion policies for PWD.

A survey carried out in public schools in São Paulo showed that some teachers do not use technologies that can be used by students with visual impairment, despite of them stating that such tools are essential in schools[14]. Several reasons are mentioned for not using these resources, such as the lack of preparation for the management of AT in the regular course program, the absence of more specific programs for students with visual impairment, the lack of information aimed at teachers and students about available AT in the courses, in addition to the disbelief of PWD with visual impairment about their own ability to use such resources. In the educational environment, living with human diversity is a reality. If the focus is the inclusive education, with the teacher playing the central role of mediator of the teaching-learning process, it is necessary to remove pedagogical barriers[15]. In this context, the technical training of teachers and the promotion of attitudinal accessibility are fundamental and characterized by the elimination of prejudices, stigmas, stereotypes and discrimination[16].

Although medical courses in Brazil seem to be more adapted to welcome students with reduced hearing or deafness, these people demand even more attention when entering the clinical phase of the course. Authors warn that the acts of listening to the sounds of the heart, lungs, intestines, as well as verbal communication with the use of surgical masks and over the phone are part of this stage of training and constitute challenges to be overcome by these students[17]. They add that common environmental noises can make communication with clinicians, residents, interns and, especially with patients, difficult. Bearing in mind that these students have their rights guaranteed by law[1], these needs must be duly met by the managers of medical education in Brazil.

The degree of comprehensiveness of medical courses to welcome students with disabilities should be public and easily known to all interested parties. That, in addition to facilitating choices, would give the student the right to confidentiality about personal issues that may determine future directions in the teaching-learning process, and above all, would keep the focus on what the courses supply and not on the characteristics of individuals with disabilities, who would be spared from making personal disclosures prematurely. The need to establish a relationship of professionalism and impersonality between students with disabilities and the HEI is highlighted[18]. Such guidelines help to prevent the embarrassment of intruding on the student's personal life and to keep the focus on their academic needs. It is also reinforced that it is exclusively up to the student to choose what they want to reveal about their disability, and it is recommended that they explain only the demands aimed at accessibility itself. The idea is to avoid comments and attempts at unnecessary interventions based on the type of disability and to provide the student exclusively with what they need[18].

AT in medical courses can favor the training of physicians who have some type of disability and are, due to their condition, more prepared to sensibilize their peers, professionally, within the academic environment, as well as to assist patients who are PWD and require care. According to the Brazilian Institute of Geography and Statistics[19] (IBGE, *Instituto Brasileiro de Geografia e Estatística*) an important part of the Brazilian population needs health professionals who are sensitive to their needs. The demographic census data reviewed in 2018 showed that about 6.7% (12,748,663) of the people living in the country have some type of disability. This information allowed observing the proportion of PWD and categorizing the types of disability in the national population: hearing impairment (1.1%), visual impairment (3.4%), motor impairment (2.3%) and mental impairment (1.4%), which allows a better knowledge for the expansion and improvement of services, institutional actions and adequacy of resources. In Canada, for example, 13.1% of young individuals aged between 15 and 24 reported some type of disability in 2017[20]. These Canadian statistics emphasize the importance of knowing the profile of PWD needs, aiming to provide accommodations and favor the transition of these young individuals from high school to higher education or directly to the labor market.

This study has the merit of evaluating the supply of AT in medical courses in Brazil. It is worth mentioning that the training of physicians representing people with disabilities, and, consequently, better prepared to fight for and deal with the process of inclusion, guarantee of rights and reduction of discrimination, is of the utmost importance for the academic and care environment. However, the topic is still little explored in the country.

The challenges for the inclusion of PWD in higher education demand effective and urgent confrontation and solutions. The present study allowed estimating that almost 10% of medical courses do not offer any of the assistive technologies monitored by Inep. It is also clear that in Brazil the curricular contents of medical courses are transdisciplinary, covering human sciences, exact sciences and health sciences[21], constituting a context of complexity for the adaptation and provision of educational needs aimed at PWD. Notwithstanding what the National Curriculum Guidelines (NCG)[21] say about the training of physicians prepared to deal with PWD, educational strategies for this purpose were considered insufficiently mentioned in the pedagogical projects of 89 courses that made their pedagogical projects publicly accessible via the internet, among the 320 existing medical courses in Brazil[22]. That is, regardless of the curricular model, whether 'competence-based', 'problem-based', 'traditional', etc., the course pedagogical project needs to recognize that the medical school has a commitment with PWD and that the student who has a disability is a reality present in the student body, requiring ways of inclusion/integration, as well as the preparation of the environment, but above all, of the teachers.

The effort must be based on meeting the individual needs of each student, who can never be seen as incapable, but only requiring adaptations that put them under the same conditions as the other students. Such an example was experienced at the Faculty of Medicine of Itajubá[23]. The adaptation covered the discipline of histology, adopted some specific technologies and met the needs of a student with congenital dyschromatopsia (color blindness), who could not correctly differentiate the shades of purple and pink, common in the discipline practices. The Association of American Medical Colleges (AAMC) highlights that the color combinations that a colorblind person has the most difficulty to differentiate are red/green, followed by blue/green and blue/yellow, and it is necessary to identify the problem early to prevent errors caused by poor color perception.

This study has some limitations. Although the Inep investment to guarantee that the quality of the census data is high, some inconsistencies may have influenced our results. Such is the case of the under- or overestimation of measures as a result of administratively collected data, without the intention of research. It is also important to acknowledge that the quality of the data collection process from the school and their report to Inep to feed the census platform depends on the commitment and involvement of the people responsible for carrying out the work at the HEI. However, Inep has invested in the quality of the provided information and reports on methodologies to deal with the Census have been published and show the commitment of institutional researchers to the Higher Education Census in Brazil[24]. The workflow includes the offer of training at Inep headquarters for the enrolled institutional researcher who performs the local and decentralized data collection. Finally, it is also worth noting that the fact that the HEI informs that it has AT does not mean that the technology is really accessible to the student who needs it. Bearing these limitations in mind, we believe that the study discloses a profile of possibilities for AT provision by medical courses and, therefore, making possible a judgment on the part of students with disabilities who manage to break through barriers and attend a medical school in Brazil.

CONCLUSION

Assistive technologies are offered in most medical courses in Brazil, but in an incomplete and unequal way. Private courses are better equipped than public courses, especially regarding the provision of AT that are simultaneously used by students with hearing impairment, as well as by those with visual impairment. Despite the legal apparatus supporting PWD, the fact that assistive technologies are more frequently found in private medical schools imposes an additional burden on students who, because they are PWD, have certainly invested a large part of their resources to reach higher education and will need to continue investing to become physicians.

AUTHORS' CONTRIBUTION

The authors contributed equally to the phases of study design, analysis and interpretation of results and the writing of the manuscript. The authors are responsible for the study content and have approved the final version that has been submitted for publication.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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