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Carneiro JB, Silva FNS, Luzia FJM, Oliveira PMP, Galindo Neto NM, Barros LM, et al.
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Rev Gaúcha Enferm. 2026;47:e20250363.
<https://doi.org/10.1590/1983-1447.2026.20250363.en>

Knowledge of deaf people about blood donation before and after an educational intervention

Conhecimento de surdos sobre doação de sangue antes e após intervenção educativa

Conocimientos de las personas sordas sobre la donación de sangre antes y después de la intervención educativa

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How to cite this article:

Carneiro JB, Silva FNS, Luzia FJM, Oliveira PMP, Galindo Neto NM, Barros LM, et al.
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ABSTRACT

Objective: To assess the knowledge of deaf people about blood donation, before and after the application of an accessible educational video in Libras ((Brazilian Sign Language).

Method: A quasi-experimental study, conducted with 32 deaf individuals in two public institutions located in one of the states of Northeast Brazil, between June 2023 and March 2024. The data collection instrument consisted of ten questions about blood donation organized in increasing order of complexity. It was administered at three different time points: pre-test, applied before the intervention; immediate post-test, applied immediately after the

intervention; and delayed post-test, applied 15 days later. Data analysis was performed using McNemar and Wilcoxon tests, considering differences significant by $p \leq 0.05$.

Results: A statistically significant difference was identified in the comparison of correct responses between the immediate post-test and the pre-test in three questions: appropriate moment to encourage potential donors ($p=0.039$), weight and age criteria for blood donation ($p=0.013$), and types of blood donation ($p=0.012$). Participants' knowledge improved significantly immediately after the intervention ($p=0.010$).

Conclusion: The educational video enabled deaf participants to acquire information about blood donation immediately after the educational intervention; however, this knowledge was not maintained after 15 days.

Descriptors: Self-help devices; Instructional film and video; Blood donation; Persons with hearing disabilities.

RESUMO

Objetivo: Avaliar o conhecimento de surdos sobre doação de sangue, antes e após a aplicação de vídeo educativo acessível em Libras.

Método: Estudo quase-experimental, realizado com 32 surdos em duas instituições públicas localizadas em um dos estados do Nordeste brasileiro, entre junho de 2023 a março de 2024. O instrumento de coleta de dados foi composto por dez perguntas sobre doação de sangue organizadas em ordem crescente de complexidade. O instrumento foi aplicado em três momentos distintos: pré-teste, aplicado antes da intervenção; pós-teste imediato, aplicado imediatamente após a intervenção; e pós-teste tardio, aplicado 15 dias após. A análise dos dados foi realizada com testes de McNemar e Wilcoxon, considerando-se diferenças significativas por $p \leq 0,05$.

Resultados: Identificou-se diferença estatisticamente significativa na comparação do índice de acertos no pós-teste imediato em comparação com o pré-teste em três questões: momento para sensibilização do possível doador ($p=0,039$), critérios de peso e idade para ser doador ($p=0,013$), e tipos de doação de sangue ($p=0,012$). O conhecimento dos participantes foi significativamente melhor imediatamente após a intervenção ($p=0,010$).

Conclusão: O vídeo educativo possibilitou a aquisição de informações dos surdos sobre doação de sangue imediatamente após a intervenção educativa, mas não se manteve após 15 dias.

Descritores: Tecnologia assistiva; Filme e vídeo educativo; Doação de sangue; Pessoas com deficiência auditiva.

RESUMEN

Objetivo: Evaluar el conocimiento de las personas sordas sobre la donación de sangre, antes y después de la aplicación de un video educativo accesible en Libras.

Método: Estudio cuasiexperimental realizado con 32 personas sordas en dos instituciones públicas ubicadas en uno de los estados del noreste de Brasil, entre junio de 2023 y marzo de 2024. El instrumento de recolección de datos estuvo compuesto por diez preguntas sobre donación de sangre organizadas en orden creciente de complejidad. Se aplicó en tres momentos: preprueba (antes de la intervención), posprueba inmediata (inmediatamente después) y posprueba tardía (15 días después). El análisis de los datos se realizó mediante las pruebas de McNemar y Wilcoxon, considerando diferencias significativas por $p \leq 0,05$.

Resultados: Se observó diferencia estadísticamente significativa entre la preprueba y la posprueba inmediata en tres preguntas: momento para sensibilizar al posible donante ($p=0,039$), criterios de peso y edad para donar ($p=0,013$) y tipos de donación de sangre ($p=0,012$). Los conocimientos de los participantes mejoraron significativamente inmediatamente después de la intervención ($p=0,010$).

Conclusión: El video educativo favoreció la adquisición de información sobre donación de sangre inmediatamente después de la intervención, pero este conocimiento no se mantuvo tras 15 días.

Descriptores: Dispositivos de autoayuda; Película y video educativos; Donación de sangre; Personas con deficiencia auditiva.

INTRODUCTION

Blood donation in Brazil is a voluntary, altruistic act that is fundamental to maintaining blood component inventories, an essential practice in public health care. The blood donation facilitates complex medical procedures, supports patients undergoing treatment for chronic diseases, enables surgical interventions and emergency care, and assists in situations involving significant blood loss⁽¹⁾.

Despite its well-recognized importance, only 1.6% of the Brazilian population donates blood regularly. This rate is below the 3% recommended by the World Health Organization (WHO), highlighting the ongoing need for strategies aimed at raising awareness and promoting social mobilization⁽²⁾. Thus, health education actions are important tools for disseminating information about blood donation, contributing to raising awareness among the population about its relevance⁽³⁾.

These initiatives must be accessible to reach the largest possible number of potential donors, including groups that are not usually targeted by conventional approaches for disseminating health information. Among these groups, the deaf population stands out, as it requires educational strategies appropriate to its teaching-learning process and faces recurrent challenges in accessing health information⁽⁴⁾.

Although 2.6 million Brazilians are people with hearing impairments⁽⁵⁾, there is still a shortage of accessible educational materials and insufficient training of health professionals regarding inclusive care, resulting in significant barriers to understanding and exercising health rights among this population⁽⁶⁾. These barriers become even more evident in topics less frequently addressed with deaf people, such as blood donation. The absence of accessible content limits understanding and contributes to the low participation of deaf people in campaigns and actions aimed at voluntary blood donation.

The full inclusion of this population in health promotion actions is essential to strengthen citizenship and expand the reach of public health policies⁽⁷⁾. However, for inclusion to occur effectively, it is necessary to recognize the cultural and linguistic specificities of the deaf community, enabling access to information through appropriate

resources, such as the production of audiovisual materials in Brazilian Sign Language (Libras), the use of subtitles, and the presence of interpreters in health care settings⁽⁷⁾.

Despite existing research focused on developing and validating educational technologies accessible to the deaf audience, gaps remain in the literature regarding their implementation and evaluation of effectiveness in practice⁽⁸⁾. The technologies developed are predominantly video-based, with accessibility resources in sign language, and the most frequently addressed topics include diabetes, sexual and reproductive health, and health communication⁽⁸⁾. These aspects reinforce the need to implement strategies addressing topics related to blood donation practices.

Despite this limitation, available evidence indicates positive outcomes from educational interventions within this population. An experimental study using an educational video accessible in Libras for deaf people demonstrated the effectiveness of the strategy in increasing knowledge retention and skills related to cardiopulmonary resuscitation (CPR), with maintenance 15 days after the intervention⁽⁹⁾. Additionally, a pilot test of an educational program for hypertension self-management accessible in sign language for deaf people showed promising results regarding participant satisfaction and promotion of self-care⁽¹⁰⁾.

From this perspective, educational interventions have proven to be effective tools for overcoming communication barriers and disseminating information in a clear and accessible manner. In this context, audiovisual resources adapted or developed in Libras have great potential to reach the deaf population, respecting their form of communication and facilitating the understanding of technical and normative content⁽¹¹⁾. Regarding blood donation specifically, the use of educational videos in Libras represents a promising strategy to inform, dispel myths, and encourage the participation of deaf individuals in altruistic health initiatives, thereby directly addressing the issue of unequal access to information⁽¹²⁾.

In light of these considerations, it is essential to implement educational strategies that promote communication inclusion, such as the use of accessible resources in Libras, and contribute to ensuring the right to information and participation in public health actions. Therefore, this study aimed to assess the knowledge of deaf people about blood donation before and after the application of an accessible educational video in Libras.

METHOD

This was a quasi-experimental, single-group pre- and post-test study, guided by the Transparent Reporting of Evaluations with Non-randomized Designs (TREND) checklist in which the intervention group served as its own control. It was conducted between June 2023

and March 2024 at two public institutions in a state in Northeast Brazil, both attended by the bilingual deaf community, that uses Libras as its primary language and written Portuguese as its secondary language.

The first institution was a regular educational institution operating in three shifts and serving 129 deaf individuals, with classes composed of approximately 15 participants. However, the institution's administrators reported that attendance varied considerably, resulting in classes with an average of only five regular attendees. Permission to conduct the study was granted only during the morning and evening shifts, as deaf individuals attending the afternoon shift had additional disabilities.

The second institution, a social and cultural organization, had 180 registered deaf members, however, attendance at meetings was low, ranging from two to five participants, with greater participation occurring during commemorative events. It is noteworthy that the institution's activity schedule offered limited flexibility for incorporating the proposed educational intervention.

After considering these characteristics, a convenience sampling method was adopted. All deaf individuals present on the dates scheduled by the institutions for the study were invited to participate, resulting in an initial sample of 41 participants. Inclusion criteria were: being a bilingual deaf individual regularly affiliated with one of the two institutions, being aged 16 or older (an age range consistent with eligibility for blood donation in Brazil, which is permitted at this age with legal guardian authorization), and consenting to participate in the study. Exclusion criteria included the presence of another disability associated with deafness, incomplete completion of the data collection instrument, and failure to participate in all three knowledge assessment sessions.

The educational intervention consisted of an educational video developed and validated in a previous study, with an S-CVI/Ave of 0.97⁽¹³⁾. It lasts approximately ten minutes, is animated, and is accessible in Libras. Set in a blood center, it aims to provide educational guidance on blood donation to potential donors. The animation depicts a lecture delivered by a nurse covering the following topics: eligibility criteria for blood donation, the stages of the donation process, and the care recommended after the procedure.

Data were collected using a questionnaire consisting of sociodemographic questions and ten questions about blood donation arranged in ascending order of complexity. These questions were selected from a question bank that had previously been validated for content in printed Portuguese and translated into Libras in an earlier study, with an I-CVI ≤ 0.8 ⁽¹³⁾. The complete question bank comprised 23 multiple-choice questions, classified as eight low-

complexity (34.8%), 12 medium-complexity (52.2%), and three high-complexity (13.0%) questions. This classification was established in the previous study⁽¹³⁾, according to the level of knowledge required to answer each question and was maintained in the present study. To minimize the research burden on participants, the total number of questions was reduced through simple random sampling, resulting in the unbiased selection of three low-complexity questions (30%), five medium-complexity questions (50%), and two high-complexity questions (20%). The number of questions selected from each complexity level was defined to preserve a distribution similar to that of the original bank.

The instrument was made available in two versions: a printed version in Portuguese and a recorded version in Libras. It was administered at three distinct times: a pre-test, conducted before the intervention; an immediate post-test, administered right after the intervention; and a delayed post-test, administered 15 days later.

The video and knowledge tests were conducted in private rooms, depending on availability. At the first institution, the session took place in a computer lab equipped with a television. Participants were organized into subgroups of up to eight individuals to accommodate everyone in the available seating. At the second institution, the sessions were conducted in the meeting room, which was also equipped with a television, with participants seated in groups of up to five individuals. In both settings, the video was displayed from a notebook computer connected to the television using screen mirroring.

In the first stage, participants were informed about the research, and the Informed Consent Forms (ICF) were signed after being read and simultaneously translated into Libras. Participants younger than 18 years of age were informed that authorization from their legal guardians was required. Accordingly, the ICF was signed by the parents and/or legal guardians, and the minors subsequently signed the Informed Assent Form (IAF). The consent and assent forms were provided to interested participants and returned signed within the previously established deadline before the beginning of data collection.

In the second stage, the pre-test was administered to assess participants' prior knowledge of the topic. The video for each question was shown in Libras, and answers were recorded on the printed instrument. In the third stage, the educational video was shown once, and the immediate post-test was administered right afterward. Finally, after a 15-day interval, the delayed post-test was administered at the same location and under the same conditions as the previous tests. It should be noted that throughout all stages, the researcher was accompanied by Libras interpreters from the institutions to ensure effective communication with the participants.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 24. The Shapiro-Wilk normality test was applied to assess data distribution. Data analysis was based on comparisons of the proportion of correct responses across the three time points. The McNemar test was used to compare the percentage of correct responses for each question (secondary outcome), and the Wilcoxon test was used to compare participants' knowledge across the different assessment time points (primary outcome). Statistical significance was established at $p \leq 0.05$ for all inferential procedures.

Approval from the Research Ethics Committee was granted under opinion No. 6.025.423/2023 (CAAE: 66533322.3.0000.5576). Ethical standards regarding research involving human beings were observed in accordance with Resolution 466/12.

RESULTS

Of the 41 participants, seven were excluded because they did not participate in all three proposed assessment moments, one due to incomplete completion of data collection instrument, and one because the parents withdrew their consent. The final sample consisted of 32 participants.

Most participants were female (53.1%), single (81.3%), and aged between 16 and 53 years, with a mean age of 29.3 years. Regarding educational level, 65.6% of the participants had completed high school. Only 15.6% reported having received information about blood donation through educational activities, and 3.1% had access to educational material. Most had never donated blood (87.5%) and identified lack of knowledge as the main reason (75%%).

Table 1 describes the topic and the respective correct response rate for each question. The highest rate of correct responses in the pre-test was observed for the question regarding health requirements for blood donation (65.6%), while the lowest performance was observed in the question concerning weight and age criteria for donors (only 12.5% correct). In contrast, this latter question showed the greatest increase in the proportion of correct responses, reaching 43.8% in the immediate post-test and 46.9% in the delayed post-test after 15 days.

Table 1 – Absolute and relative frequencies of correct response rate for each question across the three assessment points. Redenção, Ceará, Brazil, 2024.

Complexity	Blood donation questions	Pre-test		Immediate post-test		15-day post-test	
		n	%	n	%	n	%

Low	Definition of a repeat donor	10	31.3	13	40.6	12	37.5
	Timing of awareness for potential donors	9	28.1	16	50.0	6	18.8
	Health requirements for blood donation	21	65.6	20	62.5	20	62.5
	Questions on medication use and previous diseases	14	43.8	11	34.4	11	34.4
Medium	Clinical screening questions	5	15.6	9	28.1	14	43.8
	Weight and age criteria for blood donors	4	12.5	14	43.8	15	46.9
	Blood donation consent form	11	34.4	16	50.0	17	53.1
High	Definition of a replacement donor	9	28.1	9	28.1	10	31.3
	Types of blood donation	9	28.1	18	56.3	7	21.9
	Care of the blood collection site	20	62.5	20	62.5	17	53.1

Source: the authors, 2025.

Among the questions with the highest correct response rates in the immediate post-test, notable increases were observed for the question regarding the timing of potential donor awareness/engagement which increased from 28.1% to 50.0%, and the question on types of blood donation, which increased from 28.1% to 56.3%. Regarding the increase from the pre-test to the delayed post-test after 15 days, improvements were observed for the question on clinical screening questions, which increased from 15.6% to 43.8%, and for the question on the document providing consent for blood donation, which increased from 34.4% to 53.1%. Table 2 presents descriptive statistics for the percentage of correct responses and the results of the normality test applied at each stage.

Table 2 – Descriptive statistics and normality test for the correct response score across the three knowledge assessment time points. Redenção, Ceará, Brazil, 2024.

Assessment time point	Mean $\pm$ Std. Deviation	Median (1 st – 3 rd quartile)	Minimum - Maximum	p-value*
Pre-test	3.5 $\pm$ 2.7	4.0 (1.0 – 6.0)	0 – 7	≤ 0.001
Immediate post-test	4.6 $\pm$ 2.8	5.5 (2.0 – 7.0)	0 – 9	0.010
15-day post-test	4.0 $\pm$ 2.4	4.0 (2.0 – 6.0)	0 – 9	0.437

Source: the authors, 2025. *Shapiro-Wilk normality test.

The median number of correct responses was higher in the immediate post-test, with 5.5 correct answers, compared with the other assessment time points. The normality test indicated a non-normal distribution of the correct response score in two of the three assessment time points, with normality observed only in the 15-day post-test ($p=0.437$). Therefore, the following nonparametric tests were performed: the McNemar test to compare the percentage of correct responses for each question across the different assessment time

points, as presented in Table 3; and the Wilcoxon test to compare the medians across the different assessment time points, as presented in Table 4.

Table 3 – *p* values for the paired comparison of the percentage of correct responses for each question across the three assessment time points. Redenção, Ceará, Brazil, 2024.

Complexity	Blood donation questions	Pre-test × Immedi ate post- test	Pre- test × 15-day post- test	Immedia te post- test × 15- day post- test
		p-value*		
Low	Definition of a repeat donor	0.508	0.754	1.000
	Timing of awareness for potential donors	0.039	0.549	0.021
	Health requirements for blood donation	1.000	1.000	1.000
	Questions on medication use and previous diseases	0.549	0.581	1.000
Medium	Clinical screening questions	0.125	0.012	0.227
	Weight and age criteria for blood donors	0.013	0.003	1.000
	Blood donation consent form	0.125	0.146	1.000
	Definition of a replacement donor	1.000	1.000	1.000
High	Types of blood donation	0.012	0.727	0.001
	Care of the blood collection site	1.000	0.549	0.375

Source: the authors, 2025. *McNemar test.

In the low-complexity category, the question regarding the timing of potential donor awareness/engagement showed a statistically significant increase in the percentage of correct responses in the immediate post-test compared to the pre-test ($p=0.039$). However, this improvement was not sustained in the 15-day post-test, as a significant decrease was observed ($p=0.021$).

Regarding the intermediate complexity category, the question concerning clinical screening showed a significant increase in the percentage of correct responses at the 15-day post-test compared to the pre-test ($p=0.012$). Additionally, the question regarding weight and age criteria for blood donation showed a significant increase at the immediate post-test compared to the pre-test ($p=0.013$), a result that was maintained at the 15-day post-test ($p=0.003$).

Finally, in the high-complexity category, the question on types of blood donation showed a significant increase in the immediate post-test compared with the pre-test ($p=0.012$).

However, a significant reduction in the percentage of correct responses was observed in the 15-day post-test compared with the immediate post-test ($p=0.001$).

Table 4 - Comparison of median correct responses across the knowledge assessment time points. Redenção, Ceará, Brazil, 2024.

Comparison	Time point 1	Time point 2	P-value*
Pre vs. Post	4.0 (1.0 – 6.0)	5,5 (2.0 – 7.0)	0.010
Pre vs. Post-15	4.0 (1.0 – 6.0)	4,0 (2.0 – 6.0)	0.272
Post vs. Post-15	5.5 (2.0 – 7.0)	4,0 (2.0 – 6.0)	0.244

Source: Author, 2025. *Wilcoxon test

The comparison of the medians for the correct response score was statistically significant between the pre-test and the immediate post-test ($p=0.010$), unlike the comparisons between the other assessment time points, and this difference was not maintained in the 15-day post-test ($p=0.272$). Consequently, it was observed that participant knowledge was superior immediately after the educational intervention.

DISCUSSION

Lack of access to health information is one of the barriers faced by the deaf community, impacting the quality of access to services⁽¹⁴⁾. The findings of this study highlight this difficulty, as most participants reported limited exposure to educational materials regarding blood donation. Furthermore, a lack of knowledge about the process was cited as the primary reason for never having donated blood.

Studies conducted in the United Kingdom and Portugal reported similar findings, identifying misinformation on the subject, a lack of previous consideration regarding the possibility of becoming a donor, and insufficient encouragement to donate as the main factors influencing people not to donate blood^(15,16). In addition, the limited availability of accessible educational technologies on this topic further hinders understanding among this population. Therefore, it can be inferred that knowledge plays an important role in this decision, as individuals who are more familiar with the subject demonstrate a greater intention to donate blood⁽¹⁷⁾.

The pre-test results, in which more than half of the questions showed low correct response rates, reinforce the knowledge gap on this topic among deaf people. Among these questions, the one addressing the eligible age range for blood donation stands out, indicating

limited understanding of one of the main eligibility criteria. Furthermore, the poor performance observed for other questions may reflect participants' limited familiarity with blood donation terminology.

The increase in correct answers was most significant for questions regarding the appropriate timing to raise awareness among potential donors and the types of donations. However, both showed a significant decline after the 15-day period, suggesting that although the educational technology increased correct responses, that is, facilitated knowledge acquisition, when assessed immediately after the intervention, knowledge retention decreased over time. A study conducted with nurses in São Paulo, Brazil, reported similar findings, showing that knowledge retention was less pronounced three months after the educational intervention. This suggests that time is an important factor influencing learning, as knowledge may decline substantially over a period of six months to one year⁽¹⁸⁾.

Another finding was the significant and sustained improvement, after 15 days, in the question regarding the clinical screening questions and in the question concerning the weight and age criteria for blood donation. These findings reinforce the effectiveness of the educational intervention, as it promoted the retention of knowledge about important aspects of the blood donation process over time. A randomized study conducted in Fortaleza, Brazil, supports this evidence by demonstrating that an educational video was more effective than a traditional lecture in promoting long-term learning about cardiopulmonary resuscitation among deaf individuals⁽⁹⁾.

Regarding the comparison of the highest median number of correct responses across the different assessment points, the difference between the immediate post-test and the pre-test was statistically significant. Similar findings emerged from a study with university students in Turkey, which identified that the video strategy facilitated greater retention of information about blood donation compared to other tested materials. However, the mean number of correct responses in that study was 3.12 ± 1.66 in the post-test, whereas in the present study, the mean was 4.6 ± 2.8 ⁽¹⁷⁾.

Another study conducted in Saudi Arabia involving deaf women regarding cervical cancer, which implemented educational sessions using different resources, including audiovisual materials, also reported similar findings. The researchers observed a significant improvement in the participants' knowledge after the educational intervention⁽¹⁹⁾. Such findings indicate that educational videos can contribute to the health education process, although the present study identified limitations in maintaining this knowledge after a 15-day period.

Regarding the comparison between the pre-test and the 15-day post-test, no statistically significant difference was observed in the median number of correct responses. Furthermore, a decrease in the correct response rate was identified in two of the three low-complexity questions and in all high-complexity questions. Unlike the findings of the present study, a study conducted with deaf women on breast cancer that assessed knowledge before and after an educational video intervention found that this decline was not observed in the delayed assessment compared with the initial assessment⁽²⁰⁾.

The comparison between the immediate post-test and the 15-day post-test also showed no statistically significant difference, while a reduction in the percentage of correct responses was observed in the same complexity levels identified in the previous comparison. A similar decline was reported in two Brazilian studies: one conducted in São Paulo with nurses, which assessed knowledge about external ventricular drain care after an educational lecture and video intervention, with assessments performed one week and three months later⁽¹⁸⁾ and another in Fortaleza with deaf women, assessing knowledge 15 days after an educational video intervention on breast cancer⁽²⁰⁾.

The results indicate that, although an immediate increase in knowledge was observed, the educational video used in this study showed limitations regarding knowledge retention after 15 days. This suggests that, although it is an engaging, entertaining resource that supports accessibility through the inclusion of Libras⁽²¹⁾, it is important to combine it with other educational strategies to reinforce and consolidate the content over time. Furthermore, considering the importance of the topic, additional educational interventions may be implemented as reinforcement to promote knowledge retention and contribute to the consolidation of information.

ased on the analyzed data, the findings of this study suggest potential contributions to professional health practice. The use of accessible educational interventions, such as videos in Libras, appears to be an effective strategy for improving health literacy about blood donation among deaf people. From this perspective, the development of educational materials adapted to sign language contributes to the dissemination of health information and promotes equitable access to health information.

As limitation of the study, stands out that most participants were in a school setting, which may have influenced their understanding of the presented content, consequently, different results may be observed in studies conducted with deaf people outside this context. In addition, the translation of more specific blood donation terminology using fingerspelling may have hindered knowledge retention.

It is suggested that randomized clinical trials be conducted to compare the educational video's effectiveness with other assistive technologies related to blood donation education for deaf people, to identify which educational resources provides the greatest contribution to learning in this population. Furthermore, future studies should consider new translations of the video's content into Libras using alternatives to fingerspelling, as well as additional applications of the educational intervention with the target population.

CONCLUSION

The educational video enabled deaf individuals to acquire information about blood donation immediately after the educational intervention, although this knowledge was not retained after 15 days. Nevertheless, the number of correct responses to specific questions was maintained or increased in the delayed post-test. These findings reinforce the importance and relevance of this topic within the context of healthcare for people with disabilities, as it facilitates access to information for decision-making regarding the blood donation process.

The intervention represents a potential valuable resource for health education activities, particularly for raising awareness and recruiting new blood donors among the deaf population. However, the results indicate a decline in knowledge over time, suggesting certain limitations. Therefore, it is essential to combine this approach with other educational strategies, since that a lack of knowledge contributes to the persistence of myths and taboos, which negatively impacts the engagement of voluntary blood donors.

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Data and material availability

Access to the dataset is available upon request from the corresponding author.

Acknowledgments

To the Coordination for the Improvement of Higher Education Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - CAPES) for awarding the academic master's scholarship that made this research possible.

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The authors declare that there is no conflict of interest.

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Received: 11.25.2025

Approved: 05.12.2026

Associate editor:

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Editor-in-chief:

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