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Simulation and education

Basic life support training for people with disabilities. A scoping review

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Abstract

Background: The integration of populations with various types of disabilities into basic life support (BLS) training programs could contribute to a potential increase in trained laypersons with BLS knowledge and, consequently, in survival rates. The objective of this study was to analyze the distinct educational methods which exist today on BLS for people with some type of specific disability, and to evaluate their impact on the quality of BLS maneuvers.

Methods: A scoping review in which the different training strategies in BLS for people with distinctive disabilities were analyzed was carried out. Previous studies were sought and researched in MEDLINE, EMBASE, and the Cochrane Library from the beginning up to 4 August 2023.

Results: A total of 14 studies were thoroughly analyzed. The BLS training strategies for people with disabilities were classified according to the following criteria: objective (training, content validation or analysis of learning barriers), target population (visual, hearing, physical disabilities or Down syndrome), training resources (training with/without adaptation), contents (BLS and use of the automated external defibrillator) and evaluation instrument (i.e., the simulation test and knowledge questionnaire). The variety of BLS training programs for such population is limited. Likewise, people with different disabilities are able to effectively learn BLS maneuvers, although with mixed results, mainly in those regarding the CPR quality.

Conclusion: People with visual, hearing disabilities or Down syndrome are able to effectively learn BLS maneuvers.

Keywords: Disability, Out-of-hospital cardiac arrest, Bystander, Basic life support, Training

Introduction

The immediate action in an out-of-hospital cardiac arrest (OHCA) is essential to increase survival rates, which includes an immediate and effective application of basic life support (BLS) measures and the use of Automatic External Defibrillators (AEDs) by the trained laypersons, who are generally relatives, friends, teachers or passers-by.[1] With this objective in mind, according to International Liaison Committee on Resuscitation (ILCOR), the European Resuscitation Council (ERC), among others, the recommends the teaching, training and retraining of laypeople, although both the duration and the characteristics of the training programs have yet to be ascertained[2] and in addition, proposes the online teaching of theoretical knowledge, while prioritizing hands-on training in the face-to-face part.[3–5] However, previous studies have shown the different existing educational programs on BLS, and they differ in terms of the applied methodology, duration and contextualization.[6–8]

One of the main characteristics of these educational methods must be the ability to adapt to the needs of the population receiving training, especially when these people involved have special needs. Today, 15% of the world population has some type of disability, condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions).[9] In fact, this percentage has been steadily increasing in recent years,[10] which implies that the preparation of traditional educational strategies aimed at all people would automatically add a higher percentage of potential trained laypersons from this subgroup compared to the past, and this development had been previously ruled out or not taken into account in general population training.

In this sense, the objective of this study was to analyze the different BLS training methods for people with a certain type of disability, and to evaluate the impact of such disabilities on the quality of BLS maneuvers.

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Methods

Design

A scoping review of original studies which evaluated the efficacy and/or effectiveness of different BLS teaching methods in people with different disabilities was carried out. This study was adhered to the Joanna Briggs Institute guidance for scoping reviews.[11]

Search strategy and study selection

A complete literature search was carried out in MEDLINE (via PubMed), EMBASE (via SCOPUS) and the Cochrane Library from their inception until August 4, 2023. The following relevant terms were combined through Boolean operators: 'Training', 'Education', 'Teaching', 'Cardiopulmonary resuscitation', 'Disability', 'Blind', 'Deaf', 'Down's syndrome', 'Physical disability', 'Intellectual disability', 'Child', 'People'. The search strategy used in the different databases is described in Appendix (Table A). The grey literature (including Doctoral Thesis) and the references of the selected studies were reviewed so as to identify additional studies. Articles retrieved were imported and managed by Mendeley reference manager.

Original studies which analyzed the teaching techniques used for the formation of BLS and the use of AED among people with disabilities were included. Furthermore, articles which were written in English or Spanish, and whose design was both experimental and observational, were included. Review articles, editorials, comments, guidelines, or case reports were excluded. After reviewing the original studies included, and following the PECO strategy, the following data was collected: (i) Population: people with disabilities; (ii) Exposure: exposure to teaching/learning methodology on BLS for people with disabilities; (iii) Control: absence of such teaching or training; and (iv) Outcome: BLS knowledge and skills by people with disabilities and comparison with the results described for the disabled population without knowledge of BLS and with the general population, specifically in relation to the three main technical skills included in the BLS algorithm -Opening the airway, CPR and AED use-.

Both the search strategy, studies selection and the data extraction were carried out independently by two reviewers (CBM and NMS). Disagreements were solved by consensus, and, if it could not be reached, a third reviewer was consulted (SMI).

Results

Study characteristics

The literature search produced a total of 343 studies. A total of 14 were selected from all these, after eliminating duplicates and analyzing each one by title, abstract and full text, as deemed appropriate. These 14 were finally included in the scoping review (Fig. 1).

The main characteristics of the included studies are summarized in Table 1. The average number of publications per year from 1978[12] to 2023[13,14] was n = 0.31. The years with the highest scientific production related to the study subject were 2017,[15,16] 2019,[17–19] 2021,[20,21] and 2023.[13,14] The articles were published in the United States, Italy, Brazil, Spain, Slovenia and India.[12–25]

Likewise, the diverse training strategies found in the studies analyzed could be classified based on:

a) Training objective: training in BLS,[12–15,18–21,23–25] validation of training content[22] and/or analysis and description of learning barriers.[16,21]
b) Target population: participants with visual,[18,20] hearing,[13,16,17,21,22,24,25] physical[12,14] or Down syndrome.[15,19,22]
c) Training resources: theoretical-practical training with and without adaptation to the participants - support from communicators specialized in sign language[12,13,16,18–21,24] and use of adapted audiovisual material.[15,17,23]
d) Training contents: BLS sequence and use of the AED.[12–21,23,24].
e) Evaluation instrument: simulation tests[14,15,18,20,21,23,24] and knowledge questionnaires.[13,16,19,22,25]

Finally, there are mixed results regarding the quality of CPR reported by included studies. Martinez-Isasi et al.[20] showed similar CPR quality among groups (visual impairment vs normally sighted) and reported that blind people could reach more than 70% of quality in some characteristics of the CPR sequence.[18] Likewise, Barcala-Furelos et al.[14] showed a more than 50% CPR quality in participants using a wheelchair, both in static and transport CPR test. Conversely, Jorge-Soto et al.[15] showed that people with Down syndrome reported poorer CPR quality than control group, which is in line with the study of Rodríguez-Nuñez et al.,[23] who also included people with Down syndrome.

Discussion

Cardiopulmonary resuscitation

To the best of our knowledge, this is the first scoping review that highlights the previous application of different BLS training methods to people with physical, hearing, and visual disabilities as well as Down syndrome. This scoping review indicates that the variety of BLS training programs for people with different types of disabilities is limited, and the consensus on the characteristics that such programs should have has not been reached. Additionally, this study shows that people with different disabilities are able to effectively learn BLS maneuvers, even with minimal or no modifications of the training material, although with mixed results.

Despite varying in terms of training methodology, these initiatives are all based on the inclusive access to first aid training for the population. This includes the importance of training in BLS with the objective of increasing both the survival rates after an OHCA and the rates of action by the first responder, which have been 45.7% up until now.[16,17] Another factor to consider is that there is clear previous evidence which indicates a direct relationship between the number of witnesses with knowledge of BLS and survival in the case of CPR.[20] Furthermore, this review has not found any studies which reflect an application of BLS techniques in real situations by people with some type of disability so far. In this sense, regulated and continuous training for this particular population could increase both the rates of action by the trained laypersons and the survival rates after the presence of an OHCA.[16] In the same way, the training carried out should be adapted to the individual needs of the target population, considering that they must have the appropriate cognitive conditions and motor skills to be able to carry out the techniques inherent to the BLS algorithm.[22]

Based on the profile and characteristics of the participants who have received training in BLS according to the studies included in this review, four types of disability have been described in the target population: (a) physical; (b) sight; (c) auditory; and (d) Down syndrome.

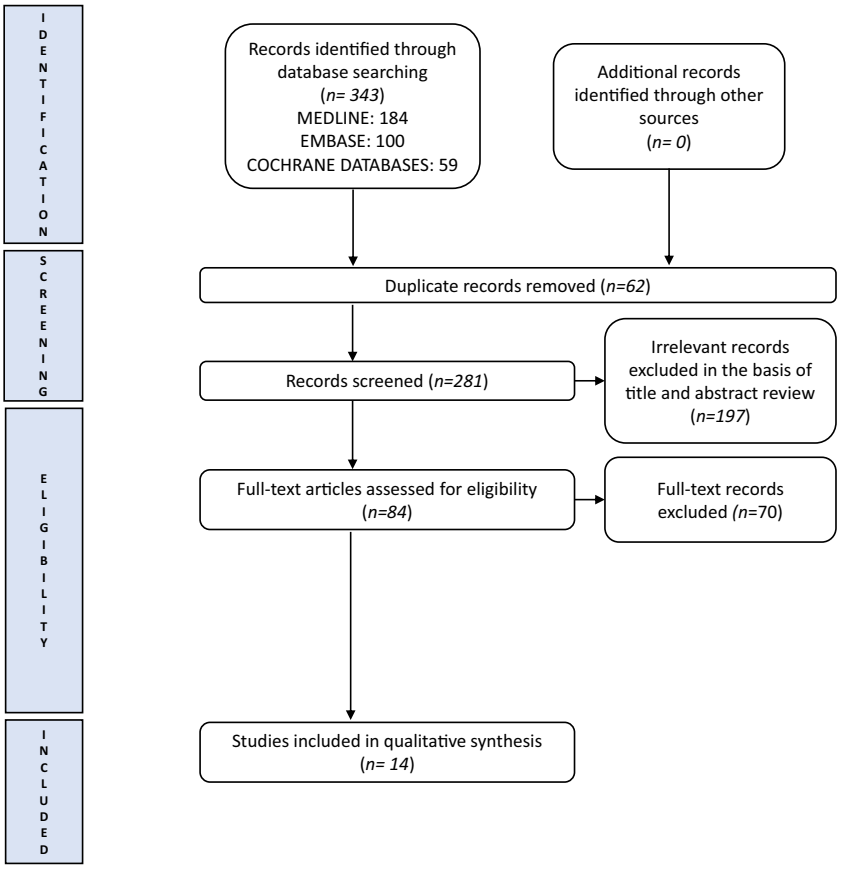

Fig. 1 – PRISMA diagram of the article selection process.

(a) Persons with physical disabilities

To the best of our knowledge, the first published study that included BLS training for 10 participants with sensory deficits or diseases, impaired limb function, or back injuries, highlighted performance during CPR. The conclusion was that physical disability was not a limiting factor, although it was a determining factor, in the teaching–learning process in BLS. However, this study highlighted that training must be flexible and individually adapted, providing alternative methods and emphasizing the physical effort involved in resuscitating a victim. Based on this effort, within the training it is necessary to take into account the possibility that real situations may limit the functional status of the rescuer with physical disabilities, noting that both fatigue and the inability to continue on the part of the rescuer are constituted as reasons for cessation of CPR, according to ILCOR recommendations.[26] However, in a recent study, participants in wheelchairs were able to perform pediatric CPR in both static and transport positions with encouraging results. Although these findings should be treated with caution, they could serve as a starting point for further development of inclusive CPR training programs.[14]

(b) Population with visual impairment

Two previously published studies have evaluated the efficacy of BLS training methods for blind people. In the first one, Martinez-Isasi *et al*, highlighted the ability of this population to solve simulated scenarios based on OHCA after one hour of training, consequently obtaining a high percentage of chest compressions performed correctly.[18] On the other hand, in another study,[20] the blind population was compared with a control group of people with no visual impairment whose eyes had been previously covered. Both groups obtained similar results after assessment, although, unlike the first study, poor results were obtained in both groups with regard to the quality of chest compressions.[20]

However, both studies concluded that blind people could become active agents both in learning and in the execution of BLS techniques, so it is necessary to promote the creation of programs and materials aimed at the visually impaired population, which will have a positive impact on individual self-esteem and social inclusion.

(c) Hard of hearing people

Hard of hearing people, who make up a total of 466 million people in the world,[22] only differ from the rest of the population due to their hearing handicap, in the absence of other cognitive or motor difficulties. Despite this, they have disadvantages in BLS training due to communication barriers and the scarcity of adapted materials in sign language.[17]

A previous study, whose objective was to assess the presence of BLS training for hard of hearing people through a survey of community and educational services directors, indicated that more than 8 out of 10 directors had not provided training to their students due to lack of available resources, although practically all of them confirmed the need for training in all age groups, especially in adulthood. Among these resources, the need for help from a sign language interpreter and the modification of technical terminology to adapt the explanation of the content to individual needs stand out.[25]

An attempt was made to cover this need for resources in three of the studies included in the review, whose common purpose was the creation of educational materials adapted to hard of hearing people. In the first one, the main objective was the validation of an educational video for hard of hearing people, in which both the various steps that the rescuer must follow, and the characteristics of optimal

Table 1 – Studies included in the scoping review.

Author	Year	Country	Title	Objective	Participants		Training Method	Evaluation	Conclusion
					N	Characteristics			
Barcala-Furelos, R., *et al.*[14]	2023	Spain	Infant cardiopulmonary resuscitation from the wheelchair. Is it feasible and worthwhile?	To evaluate pediatric resuscitation from a wheelchair.	5	Professional basketball athletes with disabilities using a wheelchair.	NA	Simulation test in two scenarios: Static CPR test Transport CPR test	The quality of CPR was similar in both scenarios (60% vs 52%). The participants using a wheelchair were able to provide CPR while they covered more than 100 meters during the moving test. The findings support the development of inclusive CPR training activities.
Galindo-Neto, N. *et al.*[13]	2023	Brazil	Effectiveness of educational video on deaf people's knowledge and skills for cardiopulmonary resuscitation: a randomized controlled trial	To analyze the effectiveness of an educational video on deaf people's knowledge and skills about cardiopulmonary resuscitation	113	Students with hearing disabilities IG:76; CG: 73	IG: Training video adapted for people with hearing disabilities.CG : Lecture with practical demonstration.	Theoretical and practical test	The correct answers were higher in the IG in the immediate post-test and after 15 days. There were no differences in the skills analysis between groups in the immediate post-test. The video seems to be effective in increasing the CPR knowledge and skills in people with hearing disabilities.
Martínez-Isasi, S., *et al.*[20]	2021	Spain	Performing Simulated Basic Life Support without Seeing: Blind vs. Blindfolded People	To compare the training during BLS maneuvers of blind people and normally sighted people with covered eyes	59	Visual impairment: 29 Normally sighted: 30	Theoretical-practical training in BLS of 90 minutes.	Simulation test	The quality of CPR was similar in both groups. Blind people have abilities comparable in quality to normally sighted people.
Strnad, M. *et al.*[21]	2021	Slovenia	Challenges in basic life support and automated external defibrillator training of deaf individuals	To assess the barriers of the people with hearing disabilities in relation to BLS-AED protocols and adapt them to measure the effectiveness of modified BLS training in simulated CPR.	51	People with hearing disabilities.	Theoretical-practical training of 75 minutes using an adapted BLS protocol with the help of a sign language interpreter.	Simulation test	A comprehensive approach to BLS training and AED use in people with hearing disabilities is needed. Slight adaptations in the BLS protocol are not sufficient for the training of this population.
Galindo-Neto, N. *et al.*[22]	2020	Brazil	Sign language instrument for assessing the knowledge of deaf people about Cardiopulmonary Resuscitation	Build and validate the CPR content of an instrument in sign language to assess the knowledge of deaf people	113	People with hearing disabilities.	NA	Questionnaire for Assessment of Assistive Technologies	The instrument had a content validity of 90% by the participants. The instrument can be used in research to find out about previous training in CPR in people with hearing disabilities,

Table 1 (continued)

Author	Year	Country	Title	Objective	Participants		Training Method	Evaluation	Conclusion
					N	Characteristics			
									as well as to assess educational interventions with this public.
Kearney, KB. *et al.*[19]	2019	EEUU	Push Hard and Fast: Teaching College Students with Intellectual Disability to Perform Hands-Only Cardiopulmonary Resuscitation	To determine the effectiveness of a training strategy in teaching a BLS technique.	4	People with intellectual disabilities: 2 People with Down syndrome: 2	Theoretical-practical training with an error correction procedure.	Analysis of 11 tasks based on the 2016 American Safety & Health Institute Guidelines.	Adolescents with intellectual and other developmental disabilities can master BLS techniques.
Galindo-Neto, N. *et al.*[17]	2019	Brazil	Creation and validation of an educational video for deaf people about cardiopulmonary resuscitation	Creation and validation of an educational video by health professionals in cardiorespiratory arrest, with the aim of training deaf students in CPR	22	Professionals trained in CPR	Training video adapted for people with hearing disabilities.	NA	The training method is considered valid and understandable for the hearing impaired population, becoming an inclusive technology for CPR health education.
Martínez-Isasi, S. *et al.*[18]	2019	Spain	Is it necessary to see to save a life? Pilot study of basic CPR training for blind people	Evaluate the learning capacity of basic life support by blind people	27	People with visual disabilities.	60 minute training in CPR and AED.	Simulation test	The CPR quality was over 70% in 'chest recoil' and 'hand positions' items. Training blind people to perform CPR with correct and adapted training.
Jorge-Soto, C. *et al.*[15]	2017	Spain	Brief training in automated external defibrillation use for persons with down syndrome	To evaluate the efficacy of brief training on the use of the AED in people with Down syndrome	39	People with Down syndrome: 27 Occupational therapists: 12	Viewing of a didactic video and practice in the use of the defibrillator.	Simulation test	Young people with Down syndrome are able to use the AED in less than two minutes in a simulated OHCA.CPR Quality: 47 (Down syndrome) vs 91.6%
Unnikrishnan, R. *et al.*[16]	2017	India	Training individuals with speech and hearing impairment in basic life support: A pilot study	Evaluate the barriers and explore the possible modifications for the teaching–learning process of people with hearing disabilities regarding adult BLS.	6	People with hearing disabilities.	Training based on the AHA 2010 guidelines on BLS with the help of a sign language interpreter.	Check-list	Both the activation of the emergency services and the follow-up of the voice instructions of the defibrillator constitute the main barriers that this population has, although all the participants completed the BLS sequence adequately.
Rodríguez-Núñez, A. *et al.*[23]	2015	Spain	Quality of chest compressions by Down syndrome people: a pilot trial	Analyze the capacity and quality of compressions in CPR maneuvers by people with Down syndrome.	36	19 people with Down syndrome and 17 people without disabilities.	Short 3-minute video and 45-minute adapted practice session.	Simulation test	Full correct CC:13 (Down syndrome) vs 39% People with Down syndrome can perform hands-only CPR, but of poor quality.

(*continued on next page*)

Table 1 (continued)

Author	Year	Country	Title	Objective	Participants		Training Method	Evaluation	Conclusion
					N	Characteristics			
Sandroni, C. *et al.*[24]	2004	Italy	Automated external defibrillation by untrained deaf lay rescuers.	To assess the ability of hearing-impaired rescuers to defibrillate effectively in simulated CPA using an AED that includes visual cues, before and after BLS-AED training.	9	People with hearing disabilities.	300-minute training in SVB-DEA, based on the ERC Guidelines, with the help of a sign language interpreter.	Simulation test	Untrained rescuers with hearing disabilities can use an AED with a defibrillator with visual instructions. Training improves AED use and reduces time to defibrillation.
Beck, K. H. *et al.*[25]	1983	USA and Canada	A national survey of cardiopulmonary resuscitation training for the deaf.	Determine the level of training in CPR of students with hearing impairment	81	Directors of community, health and training services for people with hearing disabilities.	NA	Assessment Survey	Only 1% of people with hearing disabilities received any type of CPR training in a 2-year period, due to communication barriers and lack of resources.
Macauley, CA., *et al.* [12]	1978	USA	Physical disability among cardiopulmonary resuscitation students	Implement a training program to perform CPR on people with physical limitations that are not considered a disability and do not interfere with their normal work	115	Health personnel 10 with physical limitations 105 without limitation	Training program of 720 minutes on hospital training in CPR according to the recommendations of the AHA.	NA	There are professionals not considered disabled with physical circumstances that could limit the practice of CPR. These circumstances did not prevent the participants from performing CPR. Alternative training methods must be provided to enable the disabled student to achieve the objectives of the training programs.

AED, Automated external defibrillator; AHA, American Heart Association; BLS, Basic life support; CC, Chest compressions; CG, Control group; CPR, Cardiopulmonary resuscitation; ERC, European Resuscitation Council; IG, Intervention group; N, sample size; NA, Not available; OHCA, Out-of-hospital cardiac arrest.

quality CPR are shown thanks to the support of a sign language interpreter. However, in order to complete the external validation process, more research is needed in order to determine the effectiveness of said material in the teaching–learning process in the hard of hearing people.[17] For instance, Galindo-Neto *et al.* designed an instrument in sign language that could be used to assess the prior knowledge of hard of hearing people regarding CPR, as well as the results after learning. For the validation of this instrument, which was made up of a video with sign language and a questionnaire to record the responses, a content validation process was carried out with the help of professionals and hard of hearing people, as well as an internal validation process with the application of the same to 113 hard of hearing people.[22] This tool was subsequently used to increase the knowledge and skills about CPR in 57 hard of hearing people, obtaining satisfactory findings,[13] showing that this population is fully capable of learning CPR with adapted materials. Finally, Strnad *et al.* conducted an adapted CPR training for 51 hard of hearing people, supported by a sign language interpreter, highlighting the importance of a comprehensive approach to BLS training, given the insufficiency of small training adaptations.[21]

(d) Population with Down syndrome

Down syndrome is the most common genetic cause of intellectual disability, and the active participation of this population in the community is on a growing trend, so offering them the same opportunities as the rest of the population in learning BLS will greatly help them to improve their integration into society.[23] In this regard, in the pilot study designed by Rodríguez-Núñez *et al.* in 2015, the quality of chest compressions was compared in two groups, one was made up of people with Down syndrome and the other consisted of students without physical or intellectual disabilities, after training with the same methodology. The findings of this study showed that both groups performed chest compressions, although the group without disabilities was reported to have performed them to a superior quality.[23]

However, despite the results, this study concluded that, although the population with Down syndrome requires more training time, they constitute a target population capable of achieving an adequate understanding through playful, practical and brief methodologies adapted to their characteristics, in such a way that they could improve the quality of the chest compressions performed.[23] These findings are in line with those reported in the study by Kearney *et al*, where it was concluded that adolescents with Down's syndrome and other intellectual disabilities could master BLS techniques, namely performing CPR only with compressions.[19]

Automated external defibrillators

Taking into account that publicly accessible defibrillation programs aim to increase the number of people who could respond to a CPR,[15] and that there is a relationship between the number of people who know how to use an AED and the survival of the victim before a PCR-HD,[27] three blocks of studies are included in this review, depending on the type of disability of the population trained in the use of AED.

(a) Population with visual impairment

In the study by Martínez-Isasi *et al*, the use of the AED by blind people and blindfolded people without visual impairment was compared. After the evaluation of the participants, a similar quality was observed in both groups, which shows that small adaptations in the methodology could enhance the learning of people with visual disabilities in relation to the use of the AED.[20]

(b) Hard of hearing people

Unnikrishnan *et al.* identified the barriers and challenges that hard of hearing people face when using an AED, highlighting activation of emergency services and following the AED's voice instructions. However, when the training received was adapted by an instructor with proficiency in sign language, they were able to complete a simulation based on the use of the AED.[16]

On the other hand, Sandroni *et al.* analyzed the ability of hard of hearing people to use an AED with visual cues after training with the support of a sign language interpreter. The findings of this study indicate that hard of hearing people, as well as people with hearing problems in noisy spaces, have been able to use the AED thanks to the visual indications of the defibrillator screen, thus promoting the development of materials adapted to the needs of this population.[24]

Finally, Strnad *et al.* claimed that, in the same way as it happens in BLS training, the instruction regarding the use of AED in hard of hearing people involves an integral approach that goes beyond minor training adaptations.[21]

(c) Population with Down syndrome

Given that the majority of the population with Down syndrome experiences a series of restrictions in daily activities, and that inclusion in certain activities could improve their esteem in society.[15,28] Jorge-Soto *et al.* designed a study with the objective of carrying out training in the use of the AED to people with Down syndrome, through a brief class, a viewing of videos and practice with an instructor. The results obtained show that, after innovative and adapted training, this population was capable of performing a defibrillation simulation with an AED in optimal time. In this sense, short and attractive training sessions could improve the process of learning to use the AED, thus improving the prospects of inclusion of the population with Down syndrome within the training offer for the general population.[15]

Limitations of the study

Firstly, those inherent to conducting a scoping review, such as publication and selection bias, the lack of methodological quality assessment, as well as limited information reported by original studies. Nevertheless, considering both that the scoping review design is appropriate to provide an overview of the literature[29] and the high heterogeneity concerning BLS training programs, a systematic review was not considered. The continuous development of BLS training programs for people with disabilities will allow the assessment of its effectiveness by means of systematics reviews and meta-analyses. Secondly, the total amount of studied participants was not too high. However, the study has been carried out using data from population with different disabilities from several geographical areas. Finally, it is necessary to highlight the scarce and variable scientific production in relation to BLS training for people with disabilities, so it is considered essential to carry out further research that analyze the effectiveness of diverse training methods for this population, in such a way that it is possible to properly determine the characteristics (in terms of duration, materials, retraining and context) that a training adapted to the different types of disabilities must have.

Conclusion

Despite the importance of training the lay population on BLS and the use of AEDs, this scoping review indicates that there is not a wide variety of BLS training programs for people with different types of dis-

abilities, and there is still no consensus on the characteristics that inclusive training should have for the integration of those people. Likewise, our findings show that people with physical, visual, hearing impairments or Down syndrome are able to effectively learn BLS maneuvers, even with minimal or no modifications to the training material, although with mixed results, which indicates the need to carry out further experimental research aimed at clarifying the optimal characteristics that BLS training programs must have. It is necessary to promote, through scientific and educational institutions, the inclusion of BLS contents and use of the AED, considering the learning characteristics of people with disabilities.

CRediT authorship contribution statement

Carlos Berlanga-Macías: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Roberto Barcala-Furelos:** Conceptualization, Resources, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Nerea Méndez-Seijo:** Formal analysis, Data curation, Writing – review & editing, Visualization. **Lucía Peixoto-Pino:** Methodology, Investigation, Resources, Writing – review & editing, Supervision, Project administration. **Santiago Martínez-Isasi:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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