Original Article

Awareness, utilization and barriers in accessing assistive technology among young patients attending a low vision rehabilitation clinic of a tertiary eye care centre in Delhi

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Purpose: People with visual disability need assistive technology to improve their body functioning and performance. The purpose of the present study was to understand the awareness, use and barriers in accessing the assistive technology among young patients attending visual rehabilitation clinic of a tertiary eye care hospital in Delhi. **Methods:** A cross-sectional study was conducted on consecutively recruited patients registered for the first time in visual rehabilitation clinic of the community ophthalmology department of the tertiary eye centre during June and July 2018. A study tool consisting of 42 assistive technologies was developed. Patients were screened for distance visual acuity both presenting and binocular pinhole vision using an 'E' chart with two optotype (6/18, 6/60). **Results:** 85 patients (69.4% male) were enrolled from the VR clinic. 83.5% of the patients had a best corrected binocular vision acuity <6/18 to 1/60. There was good awareness of only 2 of the 42 devices (>67% of the participants): near optical magnifiers, walking long canes. There was moderate awareness of 10 devices (34-66% of the participants) and poor awareness of the rest (<33%). Likewise, participants reported moderate usage of 3 out of the 42 devices and poor usage of the remaining devices. Non-availability of devices was the most frequently reported barrier in the study. **Conclusion:** The awareness and utilization of assistive technologies for visual disability was poor in patients attending visual rehabilitation clinic. Hospitals could procure assistive technologies and introduce strategies to improve awareness as well as promote utilization.

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Assistive technology (AT) for people with disabilities is important in order to improve the functional capabilities and independent living of people with disabilities. Globally, over one billion people need one or more assistive technologies for their functioning, with a stipulated increase to two billion by 2030.[1] It is estimated that only 10% of those who would benefit from AT are able to access assistive devices.[2] To address this substantial gap between demands and supplies, the World Health Organization (WHO) launched an initiative, Global co-operation on Assistive Technology in 2014, for which a list of 50 top priority devices has been developed; this list includes 16 devices for people with visual impairment.[3]

Many studies have shown that the use of assistive technology in people with visual impairment improve their performance in daily activities, enhanced social interaction, independent living, self -esteem, determination and quality of life.[4] Todis *et al*. and Hutinger *et al*. reported that children with visual disability were able to make choices and direct their own care with the use of augmented assistive technology.[5,6] In a similar way, assistive technology helps to improve academic and learning performance among children and young adults.[7] Studies have also reported a significant improvement of skills such as hand writing, motor skills, reading, maths, science skills and other cognitive functions in children using assistive technologies.[8,9] Other studies have shown the cognitive benefits associated with use of assistive technology including understanding of the cause – effect relationship, increased attention span, and problem-solving ability among young adults.[10]

Assistive technology for people with visual impairment can be categorized into those technologies which enhance the remaining vision, and those which use other senses such as touch or sound. The current study aimed to assess the awareness, usage and barriers in accessing assistive technology among visually disabled young people attending a low vision rehabilitation clinic in a tertiary eye care centre in New Delhi. The study will help to improve the low vision and visual rehabilitation services for young persons with visual disability.

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Methods

Study design

A cross-sectional study was conducted among young patients attending the visual rehabilitation clinic of a tertiary eye care hospital in Delhi during the month of June and July 2018. Under inclusive low vision service program, this tertiary eye care centre runs 2 separate clinics which was manned by separate staff, low vision clinic in the outpatient block of the centre and visual rehabilitation clinic at community ophthalmology department of the centre. A detailed vision examination and assessment was done in low vision clinic as routine services to prescribe optical magnifiers. After this examination, patients who required further rehabilitation service were referred to visual rehabilitation clinic of the community ophthalmology department.

Patients' recruitment and inclusion criteria

Consecutive new patients with low vision or blindness attending the visual rehabilitation clinic was recruited into the study. These patients were sent from low vision clinic of the outpatients block to avail the visual rehabilitation service. Details of the patients' age, gender, and address were recorded. The criteria for participation in the study were aged 10-25 years inclusive of first time attendees at the clinic.

Study tools and training of the team

The study tool assessed the awareness and use of 42 assistive devices (13 visual based and 29 tactile or sound-based devices); divided into 7 domains, namely, "Reading", "Writing", "Maths", "Sciences", "Games & sports", "Mobility", and "Activities of Daily Living".

The questionnaires investigated and reported on:

1. the patients' profile and vision status
2. patients' awareness of devices
3. patients' use of devices
4. frequency of usage
5. availability of training in use of devices
6. need of devices
7. barriers to access – the most important barrier was analysed.

For participants with residual vision, a colour pictorial booklet of assistive devices was developed for use with the questionnaire. The proforma questionnaire was pre-tested on 10 participants from the clinic who were excluded from the main study sample.

The study team consisted of an optometrist, two trained social workers, and one assistant. A two-day training was given to the whole team to explain the study and practice using the questionnaire. The questionnaire was read aloud in English by a member of the study team to a participant and if patients faced difficulty to understand, explanation was given in the appropriate local language.

Study definitions

Patients with best binocular distance vision less than 6/18 to 1/60 were categorized as potentially benefitting from visual based assistive technology (VAT), for example, magnifiers, large print books or typoscope. Patients with best binocular distance vision less than 1/60 were categorized as requiring non-visual based AT e.g., braille printers and writers.

'Awareness' was defined as a patient who had heard or known of the devices in question. To estimate the proportion of awareness, we used all participants in the study as denominators irrespective of their visual status. We categorized awareness as good (≥67%), moderate (34-66%), poor (≤33%).

'Use of devices' was the proportion of patients who had used the device, at least once or more in the past. In estimating the proportion of use for visual based devices e.g., magnifiers, we only included those patients whose binocular best-corrected vision was at least 1/60.

'Barriers' were defined as the prime cause for a patient not using a device that the patient was aware of.

Vision assessment and interview

A detailed vision assessment for each patient was conducted in the low vision clinic situated at the outpatient block of the centre. In the visual rehabilitation clinic of the community ophthalmology division of the centre, we conducted presenting and multiple pinhole binocular vision for distance using a modified Snellen 'E' chart with two optotypes (6/18 as small and 6/60 as large). The primary purpose of the test was to rule out whether visual-based or haptic-based assistive technology would be useful productively among these young patients.

Test with the 4 small 'Es' (6/18) at 6 meters distance

If at least 3 out of 4 small Es were correctly identified, the direction at 6 meters distance, the participant was recorded as 'without low vision'. If the participant was not able to see or identify at least 3 small Es, then the test was done using large 'Es' (6/60) in 4 different directions.

Test with the large Es (6/60) at 6, 3 and 1 meters

If 3 of the 4 presentations were correctly identified, the distance binocular vision was 6/60 or better. The vision was then measured with multiple pinhole occlude. Hence, if the vision improved, the person was then referred for refraction. If the person did not correctly identify at least 3 of large 'Es', the test was repeated at 3 meters distance with this large E.

If at least 3 out of 4 'Es' presented were seen correctly, then vision was <6/60 but equal or better than 3/60. The vision was then measured with multiple pinhole occlude. If the vision improved, the person was then referred for refraction.

If the patient was not able to see at least 3 of the large 'Es' at 3 metres, further testing was done at 1 meter distance. Patients who could not see 1/60 were tested for hand movement and perception of light. Vision assessment was performed in a well illuminated room.

Using the findings of Silver *et al*. regarding the need for visual based assistive technology,[11] participants were divided into 2 categories after refraction and best correction with spectacles; patients with binocular vision acuity between less than 6/18 to 1/60 and patients with less than 1/60 vision.

Data analysis

Data management and analysis was done in STATA 14 (StataCorp 2015, Stata Statistical Software: Release 14. College Station, TX: StataCorp LP). Data was analysed descriptively. Confidentiality of data was maintained throughout study periods. It was encrypted and stored in password protected devices.

Ethical consideration

Ethical approval was obtained from Institute board ethics committee. Informed written consent was obtained from the patients aged 18 years and above. For participants aged less than 18 years, assent was obtained from parents or guardians. The study was conducted in accordance to declaration of Helsinki.

Results

Participants' profile

Overall, 85 patients were enrolled from the low vision rehabilitation clinic according to the inclusion criteria. There were 59 (69.4%) male participants and 26 (30.6%) females. The mean age of the participants was 17.8 years (SD ± 4.4); age range 10-25 years. Out of the 85 participants, 51.7% (n = 45) were currently enrolled in school and 8.3% (6) had never attended school [Table 1].

Out of the 85 participants, 83.5% (71) were potential beneficiaries for visual based assistive devices with binocular best corrected vision acuity of 1/60 or better. 37 participants (43.5%) wore distance glasses [Table 1].

Awareness of assistive devices

Reading

Of the 9 reading devices, only near optical magnifiers had good awareness (69.4%), among the participants followed by moderate awareness (50.6%) for distance optical magnifiers and 51.7% for Braille reading books. For all other reading devices, awareness was poor [Table 2].

Writing

Of the 8 writing devices, the handheld digital audio recorder was recognized by 61.2% of participants, followed by Braille slate and stylus 38.8%. Awareness of the remaining writing assistive devices was poor ranging from 18.8% for screen readers like NDVA, JAWS etc. to 2.4% for the typoscope multiple window [Table 2].

Mathematics

Out of the 85 participants, 33 (38.8%) were aware of the talking calculator and 31 (36.5%) had heard of the abacus. Only 1 knew of the raised line graph and no one had heard of the Braille protractor or cube [Table 2].

Table 1: Characteristics of participants (*n*=85)

Sample characteristics		*n*	%
Gender	Male	59	69.4
	Female	26	30.6
Age	10-14	20	23.5
	15-19	34	40.0
	19+	31	36.5
School attended	Current	45	51.7
	Ever	34	40.0
	Never	6	8.3
Distance Glasses	Yes	37	43.5
	No	48	56.5
Vision status <6/18-1/60	<6/18-6/60	42	49.4
	<6/60-3/60	16	18.8
	<3/60-1/60	13	15.3
<1/60	Light perception (+) ve	8	9.4
	Light perception (–) ve	6	7.1

Sciences

Of the 2 devices for learning sciences, 10.6% of the participants knew about tactile maps and 3.5% knew about tactile science diagrams sets.

Mobility

Six orientation and mobility canes were included in the questionnaire. The awareness for walking long canes was good (86%), whereas moderate awareness was reported for mobile navigation apps (58%). The awareness was poor for the other devices, 25% for smart canes, 7.1% for children's canes [Table 2].

Games and leisure

Five sports-related devices were included. Awareness of audible balls was reported by 42.3% of participants, but there was poor awareness for the rest of the sport devices—ranging from 2.3% for Braille cards to 13% for Braille chess [Table 2].

Daily living equipment

More than half of the participants (54%) had heard about simplified mobile phones for visual impairment, and 48% knew about the talking watch. Only 3.5% had heard of the liquid sensor and 1.2% of the colour detector.

The use of assistive technology (AT)

Reading

Out of the 71 potential beneficiaries (1/60 vision or better), 25 (35.2%) used near optical magnifiers for reading, of which 18.3% used them regularly, whereas 12 (15.5%) of them used distance optical magnifiers. Very few potential beneficiaries used any of the other visual-based assistive technology – large print book (1), electronic magnifiers (1), reading stands (2), and low vision enhancing lamps (4).

Of all 85 participants, 9 (10.6%) used Braille reading books and 4 (4.7%) used audio format materials [Table 3].

Writing

Three of Eight ATs were visual-based assistive technology, with all of them having poor utilization, one participant each for multiple window typoscope, large print key board, and handheld pen magnifiers.

Of the remaining 5 non visual-based ATs, handheld digital audio recorders were used by 29 participants (34.1%) of which 10 used them regularly, and Braille slate and stylus were used by 10.6% of participants. Six participants (7%) used screen readers [Table 3].

Mathematics and sciences

The abacus was used by 7% of students, but other maths and science ATs were rarely used [Table 3].

Mobility

The mobile navigation app was used by 19 of 85 participants (22.3%), followed by long walking canes (15.3%). Smart cane was used by 3 participants only and no one used symbol canes [Table 3].

Table 2: Awareness of assistive devices among patients attending LVR RPC AIIMS

Type of Assistive Technology	A. Have you heard of		Awareness %
	No	Yes	
1. Reading			
1.1. Large print books	57	28	32.9
1.2. Reading stands	64	21	24.7
1.3. Optical magnifier (Near)	26	59	69.4
1.4. Optical magnifier (Distance)	42	43	50.6
1.5. Typoscope (one window)	83	2	2.3
1.6. Low vision lamps (enhance lighting)	66	19	22.3
1.7. Braille reading books	41	44	51.7
1.8. Electronic Magnifiers Aids (Video magnifiers, CCTV)	64	21	24.7
1.9. Audio Format Materials (DAISY)	67	18	21.2
2. Writing			
2.1. Braille slate and stylus	52	33	38.8
2.2. Braille typewriter	76	9	10.6
2.3. Typoscope (multiple window)	83	2	2.3
2.4. Large computer key board	72	13	15.3
2.5. Braille key board	82	3	3.5
2.6. Handheld pen magnifiers	81	4	4.7
2.7. Handheld audio recorder	33	52	61.2
2.8. Screen readers (JAWS, NVDA)	69	16	18.8
3. Mathematics			
3.1. Abacus	54	31	36.5
3.2. Braille compass	83	2	2.3
3.3. Talking calculator	52	33	38.8
3.4. Braille ruler	83	2	2.3
3.5. Braille protractor	85	0	0
3.6. Raised line graph	84	1	1.2
3.7. Tactile geometric kits	83	2	2.3
3.8. Braille cube	85	0	0.0
4. Sciences			
4.1. Tactile maps	76	9	10.6
4.2. Tactile diagram sciences set (Heart)	82	3	3.53
5. Mobility			
5.1. Walking (long) canes	12	73	85.9
5.2. Children's canes (60 to 85 cm)	79	6	7.1
5.3. Guide canes	84	1	1.2
5.4. Smart canes	64	21	24.7
5.5. Symbol canes	85	0	0.0
5.6. Mobile Apps (GPS)	36	49	57.6
6. Games and leisure			
6.1. Tactile dice	79	6	7.0
6.2. Large print play cards	75	10	11.7
6.3. Large print with Braille cards	83	2	2.3
6.4. Braille chess	74	11	12.9
6.5. Audible Balls (cricket, basketball)	49	36	42.3
7. Daily living equipment			
7.1. Liquid sensor	82	3	3.5
7.2. Colour detector	84	1	1.2
7.3. Simplified mobile phone	39	46	54.1
7.4. Talking watch	44	41	48.2

Visual based assistive technology (VAT): 1.1, to 1.6, 1.8, 2.3, 2.4, 2.6, 5.3, 5.5,6.2, *n=71, number of potential beneficiaries for visual based assistive technology (PB-VAT)

Table 3: Use of assistive devices among patients attending LVR RPC AIIMS

Type of Assistive Technology	Do you use the AT?			Total use	Potential Beneficiaries of each AT* (*n*)	Use in %
	No	Occasional	Regular			
1. Reading						
11. Large print books	27	1	0	1	71	1.4
12. Reading stands	19	2	0	2	71	2.8
13. Optical magnifier (Near)	34	12	13	25	71	35.2
14. Optical magnifier (Distance)	32	5	6	11	71	15.5
15. Typoscope (one window)	2	0	0	0	71	0.0
16. Low vision lamps (enhance lighting)	15	1	3	4	71	5.6
17. Braille reading books	35	4	5	9	85	10.6
18. Electronic Magnifiers Aids (Video magnifiers, CCTV)	20	1	0	1	71	1.4
19. Audio Format Materials (DAISY)	14	1	3	4	85	4.7
2. Writing						
21. Braille slate and stylus	24	3	6	9	85	10.6
22. Braille typewriter	6	3	0	3	85	3.5
23. Typoscope (multiple window)	1	1	0	1	71	1.4
24. Large computer key board	12	1	0	1	71	1.4
25. Braille key board	2	1	0	1	85	1.2
26. Handheld pen magnifiers	3	1	0	1	71	1.4
27. Handheld audio recorder	23	19	10	29	85	34.1
28. Screen readers (JAWS, NVDA)	10	2	4	6	85	7.0
3. Mathematics				0		
31. Abacus	25	6	0	6	85	7.0
32. Braille compass	2	0	0	0	85	0.0
33. Talking calculator	31	2	0	2	85	2.3
34. Braille ruler	1	1	0	1	85	1.2
35. Braille protractor	0	0	0	0	85	0.0
36. Raised line graph	1	0	0	0	85	0.0
37. Tactile geometric kits	1	1	0	1	85	1.2
38. Braille cube	0	0	0	0	85	0.0
4. Sciences				0		
41. Tactile maps	7	1	1	2	85	2.3
42. Tactile diagram sciences set (Heart)	3	0	0	0	85	0.0
5. Mobility						
51. Walking (long) canes	60	9	4	13	85	15.3
52. Children's canes (60 to 85 cm)	6	0	0	0	85	0.0
53. Guide canes	1	0	0	0	71	0.0
54. Smart canes	18	2	1	3	85	3.5
55. Symbol canes	0	0	0	0	71	0.0
56. Mobile Apps (GPS)	30	9	10	19	85	22.3
6. Games and leisure						
61. Tactile dice	3	2	1	3	85	3.5
62. Large print play cards	9	1	0	1	71	1.4
63. Large print with Braille cards	0	0	2	2	85	2.3
64. Braille chess	8	2	1	3	85	3.5
65. Audible Balls (cricket, basketball)	28	4	4	8	85	9.4
7. Daily living equipment						
71. Liquid sensor	3	0	0	0	85	0.0
72. Color detector	1	0	0	0	85	0.0
73. Simplified mobile phone	5	24	17	41	85	48.2
74. Talking watch	31	5	5	10	85	11.7

Visual based assistive technology (VAT): 1.1, to 1.6, 1.8, 2.3, 2.4, 2.6, 5.3, 5.5,6.2. *n=71 potential beneficiaries for visual based assistive technology (PB-VAT)

Games and leisure

8 (10%) of the participants enjoyed playing games and sports with audible balls. Tactile dice and Braille chess each were used by 3 participants.

Assistive technology for ADL

Nearly half of the respondents (48.2%; 41/85) used a simplified mobile phone for daily communication and 11.7% of them used a talking watch. None of participants used liquid level sensor or colour detector for their daily living.

Barriers in utilization for assistive technology

The 25 participants who were aware of assistive technology—but were not using it—reported that the main barriers were non-availability to buy (29%), lack of felt need (20%) and financial constraints (7%).

Discussion

People with blindness and visual impairment have a compromised quality of life. The use of assistive technology in people with visual disability can improve the quality of life, promote independent living. Generally, children and young adults with visual loss have a long way to live than older adults with visual loss. Therefore, augmenting their life from early age with use of assistive technology is a paramount importance.

Moreover, the fundamental component of the WHO Global Disability Action Plan 2014-21 is to improve accessing to assistive technology for persons with disabilities.[12] In a recently concluded WHO GREAT Summit, WHO has identified top five research themes on assistive technology.[13] The assessment of awareness, need, use of AT were identified as one of them. Further, the WHO Rehabilitation 2030: A Call for Action, a comprehensive and quality rehabilitation service that includes equitable access to assistive products is one of ten areas for global action.[14] Similarly, in the context of eye health, one of the key functions of the Universal Eye Health Coverage is the provision of rehabilitative care and appropriate assistive health technology the amongst people with visual loss.[15]

In the line of this important aspect, the present study explored the awareness, utilization and barriers in accessing assistive technology among young patients attending a visual rehabilitation clinic in community ophthalmology department of a tertiary eye care centre in Delhi. To the best of our knowledge, this study which covered a total of 42 assistive technologies was first of its kind in India.

The study showed good awareness (67+% of the participants) of only two of forty-two assistive technologies - near optical magnifiers and walking long canes moderate awareness (34-66% of participants) was reported for ten devices and poor awareness (<33% of participants) for the remaining 30 assistive technologies [Table 2].

Of the 42 assistive devices, only 3 were reported as having moderate utilization (34%-66% of the participants), with the remaining 39 assistive devices being reported as utilisation of less than 33% by participants.

Encouraging the maximum use of residual vision with the help of visual based devices is important in patients with best corrected binocular visual acuity <6/18 to 1/60. However, use of such assistive devices was poor in this study. It is important to ensure availability of devices and training in the use of these type assistive devices.

Assistive technology like screen readers e.g., NonVisual Desktop Access (NVDA) are freely available online, but their awareness and use were poor. Lack of awareness and/or lack of training could be the reasons for poor utilization of screen readers. In a study in Nigeria, the awareness of screen readers was 36% among age group 20-59 years.[16] In today's society with plenty of low cost technology, generating awareness about screen readers is important for people with vision loss. Educating care givers and patients could be of help to improve awareness of these devices.

The study was hospital based, so patients attending visual rehabilitation clinic could be triaged into two categories as patients with BCVA <6/18 to 1/60 and patients less than 1/60 for visual rehabilitation services.

Awareness and education on assistive technology could be delivered in the hospital setting based on this triage system. The hospital is a good place to improve awareness among such needy patients and their care givers. A hospital-based awareness program about assistive technology can be planned. It can be done as direct and indirect awareness program. In direct awareness program, a clinic-based patient centred educational activities e.g., face to face talk on assistive technology or regular educational talk in outpatients waiting areas about different type of assistive technologies and its' usage can be done. A colour pictorial copy of the devices can be developed, which will help patients with usable visual function or care givers to understand each assistive device easily.

As an indirect program, various information education communication (IECs) materials like banners, brochures, posters, e-poster for kiosk in waiting areas, billboards can be designed for patients or accompanying attendant irrespective of visual status. It is a one-way communication strategy to the target audience. Further study may be recommended to identify evidence-based best communication strategy for awareness activities on assistive technologies. An annual specific day on assistive technology for visually disabled people similar to other eye health observance day could be organized at the state or national level or it can be integrated to existing observance days e.g., world sight day or glaucoma week etc. which will certainly help to raising awareness and attention to the subject matters.

The hospital could also procure more assistive devices and ensure that initial training for visually disabled people attending in the visual rehabilitation clinic before referring for community-based visual rehabilitation program if participant needed.

Limitations

This is a hospital-based study from a tertiary eye care centre, and therefore will not represent all young people with visual impairment. The fact that awareness and utilisation in this setting was poor would indicate that the situation may be worse outside an urban teaching centre. The study was also confined to people aged 10-25 years. The study did not take into account the aetiology of visual loss which may affect the need for ATs among patients. A comprehensive list of forty-two

ATs was used, and it must be recognised that not all ATs are required by each patient.

Conclusion

The awareness and utilization of assistive technologies for visual disability was poor in patients attending visual rehabilitation clinic. Hospitals could procure assistive technologies and introduce strategies to improve awareness as well as promote utilization.

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Conflicts of interest

There are no conflicts of interest.

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