ORIGINAL RESEARCH

Effectiveness of a Verbal Expressive Skills Management Program for Pakistani Patients with Broca Aphasia: A Randomized Clinical Trial

Humaira Shamim Kiyani, PhD; Sajida Naz, PhD; Raffa Mubeen, MS; Rabia Zubair, MS

ABSTRACT

Background • It is estimated that 25% of the patients in Pakistan experience stroke resulting in problems with language. Among many of the conditions, problem with verbal expressive production (Broca's Aphasia) is one of the main problem faced by people having stoke. Many traditional therapies are incorporated to treat symptoms of Aphasia including fluent and non- fluent Aphasia.

Objectives • The primary objective of the current study was to determine the effectiveness of Verbal Expressive Skill Management Program in Urdu (VESMP-U) with convention speech therapy, Melodic Intonation therapy (MIT) in enhancing the verbal expressive skills in patients with severe Broca's Aphasia. Another objective of this study was to compare the efficacy of Verbal Expressive Skill Management Program in Urdu (VESMP-U) with traditional therapy, as well as the quality of life of patients with severe Broca's Aphasia.

Methods • A randomized control trial (NCT03699605, clinicaltrials.gov) was conducted from November 2018 – June 2019 in Pakistan railway Hospital (PRH). Patients having a three-month history of severe Broca's Aphasia, aged between 40-60 years, bilingual (Urdu and English language) and having the ability to use a smart phone were included in the study. Patients with cognitive impairments were excluded. Total of 77 patients were evaluated for eligibility criteria according to the G Power software for sample size. Out of 77, 54 individuals fulfilled the inclusion criteria. The participants were divided into 2 groups (27 each) through sealed envelope method. Patients of both groups were assessed pre and post intervention using the Boston Diagnostic Aphasia Examination (BADE) battery (Primary outcome measure). Experimental group n = 25 received VESMP-U therapy and control group n = 25 (2 drop out in each group) received MIT for 16 weeks i.e. 4 days per week having 64 sessions altogether. Each intervention session lasted up to 30-45 minutes for both groups.

Results • Within and between group analysis after intervention showed that the VESMP-U group had significantly improved BDAE scores ($P = .001$; 95% CI) than the MIT group for all variables (articulatory intelligibility, phrase length, grammatical form, prosody/intonation, spontaneous speech, word finding, repetition, and auditory comprehension). The BDAE scores of participants in experimental group having VESMP-U therapy pre- and post-intervention were statistically significant ($P = .001$; 95% CI), which indicates that participant's communication skills were enhanced by use of VESMP-U.

Conclusion • Android based application VESMP-U has been found to be effective in improving expression and quality of life of patients with severe Broca's aphasia. (*Altern Ther Health Med.* 2023;29(6):204-208).

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INTRODUCTION

Aphasia is an acquired neurological language disorder that mainly occurs as a result of stroke. Aphasia refers to the disturbance of any or all of the skills associated with spoken and written language due to pathology of certain brain areas that are specialized for these functions.[1] Aphasia affects 20% of people who have had an ischemic stroke for the first time. The estimated incidence rate of aphasia is 7.06% in every 100 000 people per year.[2] The prevalence of aphasia is approximately 100 000 people per year in the United States.[3] Among all speech and language disorders, the prevalence of post stroke aphasia is 25% in Pakistan.[4] Aphasia negatively

influences the quality of life of patients and is one of the most common factor which has a negative impact on patients' social outcomes.[5]

There are several conventional speech therapies (CSTs), including the stimulation-response method, melodic intonation therapy, linguistic-oriented learning approaches, response elaboration training, and constraint-induced aphasia therapy. These are used to improve verbal abilities in patients with aphasia.[6-8]

Some computer-based programs are also used for the management of verbal expressive language skills.[9] A study based on linguistic therapy was conducted on patients with aphasia, which improved their naming skills.[10] Computer-based aphasia therapies based on syntax and literacy are effective approaches to aphasia management and have positive effects on sentence making, reading, and writing.[11]

There is paucity in the literature regarding the utilization of computer-based or smart phone based applications to improve verbal expressive language skills in Urdu speakers with Broca aphasia. A verbal expressive skills management program in Urdu (VESMP-U) was previously developed for stroke survivors that had limited access to intensive CST services.[12,13] VESMP-U is an individualized management program, mainly focused on naming, reading, writing, and repetition skills of outpatients with aphasia. We hypothesized that VESMP-U could significantly improve the verbal expressive skills of patients with severe Broca aphasia. The purpose of this study was to evaluate the effects of an Android-based VESMP-U on the verbal expressive skills of Urdu-speaking patients with severe Broca aphasia.

The literature suggests that computer-based training in many other native language has already been tested on patients with aphasia. However there is no such culturally appropriate program in the Urdu language to manage Broca aphasia. The VESMP-U was specifically developed for the management of aphasia in the Pakistani population, targeting naming, reading, writing, and repetition skills. The objective of this study was to determine the effectiveness of VESMP-U on the verbal expressive skills of patients with severe Broca's aphasia, which will help in improving the verbal production and the functional life of patients with severe Broca's Aphasia.

METHODS

Patient recruitment

A randomized controlled trial (NCT03699605, clinicaltrials.gov) was conducted from November 2018 to June 2019 at Pakistan Railway Hospital, Rawalpindi, Pakistan, after the approval from the Advanced Studies and Research Committee (ASRC) of Isra Institute of Rehabilitation Sciences Isra University Islamabad Campus. Ethical, legal, and regulatory norms and standards were considered according to the Declaration of Helsinki as a statement of ethical principles for medical research involving human subjects. Participants with a 3-month history of severe Broca aphasia who were aged 40 to 60 years, bilingual (Urdu and English), and able to use a smartphone were included in the study. Patients with cognitive impairment were excluded. A total of 77 subjects were evaluated for eligibility. A total of 50 subjects fulfilled the inclusion criteria and were randomly divided into VESMP-U (n = 25) and CST (n = 25) groups.

The randomization was done through the sealed-envelope method using a computer-generated random number table. Randomly assigned index cards bearing consecutive numbers were prepared before the study, and once folded, were put in thick sealed envelopes. The researcher opened the sealed envelopes and provided the required treatment in accordance with the group allocation. Figure 1 shows the CONSORT diagram.

Patient intervention

We developed an Android app for the VESMP-U. The app was designed with specific consideration for the patients' level of education, its low cost, and patients' familiarity and comfort with the use of electronic devices. The VESMP-U was installed on the Android smartphone of each participant in the VESMP-U group. The VESMP-U app contains the domains of naming, reading, writing, and repetition (Table 1), and it tests functional vocabulary based on words, phrases, and sentences. The interventional stimuli consisted of images of objects along with auditory sounds of people and action cues. The voice output was operated by touching a selected picture with a finger. The training sessions of the VESMP-U, were 30 - 45 minutes long in duration, and were conducted by a speech-language pathologist with the patient with aphasia and his/her attendant. All patients in the VESMP-U group then received 64 sessions of VESMP-U intervention for 16 weeks (4 days/week). The MIT group

Figure 1. CONSORT diagram

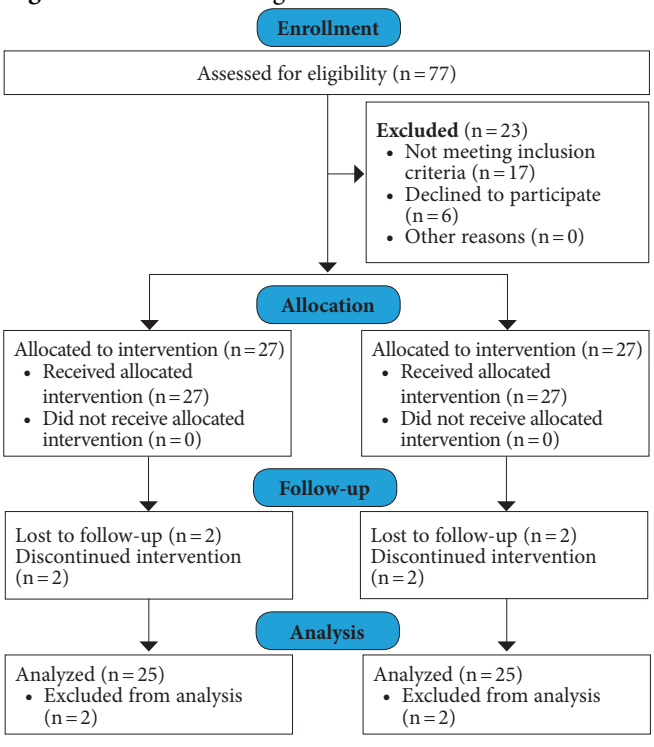

Table 1. Domains of the verbal expressive skills management program in Urdu

Sr.no	Domain	Description	Level
1	Naming	Pictures of daily functional items are presented in order, and the patient is asked to name each item. For word fluency, patients repeat the phrase and sentence written below relevant picture. Then action pictures are shown, and the patient has to describe each picture. Cues: the sound that each word starts with is given, then the word is spelled out and the name of the picture is displayed alongside auditory feedback.	I: Naming of pictures II: Responses to phrases and sentences III: Narration of pictures
2	Reading	This domain involves simple reading of a list of functional items, symbol recognition, number matching, word identification, sentence completion, phrase and sentence reading, and paragraph reading. Each part has 4 options; the patient clicks the statement that matches the representative item. If a wrong response is given, then the option color fades out.	I: Match item to picture II: Response according to functional aspects of the item III: Patients answer questions after reading a paragraph
3	Writing	The patient sees a picture and is asked to write the name of the item. This domain also involves filling in blanks, copying the alphabet, writing a word related to a given picture, spelling the item that the patient sees, and spelling a word that the patient hears. The patient is asked to write about what is happening in a picture. For assistance clicks or touch the hint option the fewer letters are shown on screen for the said picture description.	I: Easy II: Medium III: Difficult
4	Repetition	The patient is asked to repeat listed words from different categories, and their responses are recorded. Hints related to that word are presented in written and auditory form.	I: Easy II: Medium III: Difficult

received melodic intonation therapy, which was provided by speech language pathologists during the patients' regular therapy sessions, for 4 days per week for approximately 30-45 minutes each for a total of 16 weeks.

Patient assessment

The Boston Diagnostic Aphasia Examination (BDAE) is a neurological battery of tests to evaluate aphasia. The BDAE assesses perceptual modalities of language skills, such as visual, auditory, and gestural; specific higher mental processes, such as problem-solving and comprehension; and modalities of response, such as writing, articulation, and manipulation. The administration time for BDAE is 120 minutes; it consists of variables for articulatory agility, phrase length, grammatical form, prosody/intonation, spontaneous speech, word finding, repetition, and auditory comprehension.

Patients were assessed using the BDAE at 0 weeks (baseline) and after 16 weeks of intervention. The data were analyzed on the basis of pre- and post-intervention scores. The Shapiro-Wilk test for normality did not show normal distribution of data, so the nonparametric Wilcoxon signed-rank test was used for within-group analyses. The Mann-Whitney U test was used for between-group analyses. ($P < .05$) was considered as the level of statistical significance, and SPSS v. 21 was used for analysis.

RESULTS

Patient demographics

The Mean ± SD (Standard Deviation) patient age of the VESMP-U and CST (Melodic Intonation Therapy MIT) groups was 55 (11.7) years and 60 (2.1) years, respectively. The distribution of participants according to their gender, handedness, and languages in both groups can be seen in Figure 2.

Within-group analysis of BDAE scores

Within-group analysis showed that the VESMP-U group had significantly improved BDAE scores ($P = .001$) after intervention for all variables (articulatory agility,

Figure 2. Patient Demographics

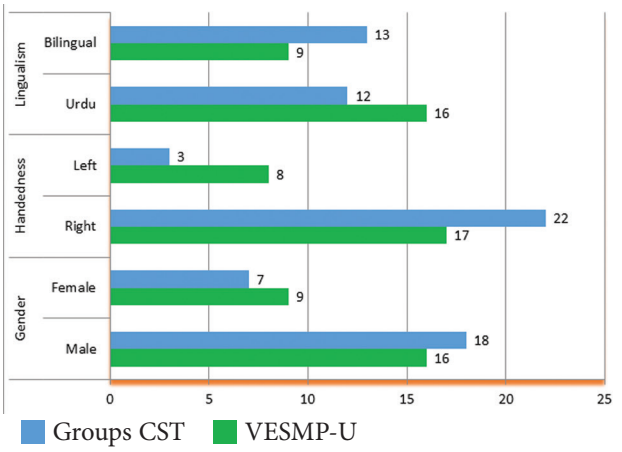

Table 2. Within-group Analysis (Boston Diagnostic Aphasia Examination Scores)

Variable	Intervention status	VESMP-U group Median (IQR)	VESMP-U group Z score	VESMP-U group *P* value	CST group Median (IQR)	CST group Z score	CST group *P* value
Articulatory agility	Pre	2 (0)	-4.45	.001	4 (1)	-3.54	.05
	Post	6 (0)			5 (2)		
Phrase length	Pre	2 (1)	-4.39	.001	2 (1)	-4.01	.001
	Post	5 (2)			4 (1.5)		
Grammatical form	Pre	1 (1)	-4.40	.001	2 (2)	-4.31	.001
	Post	5 (2)			4 (1)		
Prosody/ Intonation	Pre	2 (2)	-4.40	.001	1 (1)	-3.38	.05
	Post	6 (2)			4 (2)		
Spontaneous speech	Pre	1 (0.0)	-4.42	.001	1 (1)	-2.38	.06
	Post	4 (1.5)			3 (2)		
Word finding	Pre	3 (2)	-4.32	.001	3 (1.5)	-2.78	.06
	Post	6 (2)			4 (4)		
Repetition	Pre	20 (10)	-4.39	.001	20 (10)	-0.32	.76
	Post	70 (30)			50 (20)		
Auditory comprehension	Pre	50 (15)	-4.40	.001	70 (30)	-4.40	.001
	Post	80 (15)			70 (20)		

Note: The interquartile range takes the third quartile value and subtracts the first quartile value. Equivalently, the interquartile range is the region between the 75th and 25th percentile.

Abbreviations: CST, conventional speech therapy; VESMP-U, verbal expressive skills management program in Urdu.

Table 3. Between-group Comparison (Boston Diagnostic Aphasia Examination Scores)

Variable	Group	Pre-Intervention			Post-Intervention		
		Median (IQR)	*U* score	*P* value	Median (IQR)	*U* score	*P* value
Articulatory agility	VESMP-U	2 (0.0)	66	.001	6 (0.0)	137	.001
	CST	4 (1)			5 (2)		
Phrase length	VESMP-U	2 (1)	287	.56	5 (3)	189	.01
	CST	2 (1)			4 (1.5)		
Grammatical form	VESMP-U	1 (1)	215	.04	5 (2)	146	.001
	CST	2 (2)			4 (1)		
Prosody/ Intonation	VESMP-U	2 (2)	262	.28	6 (2)	72	.001
	CST	1 (1)			4 (2)		
Spontaneous speech	VESMP-U	1 (0.0)	225	.39	4 (1.5)	80	.001
	CST	1 (1)			3 (2)		
Word finding	VESMP-U	3 (2)	288	.61	6 (2)	70	.001
	CST	3 (1.5)			4 (4)		
Repetition	VESMP-U	20 (10)	288	.61	70 (30)	206	.03
	CST	20 (10)			50 (20)		
Auditory comprehension	VESMP-U	50 (15)	217	.67	80 (15)	150	.05
	CST	70 (30)			70 (20)		

Abbreviations: CST, conventional speech therapy; VESMP-U, verbal expressive skills management program in Urdu.

Table 4. Comparison of Stroke-Specific quality of Life (SSQOL)

Domains	Group	Pretest Median (IQR)	*P* value	*U score*	Posttest Median (IQR)	*P* value	*U* score
Energy	Experimental	6(5)	1.0	312	11(3)	1.0	312
	Control	6(5)			15(3)		
Family role	Experimental	6(4)	.17	240	11(3)	.07	293
	Control	3(4)			11(3)		
Language	Experimental	5(3)	.66	293	20(5)	.63	293
	Control	4(2)			14(4)		
Mobility	Experimental	8(3)	.03	216	20(6)	.04	277
	Control	6(2.5)			20(5)		
Mood	Experimental	5(7)	.89	303	5(7)	.93	308
	Control	5(7)			18(4)		
Personality	Experimental	3(5)	.46	275	3(2.5)	.68	291
	Control	3(2.5)			18(4)		
Self-care	Experimental	6(4)	.51	281	5 (2)	.45	275
	Control	5(2)			15(3)		
Social role	Experimental	6(4)	.52	282	6(2)	.05	212
	Control	6(2)			15(8)		
Thinking	Experimental	5(3.5)	.43	273	6(5)	.45	275
	Control	6(5)			9(3)		
SSQOL	Experimental	55 (37)	.48	276	53(12.5)	.34	263
	Control	53 (12.5)			126(12)		

Table 5. Comparison between VESMP-U and Convention Therapy (Melodic Intonation Therapy)

Sr. no	Variables	n	Mean ± SD	*P* value	*t*
1	VESMP-U	25	488.1 ± 42	.001	58.4
2	Convention Therapy	25	258.4 ± 41		33.5

phrase length, grammatical form, prosody/intonation, spontaneous speech, word finding, repetition, and auditory comprehension). In contrast, the CST group had significantly improved BDAE scores ($P=.001$) after intervention for only phrase length, grammatical form, and auditory comprehension (Table 2).

Between-group analysis of BDAE scores

Between-group analysis after intervention showed that, compared with the CST group, the VESMP-U group had significantly improved BDAE scores for nearly all variables, namely articulatory agility ($P=.001$), phrase length ($P=.001$), grammatical form ($P=.01$), prosody/intonation ($P=.001$), spontaneous speech ($P=.001$), word finding ($P=.001$), and repetition ($P=.003$). Only auditory comprehension was not statistically significant between the groups ($P=.05$) (Table 3).

Comparison of Stroke-Specific quality of Life (SSQOL)

Between-group analysis on SSQOL scale after intervention compared with the CST (MIT) group, the VESMP-U group had significantly improved showed on mobility ($P=.04$), and social role ($P=.05$), over all SSQOL was not statistically significant between the groups ($P=.34$) (Table 4).

Comparison between VESMP-U and Convention Speech Therapy (MIT)

The mean and standard deviation for VESMP-U and Convention speech Therapy (MIT). The value for VESMP-U was 488.1 ± 42 and for CST 258.4 ± 41. The significantly improved showed on VESMP-U ($P=.04$) (Table 5).

DISCUSSION

The main aim of the study was to enhance the verbal expressive skills of Urdu-speaking patients with severe Broca aphasia using the VESMP-U that was specifically designed to improve verbal expressive communication skills. The VESMP-U improves patients' verbal skills with severe Broca aphasia which was not observed in other CST (MIT). The current study offers a pathway for patients with aphasia to maintain and improve their quality of life. The advantage of using VESMP–U that has been developed in the current study, is that it allows home-based practice so that the patients can self-teach, maintain their improvement, and increase verbal expressive skills. We also saw increases in expressive skills and quality of life by using a smartphone-based Android app platform to deliver the VESMP-U. A scoping review indicates that technology use in care at home has positive impact on competence, independence, and management.[10]

At baseline, the patients showed significant disturbances in spontaneous speech, reading, writing,

and repetition; after applying the VESMP-U intervention, there was statistically significant improvement in almost all variables of the BDAE scores. The BDAE scores on articulatory intelligibility, phrase length, grammatical form, prosody/intonation, spontaneous speech, word finding, repetition, and auditory comprehension after intervention were also statistically significantly improved compared with before intervention ($P < .001$), showing that patients' verbal expressive communication skills were enhanced through use of the app.

A previously published review compared the effect of computer-based therapy with clinician-delivered and no therapy in improving verbal expressive skills among patients with aphasia. Computer based therapy was more successful than no therapy and was as beneficial as clinician-delivered therapy for a certain demographic of people with aphasia.[15]

In the present study, the VESMP-U significantly improved BDAE scores for repetition in the VESMP-U group compared with the conventional therapy group i.e., Melodic Intonation Therapy ($P = .001$). Thus, there is significant positive effects on speech production (verbal expression) of the patients through the implementation of the VESMP-U app.

A study on computerized reading treatment contained 29 tasks and 8 levels, for which patients were required to maintain their performance. Results revealed the positive effect of this computer-provided intervention.[16] A randomized computer-based aphasia therapy using a laptop-installed program was conducted on a patient with severe Broca aphasia; the patient showed instant recovery within sessions on confrontation naming tasks.[17]

The results of VESMP-U and CST groups on reading and writing skills from the present study were significant ($P < .05$). Previously published evidence suggests that computer-based therapy implemented for construction of sentences, finding of words, and reading and writing resulted in improved linguistic performance of the research participants.[18] Other researchers have investigated the efficacy of using a touch speaker system for assessing participants' daily use of vocabulary; the participants drastically improved after training and the statistics regarding satisfaction level were rated by 70% of participants.[19] Our study found a statistically significant difference ($P < .05$) between BDAE scores before and after VESMP-U intervention for all variables.

The generalizability of the study was limited due to the low sample size and because this was a single-center study. Confounding variables like gender and handedness were not included in the study.

CONCLUSION

We conclude that naming, reading, writing, and repetition skills were improved in patients with severe Broca aphasia using VESMP-U. The VESMP-U Android app improved the verbal expressive communication skills of patients with severe Broca aphasia. Further studies should be carried out with a larger and representative sample incorporating multilevel analyses for generalizability of the results in Pakistani setting.

CLINICAL MESSAGE

- We developed an app to deliver VESMP-U for the treatment of patients with severe Broca aphasia, targeting language and focusing on the functional communication of these Urdu-speaking patients in Pakistan.
- The results indicate that the app facilitated independent communication, which is usually ignored in conventional speech therapy.
- The app was a cost-effective intervention, as it provides a home-based program for patients which will eventually enhance their quality of life in long term.

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TRIAL REGISTRY INFORMATION

NCT03699605, clinicaltrials.gov

AUTHOR CONTRIBUTIONS

Dr Humaiara Shamim: conception, design of data collection, analysis and interpretation of data, critical revision of the manuscript for final approval, accountable for all aspects of the work. **Dr Sajida Naz:** conception, design of data collection, analysis and interpretation of data, critical revision of the manuscript for final approval, accountable for all aspects of the work. **Raffa Mubeen:** proofreading, analysis and interpretation of data, critical revision of the manuscript for final approval. **Rabia Zubair:** analysis and interpretation of data, critical revision of the manuscript for final approval, accountable for all aspects of the work.

COMPETING INTEREST

There are no known competing financial interests or personal relationships that could influence the work reported in this paper.

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