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KNOWLEDGE AND AWARENESS OF SPEECH LANGUAGE PATHOLOGISTS AND NEUROLOGISTS REGARDING NON-INVASIVE BRAIN STIMULATION FOR LANGUAGE RECOVERY IN PAKISTAN

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ABSTRACT

Background and Objective: Communication problems are quite commonly observed after a stroke. Usually, Speech and Language Therapy is the most commonly utilized therapy for acquired communication disorders like aphasia. However, in recent times, neuromodulation techniques like Non-Invasive Brain Stimulation (NIBS) to improve the effects of Speech and Language Therapy are also being widely investigated. The objective of this study was to assess the knowledge and awareness of Speech-Language Pathologists (SLPs) and Neurologists regarding NIBS for Language Recovery in Pakistan.

Methods: A cross-sectional study design was used in which 157 Speech-Language Pathologists and 54 Neurologists participated. Data was collected by a self-designed questionnaire that was developed with the help of expert opinion and a literature review. The data was analyzed using standard SPSS software Version 21.0.

Results: The results indicated that 104 Speech-Language Pathologists and 34 Neurologists agreed that the NIBS technique is pain-free and safe for the population with Speech-Language Pathologists having a higher mean score of 2.31. 95 Speech-Language Pathologists and 31 Neurologists believe that this technique plays a part in language recovery for a Person with Aphasia (PWA) with Neurologists having a higher mean score of 2.41.

Interpretation and Conclusion: It was concluded that knowledge regarding two major non-invasive procedures that are transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) and the part that they play in language rehabilitation is limited. However, the majority of both professionals agree that this technique plays a part in language rehabilitation for individuals who have aphasia.

Keywords: Language recovery, Neurologists, Non-Invasive Brain Stimulation, Speech-Language Pathologists

INTRODUCTION

The capacity of the cortex to structure and organize different synapses is referred to as neuroplasticity. This is an inborn ability of the brain which will occur as soon as any changes are perceived in the surroundings. However, this can only be done by administering procedures like Non-invasive Brain Stimulation (NIBS) [1]. This technique refers to procedures and approaches that activate and modify the activity of the brain in the absence of any invasive techniques that require entering the body or other body cavities [2]. These procedures have not only helped in highlighting the technique of neuroplasticity mainly in language areas of both individuals with a healthy brain and those of patients with aphasia [3] but have also played a significant role in opening the doors for neuroscience to new and greater avenues [4].

Neuromodulation- a relatively new concept- has garnered the right amount of attention globally because of its role in managing neurodegenerative disorders along with fueling an individual's capacities and overall performance. Brain stimulation, which plays an imperative part in neuroscience research, stands far more productive as compared to drug therapy mostly because of its rapid, and lasting effects. This stimulation holds importance because of its ability to directly alter the activity in certain brain regions, which improves brain conditions and overall functioning [5]. Neuroenhancement is another promising concept [6]. A non-invasive, easy-to-utilize, and safe procedure allows neuronal alterations which help researchers assess how these alterations influence behavior [7].

These procedures are utilized in adults who are physically fit to either explore brain techniques or to alter and augment different procedures like cognitive, emotional, behavioral, and social [8]. Restoration of brain function is imperative for language recovery in patients who develop an acquired communication disorder referred to as aphasia after a stroke. With the advent of technology, it is now evident that when the dominant area that is dedicated to language in the left part of the brain is modified, language rehabilitation is strengthened [9].

In recent times, the concept of NIBS which is also referred to as a neuromodulation tool, has come out as an encouraging treatment technique [10]. More tailor-made management guidelines are expected to be utilized due to recent technological developments. Certain drawbacks of Non-Invasive Brain Stimulation are noted by researchers including temporary headaches, pain in the neck, and short-lived auditory problems. Certain guidelines are important and should be followed while administering Non-Invasive Brain Stimulation. Other than that, due to the increasing interest as well as the implementation of Non-Invasive Brain Stimulation, medical professionals must be trained well and use the best tools when implementing Non-Invasive Brain Stimulation [11].

A study that was conducted in 2022 by Anastasios M. Georgiou and Maria Kambanaros [12] talked about the efficacy of two models in rTMS. In current-day practices, Speech Language Therapy is not only used as a management technique for treating aphasia. Non-invasive procedures of stimulation of the cortex are also being equally investigated. Two models; rTMS with a frequency of 1 Hz and continuous theta burst stimulation (cTBS) were examined here. A sample of 6 individuals was taken who were diagnosed with aphasia after a left cerebral hemisphere stroke. The patients were equally divided. The 1 Hz rTMS model was used as a therapeutic approach for 3 patients while the other three were treated by utilizing cTBS. In all 6 patients, TMS was administered over the right pars triangularis. The results indicated a betterment in numerous areas of language for all patients including receptive, and expressive language, naming abilities, and reading competency. The results are

conclusive of the fact that inhibitory TMS when administered over the right pars triangularis reinforces neuroplasticity which shows that this technique is fruitful for augmenting language rehabilitation in post-stroke aphasia.

Research that was conducted in 2022 by Sameer A. Ashaie et al., [13] aimed at analyzing the effective timing when paired with speech-language therapy (SLT). In this scenario, timing was considered an important factor for making tDCS efficient in use when paired with SLT. Online tDCS was given during SLT whereas offline tDCS was provided before or after SLT. Being a randomized study, participants were randomly divided into groups being provided any one of the four treatment options. All groups received SLT. Three groups received tDCS before SLT, simultaneously with SLT, and after SLT. The remaining group only received SLT. 48 participants divided into 12 per group were included. It was concluded that the tDCS provided before SLT helped in augmenting the language areas while tDCS followed by SLT helped in strengthening the memory of an individual.

Research conducted in 2022 by Bing-Fong Lin et al., [14] focused on determining whether language skills can be improved in patients with an acquired language disorder and the part played by rTMS. A small frequency of rTMS was applied. 33 clients including 22 males were selected who suffered a stroke in the left side of the brain along with non-fluent aphasia. Placebo and real trials of low-frequency rTMS were administered over the cortex for 10 continuous days of the week. It was observed that after LF-rTMS, significant betterment in both receptive and expressive language was observed as compared to that of the fake group.

A study conducted in 2021 by Radwa K. Soliman et al., [15] examined the rehabilitation process in an acquired language disorder when tDCS is applied. The clients included were 21 in number who had a language disorder after a stroke. Patients were randomly assorted into 2 groups where one received real tDCS while the other received fake tDCS. 10 bihemispheric tDCS sessions which were divided into 5 per week over both the left damaged area (anodal stimulation) and right non-damaged area (cathodal stimulation) were conducted. Neuroplasticity was observed due to these differences which can lead to better recovery.

A study conducted in 2021 by Mehrnaz Gholami, Nooshin Pourbaghi, and Samaneh Taghvatalab [16] discussed the aphasia rehabilitation process when stimulated with rTMS. rTMS improves the naming ability in patients who have developed aphasia after a stroke. The role of rTMS in improving naming performance has been mentioned in patients with chronic non-fluent aphasia since 2005. A systematic review and meta-analysis were conducted. The related studies were recruited which met the inclusion criteria. 423 studies were selected. 50 articles were further examined. 11 studies were finally selected. 301 stroke clients took part in these 11 studies. Prominent effects for the naming performance were noted and no patient out of the 11 studies reported any side effects from rTMS. This meta-analysis established a positive relationship between language recovery and the administration of rTMS.

A study conducted in 2021 by Julius Fridriksson and Argye Elizabeth Hallis [17] discussed the current and most used procedures for aphasia rehabilitation. Aphasia usually presents after a stroke or any other trauma or insult to the brain. Post-stroke aphasia can have a lasting impact on the life of an individual and can hamper the social life of a person. Traditional Speech Language Therapy is the most widely used treatment to rehabilitate the patient. However, other techniques are also being utilized to supplement the effect of this Therapy. Controlled trials of Speech and Language Therapy and computer-aided language therapies were examined. Behavioral therapy is supplemented with either pharmaceutical interventions or non-invasive brain stimulation methods that modulate and alter cortical plasticity. Aphasia management is received by all individuals and evidence explains how stimulating the cortex is an encouraging procedure to augment language rehabilitation. However, it was also concluded that larger clinical trials should be included in future research so that the most appropriate approaches can be utilized for the treatment of aphasia.

Research conducted in 2020 by Anastasios M. Georgiou, Ioannis Phinikettos, Chrysa Giasafaki, and Maria Kambanaros [18] aimed at finding out if TMS can help with rehabilitation in patients with aphasia. A 74-year-old female was included in the study who had a left MCA stroke 48 months earlier. In this study, rTMS burst protocols were applied to determine if this alone can aid in language recovery.

Results indicated improvement in production, a day after treatment. Better outcomes were observed in comprehension and an average betterment was seen in the reading task at 2 and 12 months after treatment. It was concluded that cTBS when applied over the right pars triangularis can bring long-lasting changes in language rehabilitation by improving skills in different language areas. Especially in individuals who are diagnosed with chronic global aphasia post-stroke.

The objective of this study was to assess the knowledge and awareness of Speech-Language Pathologists and Neurologists regarding NIBS for Language Recovery in Pakistan. Knowledge and awareness among the professionals like Speech-Language Pathologists and Neurologists regarding NIBS for language recovery have not been assessed in previous literature, especially in Pakistan. Thus, the purpose of conducting this research was to both create awareness regarding this neuromodulation technique and to analyze whether this technique can be utilized in Pakistan to augment the effects of Speech and Language Therapy.

MATERIALS AND METHODS

A cross-sectional survey was used as a study design. The study was conducted from January 2023 to June 2023 after permission was granted by the Research and Ethics Committee to collect data. The sample size for Speech-Language Pathologists was calculated to be 157 based on the total number of BS graduate Speech-Language Pathologists (N=263) by using an online sample size calculator Raosoft keeping 95% confidence interval and 5% margin of error [19]. The sample size for Neurologists was calculated to be 54 based on the number of Neurologists practicing in private and government setups (N=255) by using an online sample size calculator Raosoft keeping 95% confidence interval and 12% margin of error [20]. The sample was collected from Sheikh Zayed Hospital, Ittefaq Hospital, Lahore General Hospital, and Services Hospital, Pakistan. A Purposive Sampling Technique was used to collect the data. A questionnaire was developed with expert opinion and a literature review. The questionnaire was validated by 5 professionals in the field. The content validity index for the questionnaire was calculated to be 0.8. Before the questionnaire was distributed, a REC letter was collected from the Research and Ethics Committee (Ref. No. REC/RCR & AHS/23/0608). Once the approval was granted, informed consent was taken from both Speech-Language Pathologists and Neurologists. Data was collected from both professionals working across Pakistan with the help of the designed questionnaire. Data was collected by visiting hospitals in Lahore and from Speech-Language Pathologists and Neurologists in other cities, data was collected via an online questionnaire that was generated through Google Forms. Speech-Language Pathologists who participated in this study held at least a BS (Hons.) degree in Speech-Language Pathology and a working experience of 1 year or more with acquired neurogenic communication disorders. Consultant Neurologists, Postgraduate trainees (Neurology), and House Officers (Neurology) who had a working experience of 1 year or more also participated in the study. All other Allied Health Professionals and Consultants were excluded from this study. Data were analyzed in SPSS 21 by using descriptive statistics and also calculating mean scores.

RESULTS

Table 1 represents the summarized results of the demographics. It depicts the work experience and workplace of Speech-Language Pathologists and Neurologists. Out of 157 SLP's, the majority (112) had a work experience of 1-2 years with acquired neurogenic communication disorders. Out of 54 Neurologists, the majority (28) had a work experience of 1-2 years. Out of 157 SLPs, 59 worked in a Hospital setting. Others either worked in a Rehab setup, Teaching hospital or any Private setup. Out of 54 Neurologists, 40 worked in a Teaching Hospital with the remaining working in Hospital settings or a Private setup.

I: Summarized Results of Demographics

Demographics	**Speech-Language Pathologists**		**Neurologists**	
	Frequency	**Percent**	**Frequency**	**Percent**
Work Experience with Adult Neurological Disorders				
• **1-2 years**	112	71.3	28	51.9
• **3-5 years**	26	16.6	16	29.6
• **6-10 years**	10	6.4	3	5.6
• **11-15 years**	3	1.9	3	5.6
• **More than 15 years**	6	3.8	4	7.4
Total	157	100	54	100
Workplace				
• **Rehab Setup**	50	31.8	0	0.0
• **Hospital Setting**	59	37.6	9	16.7
• **Teaching Hospital**	14	8.9	40	74.1
• **Private Setup**	34	21.7	5	9.3
Total	157	100	54	100

Table 2 represents summarized results for comparison of responses of both SLPs and Neurologists. The results indicated that 104 Speech-Language Pathologists and 34 Neurologists agreed that the NIBS technique is pain-free and safe for the population with Speech-Language Pathologists having a higher mean score of 2.31. 95 Speech-Language Pathologists and 31 Neurologists also believe that this technique plays a part in language recovery for a Person with Aphasia (PWA) with Neurologists having a higher mean score of 2.41.

II. Summarized Results for Comparison between Speech-Language Pathologists and Neurologists of Knowledge and Awareness Regarding Non-Invasive Brain Stimulation for Language Recovery in Pakistan

QUESTIONS	**Speech Language Pathologists**			**Neurologists**		
	Agree	**Neutral**	**Disagree**	**Agree**	**Neutral**	**Disagree**
1) NIBS; a set of techniques; that uses transcranial stimulation	119	36	2	46	6	2
2) Major modalities; tDCS and TMS	101	55	1	28	23	3

3) NIBS; painless and safe; improves language deficits post-stroke aphasia	104	43	10	35	16	3
4) Only SLT used for language recovery in Pakistan	84	53	20	28	17	9
QUESTIONS	**Speech Language Pathologists**			**Neurologists**		
	Agree	**Neutral**	**Disagree**	**Agree**	**Neutral**	**Disagree**
5) One TMS device; approved by the FDA; pre-surgical mapping	73	73	11	19	21	14
6) TMS; right pars triangularis; neuroplastic changes	82	68	7	22	26	6
7) Low-frequency rTMS; right IFG; positive effect on rehabilitation	82	70	5	25	25	4
8) Low-frequency rTMS and c-TDCS; promising techniques	85	68	4	32	19	3
9) tDCS; first modern transcranial current stimulation	68	79	10	25	25	4
10) Left hemisphere activation; excitatory anodal tDCS; language rehabilitation	90	56	11	27	24	3
QUESTIONS	**Speech Language Pathologists**			**Neurologists**		
	Agree	**Neutral**	**Disagree**	**Agree**	**Neutral**	**Disagree**
11) tDCS; easy to utilize, safe, cost-friendly	71	68	18	26	18	10
12) Efficacy; TMS more than tDCS	66	88	3	19	31	4
13) Side effects of TMS; headache or neck pain	72	75	10	22	27	5

14) tDCS; low risk of adverse events	76	74	7	21	24	9
15) Seminars attended for NIBS	42	57	58	5	5	44
16) NIBS; role in language recovery	95	56	6	31	22	1
17) NIBS; the potential to treat brain disorders; despite challenges	92	56	9	36	14	4

Table 3 depicts the summarized results of the mean scores of some selected questions where SLPs have a higher mean score regarding the question of low-frequency rTMS and c-tDCS being promising techniques for the future. Neurologists have a higher mean score for the question about NIBS playing a positive role in language rehabilitation.

III. Comparison of Mean Score Responses of Speech-Language Pathologists and Neurologists

Questions	**Mean Scores**	
	Speech Language Pathologists	**Neurologists**
Q3) NIBS is painless and safe and improves language deficits post-stroke aphasia	2.31	2.28
Q4) Only Speech Language Therapy used for language recovery in Pakistan	2.46	2.63
Q7) Low-frequency rTMS over the right inferior frontal gyrus has a positive effect on rehabilitation	2.49	2.54
Q8) Low-frequency rTMS and c-tDCS are promising techniques	2.45	2.39
Q10) Left hemisphere activation by excitatory anodal tDCS is helpful in language rehabilitation	2.46	2.44
Q11) tDCS is easy to utilize, safe, and cost-friendly	2.65	2.69
Q16) NIBS has a role in language recovery	2.34	2.41

DISCUSSION

Communication problems are observed in individuals post-stroke. Post-stroke aphasia is usually treated by providing Speech-Language Therapy (SLT) but is not continuous in frequency and intensity. However, some novel and effective techniques should be utilized to boost the effectiveness of SLT. Research conducted in 2022 by Serdar Kesikburun [21] confirmed that NIBS can be considered a relatively safe technique. John Hopkins Medicine Institute and Mount Sinai which utilize the Non-Invasive Stimulation Program also confirm the same. Research conducted in 2023 by Argye Hillis [22] also confirmed that NIBS can boost the efficacy of language therapy in patients with post-stroke aphasia. In this current study, 104 Speech-Language Pathologists and 35 Neurologists agreed with the statement that NIBS is a painless and safe technique that enhances the language recovery process in patients with post-stroke aphasia with SLPs having a higher mean score. Research conducted in 2022 by Bing-Fong Lin et al., [14] confirmed that when TMS is applied over right pars triangularis, the effectiveness of post-stroke language recovery increases. In this study, only 82 Speech-Language Pathologists and 22 Neurologists agreed with the statement while the other professionals were

uncertain about the role of this technique. Low-frequency rTMS over the triangular region of the right inferior frontal gyrus has an important role in language rehabilitation as indicated by research that was conducted by Cai-Li Ren et al., in 2014 [23]. In this current study, only 82 Speech-Language Pathologists and 25 Neurologists agreed with the statement making the other professionals uncertain about this technique. When asked if the professionals think transcranial direct current stimulation (tDCS) was the first transcranial current stimulation procedure to be used, 79 Speech-Language Pathologists and 25 Neurologists were neutral regarding the statement. This showed that numerous professionals are not aware of this technique and don't know whether it is the first procedure to be utilized as confirmed by John Rothwell in 2018 [24]. Numerous researches like one conducted in 2017 by Catherine Norise and Roy H. Hamilton (9) and in 2013 by Alexandar Thiel et al., [25] have confirmed the positive role of NIBS in language recovery for patients with post-stroke aphasia. In the current study, 95 Speech-Language Pathologists and 31 Neurologists agreed with this statement.

Data could not be collected from many professionals because they reported that they did not want to fill the form. Some questionnaires also had to be discarded because of the incomplete data. Due to this reason, other hospitals and clinical setups had to be visited and questionnaire had to be shared online to complete the sample size.

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