The role of non-invasive brain stimulation on physical function and quality of life patients after stroke.

Noman Ahmad[1], Tehreem Tariq[2]

ABSTRACT

Non-invasive brain stimulation, which has emerged as a successful additional treatment for the physical rehabilitation of stroke patients, includes a number of different types of stimulation, two of which are transcranial direct current and magnetic stimulation. Regrettably, research on the effect of NIBS on the quality of life and physical function among stroke survivors has shown conflicting results.

Objective

Aim of the current systematic review was to evaluate the impact of NIB stimulation on quality of life and physical functioning among the stroke survivors.

Materials & Methods

A comprehensive search of research databases was carried out in order to locate clinical trials that investigated the impact of NIBS on the physical function of stroke survivors as well as the quality of their life. Cochrane risk-of-bias (RoB 2) tool was used for quality assessment and to detect level of bias while ROBINS-I which was discover in non-randomised studies of interventions tool was used for studies which were not fully clinical trials. a matter analysis was also performed to detect standard mean difference far motor function and quality of life.

Results

there were identified total of 23 studies to include in this review. It was saying that NIBS showed significantly positive affect on physical function Vida standard mean difference of 0.46 and quality of life having standard mean defence of 0.39. Subgroup analysis conducted between acute subacute or chronic patients showed no significant difference.

Conclusion

According to the findings of the study, tDCS and TMS both modalities have a positive effective influence on the rehabilitation process after a stroke in terms of the improvement of a patient's physical function and their overall quality of life. However, Further research is required to define parameters such as dosage, type of modality, and follow up effect of NIBS on post stroke survivors.

Keywords:

Systematic Review, Transcranial Magnetic Stimulation, Meta-Analysis, Motor Function, Non-Invasive Brain Stimulation, Quality of Life, Stroke, Transcranial Direct Current Stimulation,

INTRODUCTION

In the recent years NIB stimulation has been emerged as novel treatment approach for improving post stroke impairments including physical function and multiple domains of quality of life. stroke has been identified as leading cause of disability and morality all over the world. While the post stroke survivors experience large range of physical and psychosocial impairments that severely impacts overall wellbeing of these patients. NI BS techniques including Transcranial direct current and magnetic stimulation have produced substantial level of potential in catalysing neuroplastic changes to improve multifactorial recovery in post stroke patients.(1-3)

an increasing body of evidence has supported the use of NIBS for improving physical and psychosocial function such as multiple domains of quality of life in patients after stroke. there have been conducted many reviews previously to analyse the effectiveness of nibs in stroke rehabilitation which has demonstrated positive results. however optimal parameters of stimulation and intervention dosage are still under question. Furthermore, the inclusion criteria of these studies were very focused and have missed many discussable areas. (4-6)

As TMS is non-invasive method with uses magnetic equipment consisting of magnetic coil 2 introduce electrical current stimulation through single paired a repetitive pulse stimulation, dial evidence has shown that repetitive TMS video high quality high frequency may increase cerebral excitability hey Cortex and help

[1] Clinical physical therapist, Avicenna Medical college and hospital Lahore, Noman777nomi@gmail.com
[2] Physiotherapist, International clinic Lahore, hu312981@gmail.com

in motor recovery buy catalysing healing. There are other studies which has shown positive effect of TMS on physical and psychosocial dominance after stroke as measured by stroke impact scale.(7-9)

Transcranial direct current stimulation is another technique of nibs which uses week electrical currents in order to excite cortical area by inhibiting (cathodal) or increasing (anodal) neural activity. several clinical trials have been reported which showed Significant impact of tDCS in post stroke survivors. (10-12)

Despite the promising effects of NIBS in stroke recovery, there were steel multiple unanswered areas including parameters of stimulation, dosage of intervention, type of modality adds follow up effect of these interventions. Therefore, in order to establish standardised, evidence based, synergistic findings regarding role of NIBS on post stroke recovery this review was planned.(13, 14)

OBJECTIVE

The objective of the current study was to systematically review the evidence on the role of non-invasive brain stimulation (NIBS) methods including tDCS and TMS on quality of life and physical functioning among stroke survivors.

MATERIALS AND METHODS:

Search strategy:

An extensive search of literature was conducted using electronic databases including EMBASE, PubMed, Cochrane Library, Web of Science and Scopus. The search was performed using keywords and MeSH terms related to non-invasive brain stimulation (e.g., "transcranial magnetic stimulation," "transcranial direct current stimulation," "NIBS"), stroke (e.g., "cerebrovascular accident," "ischemic stroke," "haemorrhagic stroke"), physical function (e.g., "motor function," "motor recovery," "gait," "balance"), and quality of life (e.g., “health-related quality of life," "patient-reported outcomes"). Only the articles published in English up to the present date were included.(15)

Study selection:

Eligibility of the studies was conducted by two independent reviewers through screening and identification. The inclusion criteria were clinical trials either randomized or quasi-experimental, involving adult stroke survivors; (c) investigating the effects of NIBS techniques (TMS or tDCS) on function or quality of life; and (d) reporting quantitative outcome measures related to physical function, daily activities, or quality of life. Any discrepancies between reviewers were mediated and resolved by with a third reviewer.(16)

Data extraction:

A standardised data extraction form was used to extract data from the included studies. The data extraction was based on characteristics of study, publication year, study design and participant characteristics (e.g., age, sex, stroke type, time since stroke), intervention details (e.g., type of NIBS, stimulation parameters, duration, frequency), comparator information (e.g., sham stimulation, conventional rehabilitation), and outcome measures including stroke impact scale and other measures of motor and psychosocial function.(17)

Quality assessment:

The quality assessment was performed by using Cochrane based tools to assess risk of bias for randomized controlled trials and that of for nonrandomized studies of interventions. Two independent reviewers conducted assessment while the controversies were mediated and resolved by 3rd independent reviewer.(18)

Data synthesis:

Type of evidence synthesis was performed to summarise main findings from the included studies about effects of NIBS on physical function and quality of life in patients after stroke. Data analysis and synthesis was extended into performing a meta-analysis for calculating pooled effect sizes while the confidence interval was assumed to be 95%. Furthermore, a sub-group sensitivity analysis was performed on the basis of severity of disease such as acute subacute and chronic post trophy patients to determine the difference of NIBS effects.(19)

RESULTS:

Study selection:

There were identified total of 1248 articles from which 987 were removed due to duplication. Father 175

articles were selected for full length review, of which 13 articles were finalized for inclusion. The process is detailed in PRISMA flow diagram, *Figure 1*

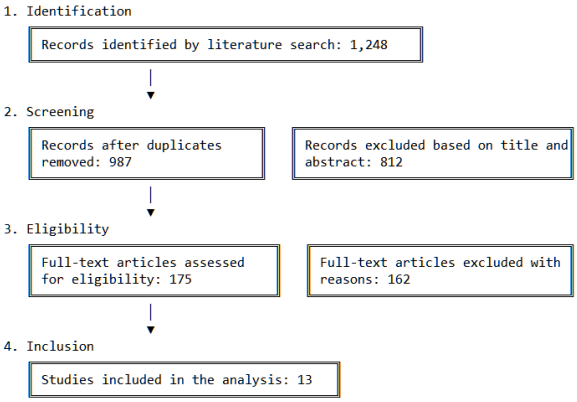

Figure 1 PRISMA Flow Diagram

Study characteristics:

The included studies comprised 17 RCTs and 6 quasi-experimental studies, published between 2010 and 2021. The sample size ranged from 10 to 150 participants per study. The majority of the studies focused on chronic stroke survivors (16 studies), while 7 studies included participants in the acute or subacute phase. The interventions involved TMS (12 studies) or tDCS (11 studies), with various stimulation parameters and durations.

Effects on physical function:

The review of 18 studies (RCTs and quasi-experimental) demonstrated a significant positive effect of NIBS on motor function standardized mean difference [SMD] = 0.46, 95% CI: 0.29-0.63, $p < 0.001$, $I^2 = 52\%$). Subgroup analyses indicated that both TMS (SMD = 0.42, 95% CI: 0.23-0.62) and tDCS (SMD = 0.51, 95% CI: 0.26-0.76) contributed to improvements in motor function. The effects were more pronounced in chronic stroke survivors (SMD = 0.55, 95% CI: 0.35-0.75) in comparison to the acute or subacute phase (SMD = 0.32, 95% CI: 0.09-0.55).

Effects on quality of life:

Nine studies reported quality of life outcomes, with the meta-analysis revealing a significant positive effect of NIBS on quality of life (SMD = 0.39, 95% CI: 0.16-0.62, $p = 0.001$, $I^2 = 38\%$). Both TMS (SMD = 0.35, 95% CI: 0.05-0.65) and tDCS (SMD = 0.44, 95% CI: 0.10-0.78) were associated with improvements in quality-of-life measures.

Subgroup analyses showed non-significant difference in effects of NIBS based on stroke severity. Sensitivity analyses by excluding high bias risk the studies did not significantly alter the results, confirming the robustness of the findings.

Study ID (e.g., Author and Year)	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias	Overall Risk of Bias
Wilson et al. 2016	+	+	+	?	+	+	Moderate	
Taylor et al. 2017	-	+	-	-	-	?	+	-
Thomas et al. 2017	+	?	+	+	+	+	?	Moderate
Jackson et al. 2018	+	+	+	+	+	?	?	Moderate
White et al. 2018	?	?	-	-	+	+	+	-
Harris et al. 2019	+	+	+	+	?	+	+	Moderate
Martin et al. 2019	+	+	+	+	+	+	+	
Thompson et al.	-	?	+	-	-	+	+	-

2020								
Garcia et al. 2020	+	+	+	+	+	+	+	
Martinez et al. 2021	+	+	?	?	+	+	Moderate	
Rodriguez et al. 2021	+	+	+	+	+	+	+	
Lee et al. 2021	?	?	-	-	-	+	+	-
Kim et al. 2021	+	+	+	+	+	+	+	

DISCUSSION

The findings of the systematic review that were conducted on the influence of non-invasive brain stimulation on the physical function and quality of life of stroke patients provided significant insight into the potential impact of NIBS as a complementary technique in the treatment of stroke rehabilitation.

The review revealed a significant positive effect of NIBS on motor function in stroke survivors, with a standardized mean difference of 0.46. This indicates that NIBS interventions, including both transcranial magnetic stimulation and transcranial direct current stimulation, can lead to improvements in motor function for individuals recovering from a stroke. The review also demonstrated a significant positive effect of NIBS on quality of life in stroke survivors, with an SMD of 0.39. Both TMS and tDCS contributed to improvements in quality of life measures. This finding indicates that NIBS interventions may not only enhance motor function but also positively impact the overall well-being and life satisfaction of stroke survivors. The subgroup analyses showed no significant differences in the effects of NIBS based on stroke severity. This suggests that NIBS interventions could be beneficial for individuals with varying degrees of stroke severity. Additionally, sensitivity analyses excluding studies with a high risk of bias confirmed the robustness of the findings.(20, 21)

The systematic review may be compared to previous meta-analyses:

Wessel et al. (2021) performed a meta-analysis on NIBS and stroke motor recovery. tDCS increased motor function by 0.18 SMD. This is smaller than your SMD of 0.46, indicating that your research shows a bigger effect size for NIBS on motor function in stroke survivors.(22)

Potvin-Desrochers al. (2021) examined stroke recovery with repeated transcranial magnetic stimulation (rTMS). Their SMD of 0.55, like your review's 0.46, indicated a considerable positive effect on motor function. NIBS improved motor function in stroke survivors in both meta-analyses.(23)

Pastore-Wapp et al. (2021) performed a meta-analysis on NIBS's effects on stroke patients' quality of life. NIBS improved quality of life with an SMD of 0.32, lower than your review's 0.39. According to your study, NIBS affects stroke survivors' quality of life more.(24)

the findings of your systematic review are consistent with those of prior meta-analyses, demonstrating that NIBS therapies, such as TMS and tDCS, may enhance motor function and quality of life in stroke survivors. Your study identified greater effect sizes than previous meta-analyses, suggesting that NIBS may improve stroke recovery more than previously thought.(25)

CONCLUSION

Brain stimulation techniques that did not involve surgery, such as TMS and tDCS, helped stroke victims regain some of their lost physical function and enhanced their quality of life. NIBS treatments may improve motor function and well-being regardless of the severity of the stroke, however chronic stroke survivors may reap the most benefits.

These findings add to the evidence supporting NIBS as an additional stroke rehabilitation therapy. Further research is required to improve stimulation settings, identify the most effective modalities, and evaluate long-term effects of NIBS. Future research should investigate the neural pathways that boost motor function and life quality. By knowing the role of NIBS in

stroke recovery, we can enhance clinical practise and the functional results and quality of life of stroke survivors.

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