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Research Article

Feasibility Testing of Context-Specific Home-Based Action-Observation-Therapy on Upper Limb Functions Among Nigerian Stroke Survivors

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Abstract

Background: Stroke is a leading cause of chronic neurological disability resulting in dysfunction of upper limbs and limitation in activity performance among survivors. Substantial constraint in accessing rehabilitation resources necessitate the need to provide alternative scalable home-based treatment options that can complement or where necessary, substitute hospital-based rehabilitation. The study reports findings from the feasibility testing of a context-specific home-based Action Observation Therapy (AOT) programme developed to improve upper limb functions among Nigerian stroke survivors (SSVs). Methods: A quasi-experimental study was conducted with ten SSVs recruited from the Medical Rehabilitation Department at the Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife. The SSVs participated in a six-week home-based AOT programme, consisting of five sessions per week, which included observation and imitation of goal-directed activities involving the upper limbs. Evaluations of motor and sensory function, hand dexterity and basic activities of daily living (BADL) were conducted using the Fugl-Meyer Assessment of Upper Extremity (FMA-UE), Box and Block Test (BBT) and Barthel Index (BI) respectively at baseline, 3rd, and 6th weeks. A repeated-measures ANOVA was applied to analyze the data, with a significance level of $p < 0.05$. Findings: The results showed a significant improvement in upper extremity motor function ($F=58.22$; $p=0.001$), indicating progressive motor gains during the six-week intervention. However, no significant differences were identified in upper limb sensation, hand dexterity and BADL ($p > 0.05$). Conclusion: The context-specific home-based AOT programme significantly improved UE motor function among Nigerian SSVs with no significant recovery of sensory function, hand dexterity and BADL. Future study involving larger sample that employ a randomized control trial design is suggested to determine the functional and clinical relevance of this motor recovery.

Keywords

Stroke Rehabilitation, Action Observation Therapy (AOT), Upper Limb Function, Motor Recovery, Home-based Intervention, Hand Dexterity, Activities of Daily Living (ADL), Neurorehabilitation

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1. Introduction

Stroke is among the leading cause of long-term neurological disability in the world, and its burden is ever-increasing, especially in developing countries, where efforts to access good rehabilitation are few [1]. Upper limb dysfunction has been documented as one of the most devastating effects of stroke among survivors as it does not only limits performing of basic daily tasks like eating, dressing, and personal hygiene but impacts involvement in important roles and responsibilities of SSVs [2]. While conventional hospital-based rehabilitation tends to focus on recovery of mobility, these are not the only indicators of complete recovery or reintegration into society [3]. Functional recovery of upper limbs is necessary so that SSVs would regain their independence and enhance their quality of life. Over the years, conventional hospital-based rehabilitation has demonstrated clinical effectiveness on upper limb function, however, its impact in sub-Saharan Africa is substantially constrained by systemic barriers, including shortages of rehabilitation professionals, high healthcare costs, and the geographical inaccessibility of rehabilitation facilities for stroke survivors, all of which limit meaningful improvements in long-term stroke rehabilitation outcomes. Thus, underscoring the need to have more viable and accessible treatment solutions [4].

Action Observation Therapy has emerged as a promising intervention in neurorehabilitation, it aims to improve motor learning and functional recovery by having patients observe and imitate goal-directed behaviors. The principle of AOT relies on the theory of the mirror neuron system, this is a neural mechanism that occurs when a person performs an action and observes someone else doing the same action [5]. Through intentional movements, patients activate the brain areas related to motor control, thus promoting neuroplastic modifications and enhancement of motor skills. AOT provides a unique way to retrain the brain and recover lost motor skills, especially in stroke survivors.

The inclusion of AOT into home-based rehabilitation is a novel and feasible approach to stroke management, particularly in under-resourced environments [6]. The home-based rehabilitation will enable patients to perform structured exercises in the comfort of their own homes, which enhances consistency, convenience, and cost-effectiveness [7]. It lowers financial and logistical restrictions that are mostly linked with visiting a hospital, and a patient becomes motivated and self-reliant. Additionally, home-based interventions are highly adaptable to the individual's progress, clinical status, and daily activities, allowing for continuous and personalized therapy. Considering the lack of rehabilitation centers and professional staff in most communities within Nigeria, home programmes that complement hospital-based intervention are viable ways of enhancing recovery post-stroke.

Despite the accumulating evidence supporting the application of AOT in stroke rehabilitation in other parts of the world, a knowledge gap remains regarding its application and effectiveness in Nigeria. Limited access to sustained stroke rehabilitation services in sub-Sharan African, Nigeria inclusive, has been associated with suboptimal recovery of upper limb function among SSVs [8]. There is a need of identifying rehabilitation interventions that are cost-effective and widely accessible, and effective. Home-based AOT presents an effective alternative as it integrates modern principles of neuro-rehabilitation with a delivery model that is appropriate to the socio-economic context of SSVs in low- and middle-income nations.

This study, therefore, reports the feasibility of a context-specific home-based AOT programme developed for improving upper limb function among SSVs receiving care at OAUTHC, Ile-Ife.

2. Methods

2.1. Research Design

This study utilized a pre-test post-test quasi-experimental research design to assess the feasibility of a context-specific home-based AOT intervention among Nigerian SSVs.

2.2. Procedure

The Ethics and Research Committee of the, OAUTHC, provided ethical approval (Ethics number: IRB/IEC/0004553). The initial steps toward the development of the context-specific AOT intervention entailed identification and synthesizing of evidence-informed AOT activities described in literature for improving upper extremity (UE) functions for neurological conditions, stroke inclusive. A desk review of literature was carried out in four databases that included CINAHL, Pubmed, Web of Sciences and Scopus using keywords relevant to the study. AOT activities and interventions were extracted from the review subsequently form the initial pool of evidence-based AOT activities for succeeding a Delph survey. The AOT activities were refined through a modified e-Delphi consensus method involving 6 panel of experts with experience in stroke rehabilitation within the Nigerian healthcare setting. The expert included 4 occupational therapists and 2 physiotherapists. A list of AOT activities that consisted of 21 items from the desk review were presented to the experts for rating based on its relevance, practicability, contextual suitability and therapeutic value. Items with content validity index score (CVI) greater than 0.79 were accepted, those with CVI score between 0.6 - 0.79 were revised and pulled a subsequent round of Delphi while CVI of < 0.6 were discarded/rejected.

Afterwards, AOT activities from the second round of Delphi survey were developed into a video in the form of storyboarding and script making using a video production methodology [9, 10]. Storyboards for each action video, outlining camera angles, participant's positioning, and key movements with onscreen text cues, were emphasized in development. Each of the activities in the intervention video were demonstrated, with the onscreen subtitle being displayed intermittently. Each video was developed in MP4 format and lasted about 2 minutes. Video recording demonstrating each item were presented to the expert panel for rating. Consensus was achieved on the AOT activities at the third round of Delphi.

The final stage of the study which is reported in this study examined the feasibility of the context-specific home-based AOT intervention using a quasi-experimental pretest–posttest design. SSVs with upper limb impairment were recruited from department of medical rehabilitation, OAUTHC, Ile-Ife, using predefined inclusion criteria. Eligibility criteria included: being an adult aged 18 years and above with a medical diagnosis of stroke, having sufficient cognitive capacity to understand and adhere to the training instructions as evidenced by a Mini-Mental State Examination score greater than 19. Conversely, SSVs with a Modified Rankin Scale score greater than 3, those with severe ideomotor apraxia as well as those with serious orthopaedic complications in the upper extremity were excluded. Additionally, individuals without access to the necessary device to watch videos at home were excluded, as the AOT intervention was home-based. The sample size of 10 was determined using a feasibility-based statistical approach, with adjustments to account for variability, dropout, and to ensure reliable data for future trials. Informed consent was obtained from eligible participants The AOT intervention programme lasted 6 weeks and consisted of five sessions per week, including two daily sessions in a calm environment at home. The sessions began with participants watching short video clips of specific upper limb actions, such as grasping objects, pouring water, or using a remote control. Upon viewing every motor activity, the participants repeated the actions after three minutes with similar objects as they were supposed to imitate in real life. There were sessions that were supervised by caregivers to ensure concentration on the videos and appropriate imitation. The participants were advised to focus on active use rather than mastering the movement in order to encourage the use of the affected limb. UE motor and sensory function were assessed with the FMA-UE [11], hand dexterity was assessed using BBT [12], and BADL was assessed using BI [13] at baseline, third- and sixth-week post-intervention. Data was collected consecutively over a 4-month period at the Medical Rehabilitation Clinic, OAUTHC, Ile-Ife.

2.3. Intervention

There were 10 home-based activities: understanding and moving objects in horizontal and vertical levels, transferring a cup, washing a table top, pouring and drinking water, eating fruit or food with utensils, throwing paper balls, and using a remote control. The activities were also divided into basic subtasks to facilitate the progressive learning of motor skills and activation of the mirror neuron system (Table 1).

Table 1. *Description of Activities within the Action Observation Therapy Intervention.*

	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
DAY 1	Grasp and move an object in a horizontal plane	Grasp and move an object in the vertical plane	Cleaning the tabletop	Drink from a cup	Eat an apple/fruit	Throw paper balls (waste) into the trash
DAY 2	Grasp and move an object in a horizontal plane	Transfer the cup from the table to the tray	Cleaning the tabletop	Drink from a cup	Eat with a fork (Yam/Carrot)	Throw paper balls (waste) into the trash
DAY 3	Grasp and move an object in a horizontal plane	Transfer the cup from the table to the tray	Pour water from the bottle into the cup	Drink from a cup	Eat with a fork (Yam/Carrot)	Use a remote control (AC/TV)
DAY 4	Grasp and move an object in the vertical plane	Transfer the cup from the table to the tray	Pour water from the bottle into the cup	Eat an apple/fruit	Eat with a fork (Yam/Carrot)	Use a remote control (AC/TV)
DAY 5	Grasp and move an object in the vertical plane	Cleaning the tabletop	Pour water from the bottle into the cup	Eat an apple/fruit	Throw paper balls (waste) into the trash	Use a remote control (AC/TV)

2.4. Data Analysis

Data was analysed using descriptive statistics, such as mean, standard deviation, frequencies, and percentages as well as inferential statistics of Repeated-measures ANOVA with significance level of $p \leq 0.05$.

3. Results

The results showed that the mean age of the participants 49.0±9.3 years with a range of 28.0-60.0 years, Majority of participants were male (70%), had experiences ischemic stroke (80%) and had moderate disability (mRS=3). The time since stroke onset among participants varied, with more than half of the participants having post-stroke duration of over one year (60%) (Table 2). The result further showed a statistically significant improvement in UE motor function among participants across AOT intervention time. (F = 58.22, p = 0.001). However, UE sensory function, remained constant throughout the treatment. In the same vein, the slight difference observed in BADL, right- and left-hand dexterity across AOT intervention period was found not to be statistically significant (F> 0.05). Although action observation therapy was shown to have a significant impact on motor functioning, it did not have a quantifiable effect on sensory functioning, BADL performance as well as right- and left-hand dexterity among the SSVs. The summary of the repeated measure ANOVA results and post-hoc analysis is shown in Table 3.

Table 2. *Sociodemographic and clinical characteristics of participants.*

Characteristic	Frequency / Mean (x̄/n)	Percentage (%)
Age	49.0 (9.26)	
≤ 40 years	2	20.0
41–50 years	3	30.0
> 50 years	5	50.0
Gender		
Male	7	70.0
Female	3	30.0
Stroke Type		
Ischemic	8	80.0
Hemorrhagic	2	20.0
Side Affected		
Right	6	60.0
Left	4	40.0
Handedness		
Right-handed	9	90.0
Left-handed	1	10.0
Modified Rankin Scale		
2	1	10.0
3	9	90.0
Time Since Stroke Onset		
3- 6 months	2	20.0
7–12 months	2	20.0
13–24 months	5	50.0
> 24 months	1	10.0

Table 3. *Comparison of Motor Function, Sensation, Hand dexterity and Basic Activities of Daily Living across Intervention Periods.*

Outcome Measure	Intervention point			F	p-value
	Baseline	Mid	Post		
FMAE-UE motor	37.70 ±10.14[a]	42.70 ±9.02[b]	48.30 ±8.81[c]	58.22	0.001*
FMAE-UE sensation	11.60	11.60	11.60	-	-
BI	87.00±8.23	87.50±8.58	88.00±9.19	1.00	0.343
Box and Block Test (Left)	20.90 ±23.14[a]	22.50 ±24.11[b]	32.90 ±22.82[b]	3.88	0.080
Box and Block Test (Right)	31.60±23.06	32.40±23.03	25.80±23.42	1.18	0.304

*Significant at p < 0.05.

4. Discussion

This novel study assessed the feasibility of a six-week home-based AOT intervention that was contextually developed to improve upper extremity function among stroke survivors in Nigeria. The findings revealed a significant improvement in UE motor function after AOT with no concomitant significant changes in sensory function, hand dexterity and BADL. These findings provide vital insight knowledge on the role of home-based AOT in post-stroke recovery within resource-constraint rehabilitation healthcare settings such as Nigeria.

4.1. Motor and Sensory Function Recovery After Home-based AOT

Across the intervention period, the motor function improvement that was observed among SSVs shows the therapeutic potential of home-based AOT in stroke rehabilitation. Our findings support existing literature on motor relearning that occur during AOT. AOT is documented to activate brain neural networks through the mirror neuron system thereby improving SSVs' motor planning, control and execution [14, 15]. As SSVs watch and imitate the videos of performing a contextual, real and relatable activity, excitation of the corticospinal tracts might have occurred resulting in use -dependent neuroplasticity. The findings of related literature indicate that improvement in motor control is usually more significant and long-lasting when AOT is used in conjunction with physical task practice [16]. The sense of accomplishment and mastery that comes when any step of the AOT is completed could serve as a form of motivation thereby increasing adherence to the home-based treatment programme. Remarkably, majority of the SSVs were in the chronic phase of recovery, with limited spontaneous neurological recovery opportunities. As such, it can be stated that the increase in motor function observed in our study supports previous literature findings that AOT enhance motor recovery among chronic SSVs. Accordingly, this home-based AOT programme could serve as pragmatic alternative to conventional hospital-based rehabilitation in a resource limited context like Nigeria where there may be shortage of rehabilitation professional such as occupational therapist.

On the contrary, throughout the AOT intervention, UE sensory function did not change. This finding is similar to results from previous literature that reported minimal gains in sensory function after AOT intervention. AOT do not directly engage the somatosensory pathway but rather targets motor neural networks that mediate motor planning, intention, and imitation [17]. Thus, in addition, it is plausible that the sensory domain of the FMA-UE may be insensitive to recognize minimal changes in sensory function in small pilot samples [18]. As such, specific interventions directed towards sensory and proprioceptive processing should be included with AOT to address sensory impairment post-stroke.

4.2. Hand Dexterity and Basic Activities of Daily Living After AOT

Despite significant motor recovery, the hand dexterity outcome, as measured by the BBT, showed a more complex and fluctuating trend. In the case of the left hand, a single post-hoc comparison was statistically significant, indicating some level of improvement in dexterity compared to the majority of the pair and contrast comparisons. In the case of the right hand, the scores actually decreased during the sixth week, suggesting that the measurements were unstable, the right hand was tired, or the right hand was not always fully engaged. Such fluctuations are not surprising, considering the small sample size and large standard deviations. Although the BBT is a well-established instrument for measuring gross manual dexterity, its minimum detectable change (MDC) and minimum clinically important difference (MCIDs) are known to be approximately 57 blocks in adults [19]. Hence, observed differences below this level of statistical significance, even in cases where statistical significance is observed, could be within the margin of measurement error or normal day-to-day variability. The large variability among participants in this study minimized statistical power and undermined confidence in the significance of the observed changes. The irregularity in the left and right hands could also mirror personal aspects, such as lesion laterality, pre-morbid hand dominance, or post-stroke motor asymmetry. As the majority of participants were right-hand dominant, the more affected or weaker limb might have exhibited proportionally higher apparent improvements due to its initially low base level of functioning, sometimes referred to as proportionate recovery. Notably, the gains in dexterity are typically evidenced when AOT is coupled with active manipulation activities that closely resemble the functional uses of a hand package, such as grasping or object transfer activities [20]. The limited dexterity development observed might thus indicate a need for more task-specific training between videos and real practice exercises. A further stimulation of hand dexterity recovery could also be achieved by the addition of bilateral or constraint components, as proposed by the previous motor learning models based on repetitive, goal-oriented, and feedback-intensive situations [21, 22].

In the same vein, the BI, a measure of independence in activities of daily living, showed an insignificant, trivial difference between baseline and week six, this finding suggests that gains in motor impairment did not translate directly into improved self-care performance and independence within the six-week period. This trend has been replicated in systematic reviews: AOT may bring quantifiable benefits to body functioning, but the extrapolation of these benefits to functional performance and improved quality of life remains modest and inconsistent [23]. This association can be attributed to the fact that ADL performance is a multifactorial phenomenon requiring the involvement of motor competence, as well as endurance, cognitive, motivational, and environmental assistance [24]. Moreover, the time duration of the intervention might likely have limited the level of behavioral integration required to perform complex tasks, there is evidence to show that longer-term AOT and repetitive task-specific training of longer periods of time (usually eight to twelve weeks) are more likely to have much stronger ADL improvements [25]. Another plausible reason may be the relatively high BADL score of SSVs at baseline, that could have resulted in a ceiling effect, thereby limiting the outcome measure's sensitivity to detect change. Accordingly, it is suggested that future programs consider a longer treatment period and incorporate multimodal approaches, task-based practice, and strength conditioning, to enhance the generalization of motor gains to proficiency in daily activities.

4.3. Rehabilitation Insight and Clinical Utility

The overall findings of this feasibility study indicate that upper limb motor recovery following stroke through home-based AOT has a positive effect; however, sensory and functional outcomes are limited. The motor gains as observed on the FMA-UE are a sign that even without intensive supervision by therapists, the mirror neuron-mediated visual-motor priming can allow cortex reorganization and relearning of motor skills. This result has practical implications for low-resource environments, such as Nigeria, where hospital-based neurorehabilitation is not readily accessible over a prolonged period. The capacity to provide AOT in basic playback equipment enables SSVs and their caregivers to participate in formal home-based therapy with minimal expense or professional supervision [26]. Nonetheless, the non-significant sensory or ADL improvement indicates the need to implement multimodal rehabilitation approaches. Functional independence does not always result when a person improves their motor performance, so home-based AOT should be viewed as a complementary treatment programme, rather than an independent one [27]. The AOT should be combined with active task practice, sensory re-education, or telerehabilitation monitoring in future research to increase engagement and guarantee treatment adherence. Moreover, stratification based on the duration of stroke chronicity and initial severity is necessary to establish which subgroups would benefit the most [28].

5. Limitations

Some limitations are identified in this study, and they should be considered when interpreting the results. To begin with, the small, non-controlled feasibility sample (n = 10) limits the statistical specificity, rendering the results susceptible to Type I and Type II errors, as well as the influence of outliers. A lack of a control group in the quasi-experimental design also restricts causal inference, as spontaneous recovery, regression to the mean, or placebo effects cannot be excluded. The heterogeneity of the participants in terms of time since the stroke and at the baseline impairment introduces additional variability, making it harder to interpret MCID. Additionally, large standard deviations in the measures of the BBT and FMA-UE diminish the statistical strength and certainty of the observed alterations. This six-week follow-up may be too short to detect a significant transfer to ADL or sensory outcomes, and dependence on caregivers or devices may have introduced bias in participation.

6. Implications of the Study

Despite these drawbacks, the study suggests that this context-specific home-based AOT is practical and presents an initial indication of efficacy, which warrants advancement to a larger randomized controlled trial. The research conducted in the future should include a sufficiently large sample to identify clinically significant changes in the FMA-UE scores and BBT scores, utilizing population-specific MCID thresholds. AOT can be combined with task-oriented training, constraint-based training, or adjunctive therapies, to reveal more significant results, especially in motor and sensory functions. This can be aided by stratifying the participants in terms of chronicity and baseline impairment so as to reach subgroups most likely to benefit. Furthermore, the increase in follow-up days and the use of patient-reported outcomes will help evaluate long-term improvement and functional improvement. Reliability will be enhanced by methodological refinements (repeated baseline testing, blinded assessment, and the interpretation using the MDC. Lastly, remote monitoring, facilitated by the implementation of telerehabilitation tools, may be more effective in terms of adherence, personalized feedback, and recording of practice intensity [29-31].

7. Conclusion

The context-specific home-based AOT programme significantly improved UE motor function among Nigerian SSVs with no significant recovery of sensory function, hand dexterity and BADL. Future study involving larger sample that employ a randomized control trial design is suggested to determine the functional and clinical relevance of this motor recovery.

Abbreviations

AOT	Action Observation Therapy
SSVs	Stroke Survivors
OAUTHC	Obafemi Awolowo University Teaching Hospital
BADL	Basic Activities of Daily Living
FMA-UE	Fugl-Meyer Assessment of Upper Extremity
BBT	Box and Block Test
BI	Barthel Index
ANOVA	Analysis of Variance
CVI	Content Validity Index
MDC	Minimum Detectable Change
MCIDs	Minimum Clinically Important Difference

Author Contributions

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Data Availability Statement

The datasets used and analyzed in this study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declared no competing interest.

References

[1] Bernhardt J, Urimubenshi G, Gandhi DB, Eng JJ. Stroke rehabilitation in low-income and middle-income countries: a call to action. The Lancet. 2020 Oct 31; 396(10260): 1452-62. https://doi.org/10.1016/S0140-6736(20)31313-1

[2] Purton J, Sim J, Hunter SM. The experience of upper-limb dysfunction after stroke: a phenomenological study. Disability and rehabilitation. 2021 Nov 6; 43(23): 3377-86. https://doi.org/10.1080/09638288.2020.1743775

[3] Wade D. Rehabilitation–a new approach. Overview and part one: the problems. Clinical rehabilitation. 2015 Nov; 29(11): 1041-50. https://doi.org/10.1177/0269215515601174

[4] Shi YX, Tian JH, Yang KH, Zhao Y. Modified constraint-induced movement therapy versus traditional rehabilitation in patients with upper-extremity dysfunction after stroke: a systematic review and meta-analysis. Archives of physical medicine and rehabilitation. 2011 Jun 1; 92(6): 972-82. https://doi.org/10.1016/j.apmr.2010.12.036

[5] You L, Wang Y, Chen W, Zhang S, Rao J, Liu L, Shan C. The effectiveness of action observation therapy based on mirror neuron theory in Chinese patients with apraxia of speech after stroke. European neurology. 2019 Oct 29; 81(5-6): 278-86. https://doi.org/10.1159/000503960

[6] Lin D, Eaves DL, Gibbons T, Aquino MR, Edwards MG, Poliakoff E, Bek J, Emerson JR. Perspectives of stroke survivors and informal caregivers on home-based mental practice for upper limb recovery after stroke: a qualitative co-design study. Neuropsychological Rehabilitation. 2025 Oct 25: 1-40. https://doi.org/10.1080/09602011.2025.2577376

[7] Candio P, Violato M, Luengo-Fernandez R, Leal J. Cost-effectiveness of home-based stroke rehabilitation across Europe: A modelling study. Health Policy. 2022 Mar 1; 126(3): 183-9. https://doi.org/10.1016/j.healthpol.2022.01.007

[8] Aderinto N, Olatunji G, Kokori E, Agbo CE, Babalola AE, Yusuf IA, Tolulope EM, Oyelude AO, Adejumo FA, Abraham IC. A scoping review of stroke rehabilitation in Africa: interventions, barriers, and research gaps. Journal of Health, Population and Nutrition. 2025 Jul 10; 44(1): 245. https://doi.org/10.1186/s41043-025-01004-z

[9] Fleming SE, Reynolds J, Wallace B. Lights. camera. action! a guide for creating a DVD/video. Nurse Educator. 2009 May 1; 34(3): 118-21. https://doi.org/10.1097/NNE.0b013e3181a0270e

[10] Alessi SM, Trollip SR. Multimedia for learning: Methods and development. Allyn & Bacon, Inc.; 2000 Nov 1.

[11] Lundquist CB, Maribo T. The Fugl–Meyer assessment of the upper extremity: reliability, responsiveness and validity of the Danish version. Disability and rehabilitation. 2017 Apr 24; 39(9): 934-9. https://doi.org/10.3109/09638288.2016.1163422

[12] Oliveira CS, Almeida CS, Freitas LC, Santana R, Fernandes G, Junior PR, Moura RC. Use of the Box and Block Test for the evaluation of manual dexterity in individuals with central nervous system disorders: A systematic review. Manual Therapy, Posturology & Rehabilitation Journal. 2016 Oct 15: 1-7. https://doi.org/10.17784/mtprehabjournal.2016.14.436

[13] Hartigan I. A comparative review of the Katz ADL and the Barthel Index in assessing the activities of daily living of older people. International journal of older people nursing. 2007 Sep; 2(3): 204-12. https://doi.org/10.1111/j.1748-3743.2007.00074.x

[14] Branchini, G. Action observation training for the acquisition of novel complex motor skills: a behavioral and neurophysiological study. Master's thesis, Department of Medicine and Surgery, University of Parma. 2022. https://hdl.handle.net/1889/4710

[15] Keysers C, Gazzola V. Hebbian learning and predictive mirror neurons for actions, sensations and emotions. Philosophical Transactions of the Royal Society B: Biological Sciences. 2014 Jun 5; 369(1644). https://doi.org/10.1098/rstb.2013.0175

[16] Estrada-Barranco C, Martinez-Javaloyes MD, Rodriguez-Costa I, Sanz-Esteban I, Bermejo-Franco A, Aranda-Ruiperez A, Gallegos-Mart ńez MD. Effectiveness of a program based on action-observation training (AOT) on motor, functional and cognitive aspects in patients with cognitive impairment: a non-randomized controlled trial. InHealthcare 2023 Apr 4 (Vol. 11, No. 7, p. 1030). https://doi.org/10.3390/healthcare11071030

[17] Zhou Z, Chen X, Li Y, Chen S, Zhang S, Wu Y, Shi X, Ren M, Shan C. Effects of integrated action and sensory observation therapy based on mirror neuron and embodied cognition theory on upper limb sensorimotor function in chronic stroke: a study protocol for a randomised controlled trial. BMJ open. 2023 Mar 1; 13(3): e069126. https://doi.org/10.1136/bmjopen-2022-069126

[18] Huynh BP, DiCarlo JA, Vora I, Ranford J, Gochyyev P, Lin DJ, Kimberley TJ. Sensitivity to change and responsiveness of the upper extremity Fugl-Meyer assessment in individuals with moderate to severe acute stroke. Neurorehabilitation and neural repair. 2023 Aug; 37(8): 545-53. https://doi.org/10.1177/15459683231186985

[19] Chen IC, Chuang IC, Chang KC, Chang CH, Wu CY. Dual task measures in older adults with and without cognitive impairment: response to simultaneous cognitive-exercise training and minimal clinically important difference estimates. BMC geriatrics. 2023 Oct 16; 23(1): 663. https://doi.org/10.1186/s12877-023-04390-3

[20] Platz T, Lotze M. Arm Ability Training (AAT) promotes dexterity recovery after a stroke—a review of its design, clinical effectiveness, and the neurobiology of the actions. Frontiers in neurology. 2018 Dec 11; 9: 1082. https://doi.org/10.3389/fneur.2018.01082

[21] Gündüz OH, Toprak CȘ. Hand function in stroke. In Hand function: A practical guide to assessment 2019 Jul 31 (pp. 125-135). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-17000-4_9

[22] Xu J, Haith AM, Krakauer JW. Motor control of the hand before and after stroke. InClinical systems neuroscience 2014 Dec 17 (pp. 271-289). Tokyo: Springer Japan. https://doi.org/10.1007/978-4-431-55037-2_14

[23] Mancuso M, Tondo SD, Costantini E, Damora A, Sale P, Abbruzzese L. Action observation therapy for upper limb recovery in patients with stroke: a randomized controlled pilot study. Brain sciences. 2021 Feb 26; 11(3): 290. https://doi.org/10.3390/brainsci11030290

[24] Ghaffari A, Rostami HR, Akbarfahimi M. Predictors of instrumental activities of daily living performance in patients with stroke. Occupational therapy international. 2021; 2021(1): 6675680. https://doi.org/10.1155/2021/6675680

[25] Lee CY, Howe TH. Effectiveness of activity-based task-oriented training on upper extremity recovery for adults with stroke: a systematic review. The American Journal of Occupational Therapy. 2024 Mar 1; 78(2): 7802180070. https://doi.org/10.5014/ajot.2024.050391

[26] Sun X, Ding J, Dong Y, Ma X, Wang R, Jin K, Zhang H, Zhang Y. A survey of technologies facilitating home and community-based stroke rehabilitation. International Journal of Human–Computer Interaction. 2023 Mar 16; 39(5): 1016-42. https://doi.org/10.1080/10447318.2022.2050545

[27] Almeida CM, Vajaratkar VP. Recent trends in occupational therapy specific to motor intervention for adults with traumatic brain injury: A scoping review. The Indian Journal of Occupational Therapy. 2023 Apr 1; 55(2): 47-56. https://doi.org/10.4103/ijoth.ijoth_27_22

[28] Gama GL, Larissa CD, Brasileiro AC, Silva EM, Galvão ÉR, Maciel ÁC, Lindquist AR. Post-stroke hemiparesis: Does chronicity, etiology, and lesion side are associated with gait pattern?. Topics in sTroke rehabiliTaTion. 2017 Jul 4; 24(5): 388-93. https://doi.org/10.1080/10749357.2017.1304865

[29] Rodrigues P, Quaresma C, Costa M, Luz F, Fonseca MM. Virtual reality-based telerehabilitation for upper limb recovery post-stroke: a systematic review of design principles, monitoring, safety, and engagement strategies. arXiv preprint arXiv: 2501.06899. 2025 Jan 12. https://doi.org/10.48550/arXiv.2501.06899

[30] Oshomoji OI, Ajiroba JO, Semudara SO, Olayemi MA. Telerehabilitation in African rural areas: a systematic review. Bulletin of Faculty of Physical Therapy. 2024 Dec; 29(1): 1-7. https://doi.org/10.1186/s43161-024-00256-w

[31] Odetunde MO, Okonji AM, Adeoye AP, Onigbinde AT. Acceptance and adoption of tele-rehabilitation by physiotherapists from Nigeria, a low resource setting: a mixed-method study. Bulletin of Faculty of Physical Therapy. 2024 May 1; 29(1): 23. https://doi.org/10.1186/s43161-024-00181-y