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The Intra-Rater Reliability and Validity of Action Reach Arm Test for Stroke Patients

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ABSTRACT

Background: The Action Research Arm Test (ARAT) can provide subjective results due to the difficulty assessing abnormal patterns in stroke patients. **Objective:** To determine the intra-rater reliability and validity of the Action Reach Arm Test (ARAT) in patients recovering from stroke. **Study Design:** An intra-rater and inter-rater reliability study. **Settings:** Department of physical therapy, University Teaching hospital, University of Lahore, Lahore Pakistan. **Duration:** Between January 2018- December 2018. **Methods:** Sixty participants (47 men and 13 women, mean age 57.78 ± 13.37 (35-77) years with a mean time after stroke 8.76 ± 14.86 (0.5–80) months with poor upper extremity function after stroke were included in the study. To examine the intra-rater reliability of action research arm test, the rater re-assessed 36 out of the 60 participants on next day. Intra-class correlation coefficients (ICCs) were used to analyze the intra-rater reliability. Upper limb function was also assessed by Fugl-Meyer Assessment concurrent with ARAT on the same day. The validity was measured by using Inter-class correlation coefficient test. The validity of the test was examined by comparing the patient's score on ARAT score and those obtained through Fugl-Meyer Assessment score. **Results:** The ICCs of the total, grasping, gripping, pinching, and gross movement scores received were 0.980, 0.975, 0.995, and 0.935 (all $p < 0.001$) respectively, indicate excellent intra-rater reliability. Thus, ARAT appeared to be a stable assessment tool. The scores of ARAT closely correlated with upper limb function Fugl-Meyer Assessment score. The high intra-rater reliability and validity of the Action Research Arm Test (ARAT) was confirmed. **Conclusion:** The preliminary results of this study support the value of the ARAT for measuring recovery of arm-hand function in stroke patients.

Keywords: *Upper extremity, Stroke, Rehabilitation, Reliability, Validity, Action reach arm test.*

INTRODUCTION

Many patients after stroke acquire motor deficit,[1] especially in upper extremities.[2] These impairments lead to the functional limitations to perform activities of daily livings after stroke.[3] More than 80% of acute stage stroke and 55-75% of stroke survivors experience upper extremity impairments and dysfunction.[4] These limitations to perform normal upper limb function affect quality of life of not only the stroke survivor but also to whole family.[5] Similarly, more efforts are geared towards attaining normal upper extremity function after stroke. The post-stroke rehabilitation depends on proper evaluation of the patient that will determine accurate diagnosis of the patient.

The Action Research Arm Test (ARAT) was developed by Lyle in 1981 as a clinical tool to evaluate post-stroke upper extremity function and fine movements.[6] The ARAT measures both arm and hand movements during different tasks and focusing on fine movements of the hand. The ARAT contains 19 items with categories of four subsets (gripping, grasping, pinching and gross movements). During the performance of the test, function is assessed of single extremity starting with sound limb. The score of each item is then summed up to total range of 0-57 points for each side.[7]

The Upper extremity Fugal–Meyer Assessment (FMA) is the most frequently used clinical tool for assessing post-

stroke Upper extremity function. Even though UE-FMA measures the level of impairment, but unable to figure out the extent of activity limitation or fine movements of hand and fingers. Similarly, this scale is not helpful to make rehabilitation protocols or the effect of these protocols on the patient's recovery level after stroke.[8] To make this clinical tool as generalized, it must be evaluated in terms of reliability and validity. To the researcher's knowledge, no previous study has been conducted to evaluate the reliability and validity of the ARAT in Pakistan. hence, the aim of the study was to assess the intra-rater reliability and validity of the ARAT in post-stroke patients.

METHODS

According to previous studies,[7,9,10] a 18-35 sample size would be enough, but sample size was increased up to 60 post stroke patients to increase the power of this study. The post stroke patients were taken from the Department of physical therapy, University Teaching hospital, University of Lahore between January 2018- December 2018. The inclusion criteria were as follows: (1) stroke patients with hemiparesis confirmed by MRI or CT; (2) at least one week after stroke; (3) at least 20° of active extension in wrist and 10° of finger extension;(4) age between 18 - 80 years; (5) capability for enter the house without a stick, represent no major stability problems;(6) Modified Ashworth Scale score ≤ 2 (7) no serious intellectual issues (Mini-Mental Condition score >22) (8) no musculoskeletal, neurological pathology or other medical condition affecting upper extremities.[11] The demographic details of subjects were gathered from hospital record and is presented in Table 1. The study was approved by ethical review board of University of Lahore. Informed consent was taken from all the subjects before study.

The ARAT is a performance-based test which is usually administrative in 10 minutes. It comprises of 19 items which are grouped into 4 sub tests. (1) grasp test (2) grip test (3) pinch test and (4) gross movement test. The grasp activity containing of different sizes of blocks, cricket ball and stone which are performed from distal to proximal. The grip activity involves the washer, different diameters of tubes and pouring the water from one glass to another glass. The pinch activity is performed by pointing out the marble and ball bearing with the help of fingers (index, middle and ring) and thumb. The gross movements performed as the hand on top of the head, behind the head and on the mouth. All of these activities are measured in 4-point ordinal scale like 0, 1, 2, 3. The zero score represent no movement performed, (1) score show that movement performed abnormally, (2) score represent movement performed abnormally but take a long time or difficulty and (3) score represent movement performed normally. The maximum scoring of the test is 57.

Intra-rater reliability was assessed by the intraclass correlation coefficient. The significance levels of all assessments were set at 0.05. All mathematical techniques were measured through the SPSS.

Table 1: Characteristics of the study participants (n=60)

Variable		Intra-rater study sample (n=36) values
Age (years)		57.78±13.37 (35-77)
Onset (months)		8.76 ± 14.86 (0.5–80)
Mini mental state examination		28.17 ±1.84 (22–30)
Sex	Male (%)	28 (77.7)
	Females (%)	8 (22.22)
Brunnstrom stage	Proximal UE	3.47 ± 1.28 (2–6)
	Distal UE	3.84 ± 1.24 (2–6)
Stroke type	Ischemic (%)	31 (86.11)
	Hemorrhagic (%)	5 (13.89)
Affected side	Right (%)	17 (47.22)
	Left (%)	19 (52.77)
Dominance	Right (%)	36 (100)
	Dominant side affected (%)	21 (58.33)
	Mild problem on speech (%)	11 (30.55)

Values were mean ± SD (range) or n (%)

Participants of the study were recruited from university teaching hospital, University of Lahore between January 2018 - December 2018. For intra-rater reliability, ARAT was again applied to 36 of the total 60 subjects on the next day. The rest of the 24 subjects were either unwilling or unable to take part in next session of testing. This time interval was set to decrease the expected effect of rapid recovery. The test was applied in quiet room and appropriate rest interval was added to minimize fatigue effect.

The second part of the study was study of validity.[12,13] Validity is defined as the comparison of values obtained with standard measurement tool. In this study the ARAT scores were compared with scores of Fugal-Mayer assessment. These were evaluated during the same time period.[14] The association between results of ARAT and Fugal -Mayer assessment was also examined.

The demographic details of the subjects and the descriptive statistics was used to analyze the clinical features. The results were presented as mean ± SD (range) or n (%).In this study Intra-rater reliability was calculated by Intraclass correlation coefficient (ICC). The Intraclass correlation coefficient were used to examine the correlations between different values taken by the same

rater at different times.[15] ICC explains how good the clinical tool is despite measurement error.[16] A high value of ICC explains that the clinical tool can significantly measure post-stroke functional limitation.[17]

The Inter-class correlation coefficient was used to assess the association between ARAT & Fugal -Mayer assessment scores. The validity was measured by assessing the correlation coefficient and its statistical significance. The results described that there was close association between the measurements taken through ARAT & Fugal -Mayer assessment scores and is shown in Figure 1. SPSS version 20.0 was used to conduct all statistical analyses.

RESULTS

60 participants (47 men, 13 women) after first stroke (ischemic, *n* = 28; hemorrhagic, *n* = 8) were included in the study. The mean age of the participants was 57.78 ± 13.37 years (range 27- 80). The mean time after stroke was 6.47 ± 12.00 months (range: 0.5–80 months). The right side was affected in ~58% of the participants. Participants' details are given in Table1. The ARAT total and subscales performance scores of 36 participants are presented in Table 2.

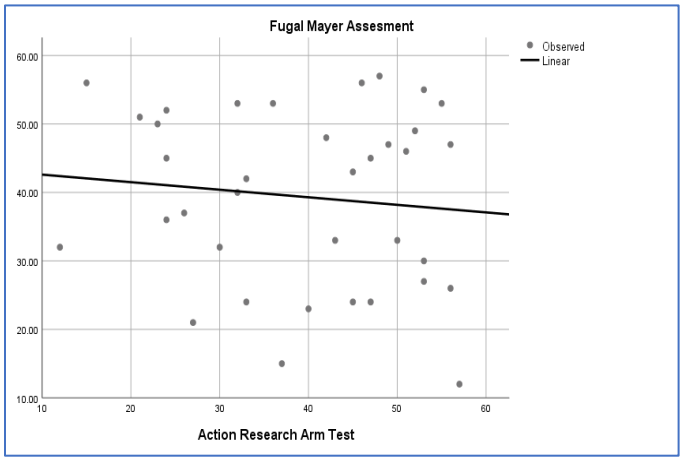
Inter-class correlation coefficient statistics indicated that two upper limb motor scales Action reach arm test and Fugal-Meyer assessment scores were highly correlated with one another with the mean of ARAT 39 ± 12 and 37 ± 13, respectively. ARAT measurements were strongly associated with FMA with r=0.11 & the level of significance was P=0.74 (p<0.05) and indicate that test is valid.

Table 2: Intra-rater Reliability

	Grasp sub-Scale		Grip sub-scale		Pinch sub-scale		Gross sub-scale		ARAT total
Observation	A	B	A	B	A	B	A	B	A /B
Mean	15.75	14.75	9.46	8.85	9.20	8.00	7.80	6.75	44.21/44.21
SD	2.07	2.25	1.96	2.00	2.56	2.25	1.44	1.35	8.03/8.05
Range	0-18	0-18	0-12	0-12	0-18	0-18	0-9	0-9	0-57/0-57
Spearman's	0.93	0.93			0.98	0.91			0.99
ICC	0.98	0.97			0.99	0.93			0.99
95% CI	0.97–0.99	0.97–0.98			0.98-0.99	0.93–0.94			0.98–0.99

ICC, intraclass correlation coefficient; CI, confidence interval; A, the first round of evaluations by rater; B, the second round of evaluations by rater. SD= Standard Deviation
Excellent correlation.
***p < 0.001, P < 0.05 indicates significant correlations.*

Figure 1: The relationship between the performance on action reach arm test and Fugal-Mayer assessment scale



DISCUSSION

The results of the study stated that the total ARAT and all subscales confirmed excellent intra-rater reliability. The results of intra-rater reliability described excellent reliability of ARAT scale and subscales after assessment of same subjects by same rater and the next day. These results were in consistence of previous studies.[10,18] In this study, the ICCs of total and subscale of pinch were less than that given by Yozbatiran. Similarly, the participants of this study were of stroke with mean duration of 8.7 months after stroke which contrasts with a study that included only chronic stroke patients.[18] The stage of the stroke at which they are assessed may affect the total recovery time of upper extremity functions because early-stage stroke patients may give rapid recovery rate. Similarly, for reliability studies, chronic post-stroke patients may give satisfactory results. The time duration between assessments could also be reduced. The results of this study described that ARAT is reliable tool to

measure upper extremity function in post-stroke patients. This result was consistent when measured on acute stroke patients who were having rapid recovery as well. The effect of rapid recovery may also describe the results of the study. Especially, the assessment of 19 (52.77%) participants who had stroke three months ago, may have had better upper extremity functions within two days. These results indicate that ARAT detect alterations in upper extremity function. However, more studies are required to confirm ARAT sensitivity.

In this study validity of action arm reach test is closely related with Fugal-Mayer assessment scores which is in accordance with previous studies that indicated that ARAT & FMA both are valid measures for upper limb motor function.[19] One more study reported that both ARAT and FMA scores both were sensitive to alter during early post-stroke management and can be equally used to assess upper limb functions.[20] While some of the studies reported contrasting results with the current study. The studies showed that FMA is more valid and highly responsive tool for measurements of upper and lower limb functions after hemiplegic patients.[21] Another study showed that different measurement tools for the upper limb function after stroke have different characteristics as some of the tests like FMA, MCA, MI require less equipment while others such as ARAT, FAT etc need use of various small objects which are very specific in different dimensions. Therefore, these tests vary in their reliability and validity.[22]

CONCLUSION

In conclusion, this study showed the high intra-rater reliability and validity of the ARAT in stroke patients and can be helpful for the stroke rehabilitation.

LIMITATIONS

There were some limitations of the study. First, the sample size was small, therefore, it was not possible to measure the tool according to different types and severity of stroke patients, type, and duration of the treatment. Second, the study subjects were of large range of onset of stroke as some of the acute and subacute patients may have shown rapid recovery. Similarly, these differences in outcome measures can lead to differences in the performance during ARAT. Nonetheless, the ARAT exhibited excellent intra-rater reliability and validity. Further research should be conducted to measure other characteristics of the clinical tool, such as the responsiveness at different stages of the stroke survivors.

SUGGESTIONS / RECOMMENDATIONS

Future research should compare the performance of raters from different disciplines with varying levels of experiences. Studies to examine the predictive validity and sensitivity to change of the ARAT are also needed. Studies with other patient groups and age ranges are also necessary to establish the clinical utility of the ARAT.

CONFLICT OF INTEREST / DISCLOSURE

The authors declare that they have no competing interests.

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