Normative Data of Fugl Meyer Assessment on Upper Extremity in Post Stroke Population
Naila Yasmin¹, Iqra Tahir², Hira Jabeen³, Qandeel Yousaft⁴, Umber Batool⁵

**Corresponding Author:**
1. nailayasmin1803@gmail.com

**Affiliations:**
1Clinical Physiotherapist Kamran Medical Complex. Sahiwal
2House Officer, Sharif Medical City Hospital, Lahore.
3Assistant Professor Riphah College of Rehabilitation and Allied health sciences, Riphah International University, Lahore
4Senior Lecturer/ Physical Therapist, Department of Physical Therapy, Imran Idrees Institute of Rehabilitation Sciences Sialkot
5Lecturer/ Physical Therapist, Muhammad Institute of Health Sciences, Multan

**Citation:**
Received: 10-12-2022
Revised and Accepted: 08-02-2023
Published On-Line: 20-02-2023

**ABSTRACT**

**Background:** Stroke is clinically diagnosed as an acute, localized neurological impairment that is caused by vascular damage (infarction, hemorrhage) to the central nervous system. This main leading cause of demise and dysfunction worldwide resulting in frequent deficit, hemiplegia, which briefly affects upper limb. This multicentered study is the first to provide updated normative reference values for FMA-UE in post-stroke adults in wide range of age in Pakistan’s population.

**Objective:** To determine Pakistani normative values of Fugl-Meyer Assessment on upper extremity in post-stroke population.

**Methods:** Descriptive cross-sectional study on 1260 post-stroke patients was conducted in various public and private physiotherapy centers of country using Fugl-Meyer Assessment (Upper-Extremity) FMA-UE scale after ethical approval. Hemiplegic survivors of both genders aged 45-75 years were taken using convenience sampling technique, informed consent was taken. Statistics was done using SPSS version 25.

**Results:** Patients included were 88.3% ischemic and 11.7% hemorrhagic. 44.1% were in acute phase (less than 2 weeks) while 55.9% were in sub-acute (2 weeks to 6 months) phase. Mean score of FMA-UE was 88.63±30.09. The cutoff score/mean value for motor impairment and sensation was recorded as 41.49 ±19.7 and 8.6±3.9 while passive joint motion and pain were calculated 18.93±5.47 and 19.57±5.1 respectively.

**Conclusion:** The scoring, in acute and subacute phases, accentuates the need to follow Pakistani-specific modified norms in Asian inhabitants instead of reference values applicable to the western population.

**Keywords:** Fugl-Meyer scale, Hemiplegia, Motor control, Post Stroke, Upper extremity

**Introduction:**
Stroke is defined as an acute, localized neurological impairment that is clinically diagnosed by vascular damage (infarction, hemorrhage) to the central nervous system. Despite development in medical field, pharmaceuticals approach, and medical technology, stroke is still an important risk of death and suffering for patients, and a health economic burden too. With roughly 6.7 million stroke fatalities worldwide in 2015, stroke causes largest death rate after ischemic heart disease. Cerebrovascular illnesses remain the fourth biggest cause of mortality, despite a declining trend, with a prevalence of 6.6 percent in 2016. The burden of stroke is predicted to rise dramatically as the population ages, putting a strain on already scarce healthcare resources. As a result, a thorough stroke rehabilitation programs must be developed for effective disease treatment plan. Globally, it is the 3rd leading cause of death and the primary reason of disability. Stroke-related deficiencies have major influence on survivors' independence, quality of life, and productivity. Multiple studies in adult stroke survivors have confirmed age regarding mobility improvement and time of leaving the hospital. According to cohort study on stroke community in Denmark, more than 58 percent of old age were sent to medical facilitated old homes or had expired while long stay at hospital. In order to prevent elderly population from being handicapped, advance rehabilitation plans and care takers are required which will help them to be independent in their ADLs. Tunk mobility is greatly affected due to atrophy of muscles leading to poor posture with functional disorders. Fugl-Meyer Assessment (FMA) is a validated and popular tool for evaluating motor function following a stroke. It is considered a gold standard for use in clinical and research settings all around the world. Reflex activity, voluntary movements inside and outside of synergies, capacity to produce independent movement, and coordination are all assessed on the scale. This hierarchical construct measures one-dimensional underlying concept, motor impairment. This means that the scale can be used in pre and post rehabilitation to investigate the movement level. For early post-stroke impairment investigation, assessment is mostly done pre-treatment, within treatment and after rehabilitation. A standardized globally usage of FMA-UE for comparison of hemiplegic or paraplegic recovery results in
improving standards of treatment. Team of Hira Rehman in 2022 conducted a randomized control trial to ascertain the results of cortical mapping in chronic stroke and observed combining action observation therapy with standard therapy an effective strategy for rehabilitating upper trunk or limb movement in patients. In 2021, Yuta Tauchi et al investigated different aspects of movement and problematic usage of items for stroke exercises in Japanese and proved FMA-UE a multidimensional and reliable tool for assessing stroke-related damage to upper extremities. Nanako Hijikata and colleagues found FMA-UE an authentic tool for measuring upper limb mobility in people with chronic stroke. While Nadinne Roman and colleagues translated and validated the Upper Extremity Functional Motor assessment scale (UEFMA) resulting a Romanian version of the UEFMA that showed excellent validity and reliability for post-stroke examination. Edwin Daniel Ona proposed FMA to be a high-resolution, autonomous, and objective tool for motor assessment in neurorehabilitation. The use of FMAUE would enable for comparisons of stroke recovery across regions and nations, thereby improving the quality of treatment and rehabilitation for stroke patients throughout the world. Shogo worked and used anchor-based approaches to determine the lowest clinically relevant difference for FMA-UE in stroke sufferers and observed score of 12.4 significant in hemiparesis to hemiplegia category. Won-Seok Kim studied upper limb movement evaluation in hemiplegics using sensor camera and concluded Kinect-based FMA scoring method most reliable in giving new quantitative metrics of stroke patients’ motion smoothness. S. Toluee stated that test-retest authenticity and less assessable alterations of the FMA-UE in sub-acute stroke individuals and showed good tool authenticity. It was need of time to have normal values of FMA-UE for Pakistani population due to certain atmospheric and geographic changes that might impact health-related quality of life along with that stroke care facilities are not good in Pakistan as compared to western stroke centers. Therefore, the rationale of this study was to make it easier for the clinicians and researchers of Pakistan to obtain FMA-UE threshold scores, allowing them to more easily assess and describe the patients’ condition. These updated norms will certainly help the clinicians to develop better quality of rehabilitation in early stroke phase ultimately benefitting the patients of Pakistan as no data was available for stroke assessment using FMA scale in Pakistan.

**Material & Methods:**
This was a descriptive Cross-sectional study conducted in main government and private physical therapy setups in each province of country after ethical approval of Research ethical committee of Riphah international university (REC/RCR &AHS/21/0257). Hospitals include Sahiwal Teaching Hospital, DHQ South City Okara, Jinnah hospital Lahore, Services Hospital Lahore, Lahore General Hospital, Agha Khan University Hospital Karachi, Benazir Bhutto hospital Abbottabad, FC hospital Quetta, DHQ Gilgit, DHQ Mardan, DHQ Skardu and DHQ Khanewal etc. Data was collected from 1260 stroke patients using 33 item Fugl-Meyer Assessment upper extremity scale and sample size was calculated using Open Epi calculator according to stroke prevalence in Pakistan with Margin of error 5%, Confidence level 95%. Convenience sampling technique was used for data collection. Post-stroke patients of both genders with age between 45 to 75 years old who presented with history of 1st stroke, history of hemiplegic stroke of acute phase (last about 2 weeks) or sub-acute phase (last up to 6 months from onset) who can understand Urdu /English language and a cognitive function score was between 24-30 on Mini Mental Examination (MME) score. While patients having other neuromuscular diseases before stroke (e.g., Parkinson’s disease, Epilepsy), any degenerative joint disease with severe comorbidities (e.g., Rheumatoid Arthritis, stage 3 or 4 Osteoarthritis), or having serious medical complications requiring intensive care (e.g., pneumonia, seizures, UTIs) were excluded. For collection purpose, few tools were required i.e., bed, cotton ball, scrap of paper, ball, pencil, stopwatch, reflex hammer and chair for the assessment of sensation, reflexes, and range of motion. With informed consent, patients were enrolled considering inclusion and exclusion criteria. After approval from ethical committee of RCR&AHS, study conducted using questionnaire consisted of demographic data like name, age, sex, type of stroke, and phase of stroke. Some risk factors were also assessed like hypertension, diabetes and smoking. Univariate analysis of some variables regarding mean and standard deviation was calculated along with frequencies of age, gender, smoking and some other variables.

**Results:**

**Table-I Demographics of patients with age 45-75 years were determined with frequency and percentage.**

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Frequency (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>616 (47.3%)</td>
</tr>
<tr>
<td>Female</td>
<td>644 (52.7%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1058 (84%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>501 (39.1%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>733 (58.2%)</td>
</tr>
<tr>
<td>Acute phase</td>
<td>556 (44.1%)</td>
</tr>
<tr>
<td>Subacute phase</td>
<td>704 (55.9%)</td>
</tr>
<tr>
<td>Right hemiplegic</td>
<td>543 (43.1%)</td>
</tr>
<tr>
<td>Left hemiplegic</td>
<td>717 (56.9%)</td>
</tr>
<tr>
<td>Ischemic stroke</td>
<td>1112 (88.3%)</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>148 (11.7%)</td>
</tr>
</tbody>
</table>

**Table-II Domains of Fugl Meyer Assessment (FMA)**

<table>
<thead>
<tr>
<th>Domains (n=1260)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor function</td>
<td>00</td>
<td>66</td>
<td>41.49± 19.73</td>
</tr>
<tr>
<td>Sensation</td>
<td>00</td>
<td>12</td>
<td>8.61± 3.99</td>
</tr>
<tr>
<td>Passive joint motion</td>
<td>00</td>
<td>24</td>
<td>18.93± 5.47</td>
</tr>
<tr>
<td>Joint pain</td>
<td>00</td>
<td>24</td>
<td>19.62± 5.12</td>
</tr>
<tr>
<td>Sum</td>
<td>24</td>
<td>126</td>
<td>88.63± 30.09</td>
</tr>
</tbody>
</table>

Mean score of motor impairment was 41.49±19.7 which showed moderate type, while mean score of sensation was 8.61±3.9. Passive joint motion and joint pain scored mean of 18.9±5.7 and 19.6±5.12 which showed moderate to good and good scoring respectively. These normative scores also showed moderate score of sensation. Mean normative values of FMA-UE for Pakistani Post stroke survivors were concluded to be 88.63±30.9. (Table 2)

**Discussion:**
Many studies underwent to investigate stroke’s normative data in western countries. Due to certain climatic or geographic differences from west and other Asian states, it is considered to observe usual mean scoring in Pakistan. The risk factors like smoking, hypertension and diabetes were also identified which played leading role in acquiring stroke illness. FMA, cost-efficient gold standard approach, is reliable by giving new quantitative metrics of stroke patients in rehab outcomes and seems useful in the evaluation of sensorimotor recovery after stroke at home (16). In current study the prevalence of smoking was 58.2%, hypertension was 84% and diabetes in stroke patients was 39.8%. The results of the study are in conformance of previous study which was conducted to find prevalence observed in diabetes, smoking, obesity and
hypertension to be the common risk factors associated with Pakistani stroke population. Prevalence of diabetes was 5.9%, hypertension was 21.8% and smoking prevalence among stroke patients was 6.6% (18). H. Rehman et al found mean scores of FMA-UE of experimental group in randomized control trial on chronic stroke. Each domain showed significant increase in mean score after treatment provision. Current study supported the evidence by concluding mean score of sensation (8.61±3.9) having moderate association with tool efficacy. The joint motion and pain domains also gave moderate to good cut off scores than previous study (10). The mean value of upper extremity (including reflexes) showed moderate association with tool and supported the study of Rietschel et al. who computed mean FMA-UE score to be 26.9±15.7 by using 33-item (including reflexes) and 22.1±15.3 by using 30-item (without reflexes) (21). Won Seok Kim and colleagues found correlation between Fugl Meyer UE using Kinect and real scores and validated it for hemiplegic stroke patients. In contrast current study provided Fugl Meyer upper limb reference values for hemiplegic post stroke individuals. Tarek M Youssef and colleagues predicted good robotic therapy effects on Fugl Meyer score and grip strength in early and late chronic stroke at Cairo University. Current study in correlation by previous research showed moderate association of sensorimotor mean values of this assessment tool in acute and subacute stroke. Italian version of culturally validated FMA scale was developed by Cecchi et al. for better assessment of Italians(23). Roman established official Romanian version of upper extremity FMA instrument validity (13). In contrast current study developed validated norms for Pakistani population of acute and sub-acute stroke. R Hegazy et al. reported mean of total motor function in a corelative study for observing motor deficit and motor dysfunction relation in hemiplegic stroke patients (24). The mean score (5.64 ±12.5) was less than current study mean score of upper extremity domain which is 41.49±19.7. Ferrero et al. concluded that the reflex activities of biceps and elbow were not dependent upon impairment levels, which showed that most of the Spanish patients had intact reflexes despite of impairment levels. This study is in difference with the current study which calculated the usual reflex activity of the biceps, triceps, and finger flexors depended on impairment level (25). The study covered acute and sub-acute stroke phases of stroke but chronic patients were not taken. The reason being the follow-up of the survivors is least in Pakistan, chronic cases are usually not reported in district head quarter hospitals from where data is collected. Financial and physical resources limited the data collection from different cities of Pakistan. Mostly data was collected from Punjab and Sindh provinces, while least data was collected from Gilgit Baltistan, Baluchistan and Khyber Pakhtunkhwa due to lack of physical therapy facilities and consent of patients to assess them. The author recommended that sponsored researches should be conducted to cover all private public setups in Pakistan. Chronic phase stroke patients should also be covered from different regions and researches should include lower extremity Fugl Meyer Assessment along with upper limb.

**Conclusion:**
This multicenter study is the first to provide updated normative reference values for FMA-UE in post-stroke adults with wide range of age in Pakistan’s population. This scoring, in acute and sub-acute phases, also accentuates the need to follow Pakistani specific modified norms in Asian inhabitants instead of reference values applicable on western population.

**Disclaimer:** None declared

**Funding:** None declared

**References:**


