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Validation of Upper Limb Self-efficacy Test (UPSET-stroke) Using Rasch Analysis

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Abstract

Purpose of the Study: The objective of the study was to validate upper limb self-efficacy test (UPSET-stroke), and determine which of the demographic and clinical characteristics of the participants will predict self-efficacy. **Materials and Method**: A cross-sectional study whose data was obtained from a Randomized Controlled Trial. The participants were stroke patients (≤4 weeks post stroke). Participants were assessed using UPSET, motor activity log (MAL), upper limb Fugl-Meyer (FM) motor function subscale, and Wolf motor function test (WMFT). The data for the clinical characteristics of the participants was analyzed using descriptive statistics. Additionally, rasch analysis and multiple regressions were carried out to determine the Unidimensionality, and item difficulty of the UPSET; and the variables that will predict self-efficacy respectively after stroke. **Results**: There were 48 participants in the study with mean age, 57.60±10.27 years. All items are unidimentional except item 16 (Use your hand to open and close the fridge), most of the items are on the easy side of the person-item map and items 1 and 20 are the easiest and the most difficult respectively. Time since stroke and MAL (how well) predicted upper limb self-efficacy. **Conclusion**: UPSET-stroke is valid instrument for measuring upper limb self-efficacy after stroke.

Key Words: Upper extremity, self-efficacy, rehabilitation, and rasch analysis

Introduction

Self-efficacy is one's confidence in his ability to carry out certain tasks, judgments or decisions. This confidence can be reduced by health conditions or diseases such as stroke [1,2]. For instance, following stroke, there could be impairment in motor function; and as the patient try to use their limbs, they may fail [3]. This failure can build up frustrations and subsequently erode one's confidence in his ability to use the limbs. When this happened, one's ability to carry out activities of daily living may be impaired [4,5]. Thus, measurement of self-efficacy as an outcome after stroke can be helpful to determine the effectiveness of rehabilitation. Consequently, there is a need to have a valid and reliable measure of self-efficacy following stroke. This will aid with rehabilitation plan as patients' self-efficacy will be targeted at the outset of rehabilitation.

To assess self-efficacy in stroke patients, a questionnaire known as stroke self-efficacy questionnaire, the Confidence in Hand and Arm Movement Scale (CHAMS), and a measure of self-efficacy for reaching movements are used [6-8]. The stroke self-efficacy questionnaire is a valid and reliable generic questionnaire consisting of 13 items [9]. Its initial scoring system ranged from 0 to 10;[6,9] but this has been modified to a range of 0 to 3, with 0 indicating not confident at all and values greater than 0 indicating increasing confidence

(6) [10]. Similarly, the measure of self-efficacy for reaching movements is a valid measure of patients' confidence in perception of reaching for distinct target combinations using computational analysis [8]. Reaching to a target combination is scored from 0 (never confident) to 1 (always confident). Additionally, the CHAMS consists of 20 items asking for one's confidence in carrying out tasks such as how certain are you at the present time that you can carry a cafeteria tray full of lunch food and drink from the cashier to a table?. Its scores range from 0 (uncertain) to 100 (very certain) [7].

Self-efficacy is however not general, and it is said to be domain specific [8]. Additionally, movements of the upper limb are far beyond reaching alone. Thus, the upper limb as it performs many intricate activities beyond just reaching movements deserves a specific questionnaire, test or tool to determine self-efficacy in using it following stroke. Consequently, the upper limb self-efficacy test (UPSET-stroke) was developed [11]. The test consists of 20 items measuring the confidence in one's ability to use their upper limb after a stroke. The test was previously reported to have positive correlation with both the amount of use and the how well subscales of motor activity log (MAL), stroke self-efficacy questionnaire. The aim of this study was to use Rasch analysis to validate the UPSET-stroke. Rasch analysis is used in evaluating the psychometric properties of instruments in order to improve the precision with which researchers construct instrument, monitor instruments quality and complete respondent's performances [12].

Method

The study is a cross sectional study that used the baseline data from a published randomized controlled trial (RCT) approved by the Ethics Sub-Committee of Operational Research Advisory Committee of Kano State Ministry of Health [13]. The approval number is MOH/Off/797/T.I/176. The population of the study was stroke patients within the first 4 weeks post stroke in Murtala Muhammad Specialists Hospital (MMSH), Kano. Details of the inclusion and exclusion criteria were reported in the previous study [13].

The sample size of the study was 78. This was calculated using G*power software version 3.1 [14]. Participants were recruited consecutively. Following recruitment, details of the study were explained to the study participants and their consents were before the commencement of the study. Thereafter, a blinded assessor carried out all assessments. The assessments carried out were for upper limb motor function, perceived motor function and upper limb self-efficacy. Motor function was measured using Wolf motor function test (WMFT) and motor function subscale of upper limb Fugl-Meyer (FM). The WMFT consists of 17 items that measure upper limb's single or multiple joints movements and functional tasks. It's said to have good psychometric properties and is scored on a scale of 0 to 5, lowest to highest score [15-16]. The motor subscale of FM is scored on a scale of 0 to 2, lowest to highest score. It is valid and reliable measure that has a maximum score of 66 [17-18].

The MAL measures movement quantity and quality of stroke patients in their activities. It is a reliable instrument that is scored on a scale of 0 to 5, lowest to highest score [19-20]. The UPSET consists of 20 items that measure confidence in the use of upper limb after stroke on a scale of 0 to 10, lowest to highest score. It was shown previously to have good correlation with the stroke self-efficacy questionnaire and internal consistency [11].

Data Analysis

The demographic characteristics of the study participants were analyzed using descriptive statistics. Unidimensionality of the items of UPSET and item difficulty hierarchy were analyzed using

Rasch analysis. Additionally, multiple regressions were conducted to determine which of the demographic and clinical variables predict upper limb self-efficacy after stroke. The rasch analysis was performed using WINSTEP software, but all other analysis using SPSS version 20.

Result

There were 48 participants in the study who were recruited between 20 February 2017 and 29 September 2017. Thirty one were male and 17 were female. Details of the characteristic of the study participants are presented in Table 1; and the study flow chart is presented in Fig. 1.

Unidimensionality

The mean infit and outfit MNSQ and ZTSD values for the UPSET are 0.99 and -0.5; and 1.23 and -0.2 respectively. These mean that, the items fit the model and are unidimentional, (items measure the same construct). This is because the MNSQ values fall between 0.7 and 1.3 and the ZTSD values fall between +2 and -2, which are within the normative values [21]. However, the analysis showed that only one item of UPSET, 16 (use your hand to open and close the fridge) did not fit the expectations of the model. This means that, the confidence of the participants did not meet expectation. The details of the results of this analysis are presented in Table 2.

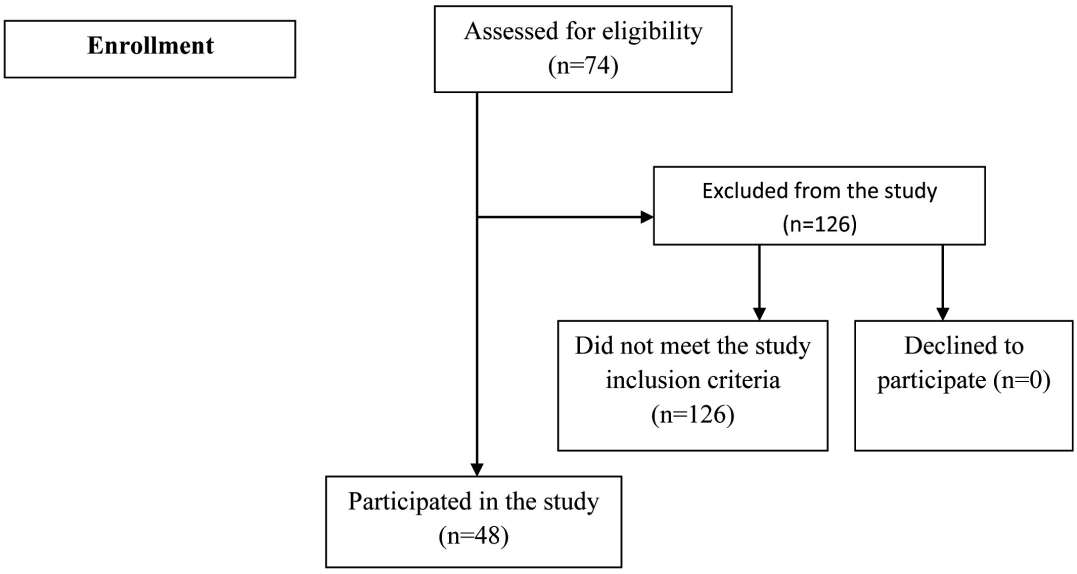

Fig. 1. The Study Flow chart

Table 1. Characteristics of the Study Participants

Variable	Mean±SD	Frequency	%
Age (years)	57.60±10.27		
Time since stroke (days)	15.98±6.98		
FM	32.83±13.43		
MAL (how well)	1.89±10.7		
MAL (AOU)	1.80±1.06		
WMFT	2.22±0.92		
UPSET	4.66±2.30		
Sex (M/F)		31/17	64.6%/ 35.4%
Side affected (R/L)		27/21	56.3%/ 43.8%
Type of stroke (I/H)		36/12	75.0%/ 25.0%
Hand Dominance (R/L)		45/3	93.8%/ 6.3%

MAL=Motor activity log, FM=Fugl-Meyer, WMFT=Wolf Motor Function Test, UPSET=Upper Limb Self-efficacy Test, R/L=Right/Left, I/H=Ischaemic/ Haemorraghic

Table 2. Fit Statistics for the Items of UPSET-stroke

Item	Total score	Measure logits	S.E	Infit		Outfit	
				MNSQ	ZSTD	MNSQ	ZSTD
Q1	189	52.04	1 .48	0.85	-0.6	0.81	-0.9
Q2	203	49.02	1.46	0.69	-1.6	0.68	-1.6
Q3	210	47.53	1.45	0.55	-2.5	0.52	-2.6
Q4	208	48.00	1.45	0.93	-0.3	1.03	0.2
Q5	219	45.66	1.44	0.80	-0.9	0.80	-0.9
Q6	218	45.86	1.44	1.05	0.3	0.91	-0.3
Q7	205	48.59	1.46	0.83	-0.7	0.75	-1.2
Q8	225	44.41	1.44	0.55	-2.4	0.48	-2.8
Q9	230	43.37	1.44	0.97	-0.1	0.92	-0.3
Q10	230	43.37	1.44	1.01	0.1	0.91	-0.3
Q11	212	47.12	1.45	1.61	2.5	1.67	2.7
Q12	229	43.58	1.44	0.90	-0.4	0.85	-0.6
Q13	222	45.03	1.44	0.60	-2.1	0.68	-1.6
Q14	229	43.58	1.44	0.58	-2.2	0.63	-1.8
Q15	237	41.91	1.44	0.73	-1.3	0.95	-0.1
Q16	248	37.80	1.45	**3.16**	**6.4**	**8.26**	**9.9**
Q17	242	40.88	1.44	0.49	-2.8	0.55	-2.2
Q18	235	42.33	1.44	0.84	-0.7	0.80	-0.9
Q19	238	41.71	1.44	0.97	-0.1	1.03	0.2
Q20	259	37.33	1.45	1.03	0.2	1.32	1.2
MEAN	222.4	44.45	1.45	0.96	-0.5	1.23	-0.2
SD	16.5	3.60	0.01	0.56	2.0	1.64	2.0

Item Difficulty Hierarchy

The result showed that the most difficult item is 20, use your hand to drive/ cycle; whereas the easiest is 1, pick up a cup with your hand and take it to the mouth. Details of the analysis are presented in Table 3.

Comparing Persons with Items

The mean confidence was 224.40 with a standard deviation of 16.5; while the mean; while the mean of item difficulty was 44.45 with a standard deviation of 1.45. Thus, it can be said that, majority of questions are located between -16.5 and +16.5. Additionally, standard deviations (and spread) persons confidence are greater than standard deviations (and spread) of item difficulty. The item– persons map clearly shows the relationship between persons confidence and item difficulty (Fig. 2).

Participant confidence measures range from approximately -10 logits to 100 logits and the item difficulties range from 40 to 50 logits. This means that most items are located on the 'easy' side; and therefore it is not difficult to have confidence in carrying out the tasks in the items.

Predictors of Upper Limb Self-efficacy after Stroke

Preliminary analyses were conducted to ensure no violation of assumption of normality, linearity, multicolinearity and homoscedasticity. For, characteristics of the study participants, the total variance explained by the model was 43.9%, F (5, 48)=2.005, p=0.098. In the final model, only time since stroke was statistically significant, with the highest beta value (beta=0.40, p=0.006).

Table 3. Item Difficulty for the Items of UPSET-stroke

Item	Total score	Measure logits	S.E	Infit		Outfit	
				MNSQ	ZSTD	MNSQ	ZSTD
Q1	189	52.04	1 .48	0.85	-0.6	0.81	-0.9
Q2	203	49.02	1.46	0.69	-1.6	0.68	-1.6
Q7	205	48.59	1.46	0.83	-0.7	0.75	-1.2
Q4	208	48.00	1.45	0.93	-0.3	1.03	0.2
Q3	210	47.53	1.45	0.55	-2.5	0.52	-2.6
Q11	212	47.12	1.45	1.61	2.5	1.67	2.7
Q6	218	45.86	1.44	1.05	0.3	0.91	-0.3
Q5	219	45.66	1.44	0.80	-0.9	0.80	-0.9
Q13	222	45.03	1.44	0.60	-2.1	0.68	-1.6
Q8	225	44.41	1.44	0.55	-2.4	0.48	-2.8
Q12	229	43.58	1.44	0.90	-0.4	0.85	-0.6
Q14	229	43.58	1.44	0.58	-2.2	0.63	-1.8
Q9	230	43.37	1.44	0.97	-0.1	0.92	-0.3
Q10	230	43.37	1.44	1.01	0.1	0.91	-0.3
Q18	235	42.33	1.44	0.84	-0.7	0.80	-0.9
Q15	237	41.91	1.44	0.73	-1.3	0.95	-0.1
Q19	238	41.71	1.44	0.97	-0.1	1.03	0.2
Q17	242	40.88	1.44	0.49	-2.8	0.55	-2.2
Q16	248	37.80	1.45	3.16	6.4	8.26	9.9
Q20	259	37.33	1.45	1.03	0.2	1.32	1.2
MEAN	224.4	44.45	1.45	0.96	-0.5	1.23	-0.2
SD	16.5	3.60	0.01	0.56	2.0	1.64	2.6

For the clinical variables, total variance explained by the model was 80.7%, $F(4, 48)=20.13$, $p<0.001$. In the final model, only two measures were statistically significant, with Fugl-Meyer recording a higher beta value (beta=0.72, $p<0.001$) than MAL how well (beta=0.58, $p=0.003$).

Discussion

The aim of this study was to validate UPSET-stroke using Rasch analysis and also determine the demographic and clinical variables that will predict upper limb self-efficacy following stroke. The results of the study showed that, items of the test are unidimentional except item 16; item 1 is the easiest and item 20 is the most difficult. Additionally, most of the items are on the easy side of the persons-item map. Furthermore, only time since stroke among the demographic variables; and MAL how well and Fugl-Meyer scores among the clinical variables predicted upper limb self-efficacy after stroke. Previously, it was also shown that UPSET-stroke has a moderate positive correlation with MAL (how well and amount of use sub-scales) [11].

From the above results, motor function and real world arm use are dependent on the one's confidence in his ability to use his arm after stroke. This is not surprising as physical functioning is related positively with self-efficacy [5,22]; and frustrations with inability to use the arm after stroke may weaken one's self-efficacy. In the literature, such frustrations were noted to lead to a phenomenon known as the 'learned non-use' [3]. By learned non-use, it means that, the patients behaviorally learn not to use the arm which is encouraged by the initial failure to use the arm immediately after stroke. Therefore, interventions to improve self-

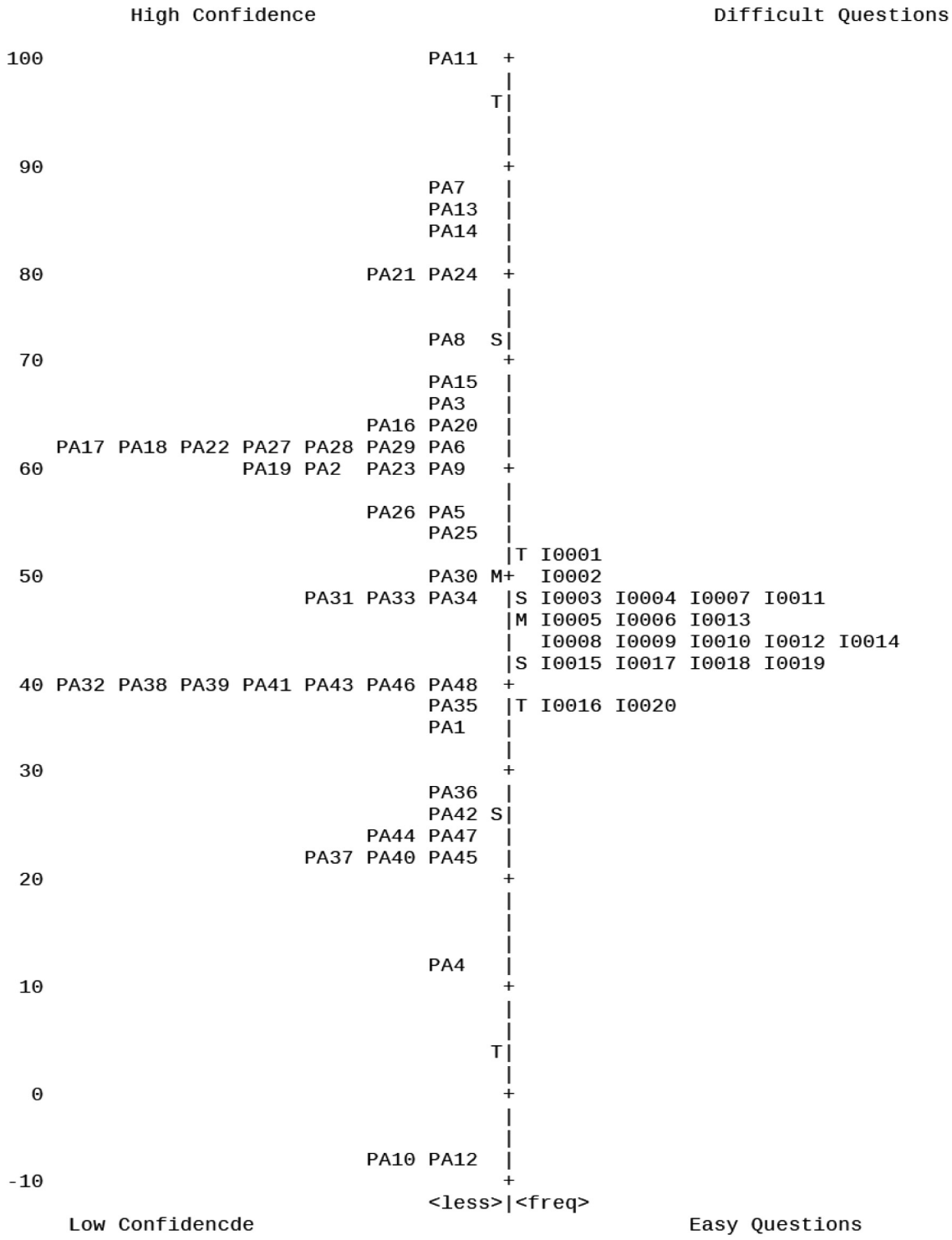

Fig. 2. Persons-Item-Map. The values at the left are the logits. T=2 standard deviation from the mean, S=1 standard deviation from the mean, M=mean

efficacy following stroke are needed. In particular, the interventions should begin as soon as possible after stroke since from the result of this study it was shown time since stroke is an important predictor of self-efficacy.

The interventions for improving self-efficacy include health education, motivational interviewing and self-management [23]. These interventions have the central focus of empowering the patients to take charge of their care 24 hourly through

improving their self-efficacy. Similarly, measures of self-efficacy are equally needed to ensure that baseline and post intervention self-efficacy is established following a stroke. So far, the existing measures of self-efficacy following stroke include stroke self-efficacy questionnaire, the Confidence in Hand and Arm Movement Scale (CHAMS), a measure of self-efficacy for reaching movements and Upper Limb Self-efficacy Test [6-8,11].

The stroke self-efficacy questionnaire is generic [6]; but domain specific questionnaires or tests are needed to appropriately assess self-efficacy after stroke. The CHAMS on the other hand is domain specific, measuring the use of upper limb for functional activities [7]. However, it is scoring system which ranges from 0 to 100 seems to be cumbersome and may scare away prospective clinician users. Additionally, the measure of self-efficacy for reaching movements assesses self-efficacy in only reaching moving movements [8]; but the movements of the upper limb are far and above only reaching movements. Consequently, a more specific, very straightforward and valid instrument is needed to measure self-efficacy in the use of the upper limb after stroke. The Upper Limb Self-efficacy Test (UPSET-stroke) is a domain specific, simple and easy to use measure of self-efficacy in the use of upper limb after stroke [11]. However, in the present study, it is possible that, item 16, use your hand to open and close fridge was a misfit because most of the participants did not have fridge. Presence of misfit items could be due to misunderstanding by the participants or the items are measuring a different construct [21]. Thus, any modification of the UPSET-stroke shall include only 19 items or replace item 16 with an equivalent that is likely practiced in this population of the study participants.

For the item difficulty, item 1, pick up a cup with your hand and take it to the mouth is the easiest probably because this kind activity is used in most of our ADLs such drinking, eating and brushing. In contrast, item 20, use your hand to drive is the most difficult probably because driving is a complex task. In one study, only 66% of the participants resumed driving after stroke [24]. However, one of the limitations of this study is the inclusion of only participants in the acute stage of stroke.

Upper Limb Self-efficacy test (UPSET-stroke) is a valid measure of confidence in the use of the upper limb after stroke. This is because its items with the exception of item 16 measure the same construct. Additionally, confidence in using the upper limb can be predicted by how well the limb is used in the real word after stroke and time since stroke. Therefore, UPSET-stroke can be used to assess confidence in the use of the upper limb after stroke.

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References

1. Bhogal SK, Teasell RW, Foley NC, Speechley MR. Community reintegration after stroke. Topics in Stroke Rehabilitation, 2003; 10: 107-129.
2. Mehta S., Pereira S., Janzen S., McIntyre A., McClure A. Effectiveness of psychological interventions in chronic stage of stroke: a systematic review. Top Stroke Rehabil, 2012; 19: 536-544
3. Taub E, Berman AJ. Avoidance conditioning in the absence of relevant proprioceptive and exteroceptive feedback. J Comp Physiol Psychol. 1963;56:1012–1016.
4. Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S. Balance self-efficacy and its relevance to physical function and perceived health status after stroke. Arch Phys Med Rehabil, 2006; 87(3):364-70.
5. Korpershoek CL, van der Bijl J, Hafsteinsdottir TB. Self-efficac and its influence on recovery of patients with stroke: a systematic review. J Advanced Nurs, 2011; 67(9):1876-94. doi:10.1111/j.1365-2648.2011.05659.x.

6. Jones F, Riazi A. Self-efficacy and self-management after stroke: a systematic review. Disabil Rehabil, 2011; 33(10):797-810. doi:10.3109/09638288.2010.511415

7. Lewthwaite R, Blanton S, Zerigue A, Winstein CJ, Wolf SL. Validity and reliability of the Confidence in Arm and Hand (CAHM) . In: Chen S, Lewthwaite R, Schweighofer N, Winstein CJ. Discriminant validity of a new measure of self-efficacy for reaching movements after stroke-induced hemiparesis. J Hand Ther, 2013; 26 (2):116-123

8. Chen S, Lewthwaite R, Schweighofer N, Winstein CJ. Discriminant validity of a new measure of self-efficacy for reaching movements after stroke-induced hemiparesis. J Hand Therap, 2013; 26 (2):116-123

9. Jones F, Partridge C, ReidF .The Stroke Self-Efficacy Questionnaire: measuring individual confidence in functional performance after stroke. J Nurs Healthcare of Chronic Illness in association J Clin Nurs 2008, 17; (7b):244–252

10. Riazi A, Aspden T, Jones F. Self-effi cacy Ques tionnaire : A Rasch-refined measure of confidence post stroke. J Rehabil Med 2014; 46: 30–36

11. Abdullahi A. Upper limb self-efficacy test (UPSET): a measure of confidence in the use of the upper limb after stroke. Adv Sci Med. 2016;1:10–18.

12. Boone WJ. Rasch Analysis for Instrument Development: Why, When, and How? CBE Life Sci Educ. 2016 Winter; 15(4): rm4. doi: 10.1187/cbe.16-04-0148

13. Abdullahi A. Effects of Number of Repetitions and Number of Hours of Shaping Practice during Constraint-Induced Movement Therapy: A Randomized Controlled Trial. Neurology Res Int, 2018. https://doi.org/10.1155/2018/5496408

14. Faul F, Erdfelder E, Lang A, Buchner A. "G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences," Behav Res Methods 2007, 39(2): 175–191.

15. Wolf SL, Lecraw DE, Barton LA. Forced use of hemiplegic upper extremities to reverse the effect of learned nonuse among chronic stroke and head-injured patients. Exp Neurol. 1989;104:125–132.

16. Wolf SL, Catlin PA, Ellis M. Assessing Wolf motor function test as outcome measure for research in patients after stroke. Stroke. 2001;32:1635.

17. Fugl Meyer AR, Jaasko L, Leyman I. The post stroke hemiplegic patient. A method for evaluation of physical performance. Scand J Rehabil Med. 1975;7:13–31.

18. Woodbury ML, Velozo CA, Richards LG, et al. Longitudinal stability of the fugl-meyer assessment of the upper extremity. Arch Phys Med Rehabil. 2008;89:1563–1569.

19. van der Lee JH, Beckerman H, Knol DL, et al. Clinimetric properties of the motor activity log for the assessment of arm use in hemiparetic patients. Stroke. 2004;35: 1410–1414

20. Uswatte G, Taub E, Morris D, et al. 2006 Reliability and validity of the upper-extremity motor activity log-14 for measuring realworld arm use. Stroke. 2005;36:2493–2496.

21. Tavakol M, Dennick R. Psychometric evaluation of a knowledge based examination using Rasch analysis: An illustrative guide: AMEE Guide No. 72. Med Teacher, 2013, 35 (1):e838-848. doi.org/10.3109/0142159X.2012.737488

22. Fritz SL, George SZ, Wolf SL, Light KE. Participant perception of recovery as criterion to establish importance of improvement for constraint-induced movement therapy outcome measures: a preliminary study. Phys Ther. 2007;87(2):170e178.

23. Cheng D, Qu Z, Huang J, Xiao Y, Luo H, Wang J (2015).Motivational interviewing for improving recovery after stroke. Cochrane Database of Systemic Reviews, 3;6:CD011398. doi: 10.1002/14651858.CD011398

24. Finestone HM[1], Marshall SC, Rozenberg D, Moussa RC, Hunt L, Greene-Finestone LS. Differences between poststroke drivers and nondrivers: demographic characteristics, medical status, and transportation use. Am J Phys Med Rehabil. 2009, 88(11):904-23. doi: 10.1097/PHM.0b013e3181aa001e

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