Model functional assessment of modified rankin score questionnaire for acute stroke

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Abstract. Stroke is the second leading cause of death and the third leading cause of disability-adjusted life years worldwide. The modified Rankin Scale (mRS) was designed to measure poststroke recovery but is often used to describe pre0stroke. To further validate the modified Rankin Scale questionnaire (mRSq), we compare it here to a well established predictor of functional outcome after stroke, the initial stroke severity. We tested 18 mRS questionnaires to determine completion rates and intermodality agreement. We involved the CSU- HAMGH clinical staff for interview patient and tick box in web https://www.surveymonkey.com/r/55YP6JR and https://www.surveymonkey.com /r/KVTK53S, involved the CSU patient/proxy ticking 1 of the 18 descriptions equating to mRS scores; the other, The mRS assessment functional quisionarare combined of mRSq 8 scale National Institutes of Health Stroke Scale (NIHSS) and Top-10 Priorities for Research Relating to Life After stroke. The modified Rankin questionnaire (mRSq), included 18 questions with Good, mid, No responses from which the mRS is derived. We compared the mRS obtained by these different methods. The mRS could be derived in 18 respondents (2%) and 53 respondents (90%) on the tick box and smRSq, respectively (difference in proportion, 7% [82% CI, 3–15].

In studies where tick box assessment of mRS is practical by CSU-HAMGH staff to follow up to responders will achieve higher levels of follow up with the tick box and also good levels of intermodality agreement with least risk of bias. The good correlation of the mRSq with the initial stroke severity further confirms the mRSq validity in assessing functional outcome after stroke.

Fifty three of 130 registered patients were visited CSU-HAMGH and respondents. The baseline clinical characteristics of the 53 analyzed and the 77 disqualified patients were similar. The correlation between the initial NIHSS and the mRSq was good ($r = 0.911$; 0.287, $R^2 = 0.830$, $P < 0.001$) and studies in which face-to-face interviews are impractical might use a combination of a tick box mRSq and a interviews. This combination will result in the best completion rate and roughly equivalent scores with both methods.

1. Introduction

The modified Rankin Scale (mRS) [1],[2] is a well-established and useful scale for assessing global function after stroke[3]-[5]. We identified patients for this study in CSU-HAMGH and approved registry of patients treated and we identify using assessment functional quisionarare combined of mRS 8 and Top-10 Priorities Life After stroke. The mRS is an ordinal scale with

broadly defined scores from 0 (no residual symp0toms from stroke) to 5 (bedridden) and 6 for death. The mRS assessment functional quisionarare combined of mRS 8 scale National Institutes of Health Stroke Scale (NIHSS)[19] and Top-10 Priorities for Research Relating to Life After stroke [20]. The ini0tial assessment the colected dataset. Although validated, the mRS contains inherent sub- jectivity resulting in suboptimal reliability[6]. To limit subjectivity in mRS scoring, two structured inter0view tools to score the mRS have been proposed [8]-11]. Also, we recently developed and tested a simplified questionnaire to score the mRS, the mRS questionnaire (mRSq)[12]. The mRSq showed good reliability, correlation with quality of life, and an average completion time of 1.5 minutes. To fur-ther validate the mRS questionnaire, we compare it here with a well-established predictor of functional outcome after stroke, the initial stroke severity indi-cated by the NIH Stroke Scale (NIHSS)[12]–[16]. Score the mrsq in a large proportion of the screened patients was a limitation in this study. However, the clinical characteristics of those patients are similar to the analyzed patients, indticating that a selection bias was unlikely.a less than excellent correlation between the ini0tial nihss, a neurological impairment scale, and the mrsq, a global function scale, can be expected given the different nature of these two scales. Also, factors other than the initial stroke severity, such as prestroke disability, patient age, and stroke type, influence functional outcome[23]. The good correlation between the initial nihss and the mrsq aided mrs in this study further sup-ports the validity of the mrsq in assessing func-tional outcome after stroke.

2. Material and Methods

Study population

We are collected clinical data from sequential stroke admissions using Assessment of Modified Rankin Score (mRS) Questionnaire. Data collection was from February to May 2019 inclusive. Data capture included a 4 month follow-up. In brief, included patients were aged over 20 years, with stroke confirmed and phenotyped by expert multidisciplinary clinical assessment. Our population included both first ever stroke and recurrent stroke and all included patients were treated as per institutional practice and stroke guidelines. Relevant institutional and ethical approvals for use of these data were in place.

mRS Assesment Functional

The mRS assessment functional quisionarare combined of mRS 8 scale National Institutes of Health Stroke Scale (NIHSS) [19] and Top-10 Priorities for Research Relating to Life After stroke [20]-[21]. The ini tial assessmentthe colected dataset was based on the modification quisionare with of https://www.surveymonkey.com/r/55YP6JR and https:// www.surveymonkey.com /r/KVTK53S. The Basic Stroke Register Database but including process of care measures. Scores the value of each mRSq i.e. 0=Never, 1=Sometimes, 2=Always.

Data were collected by clinical staff and trans0ferred to an electronic database. Pre-stroke mRSq was part of the ini tial assessment. All mRSq assessments (pre stroke) were per formed by clinical staff using an unstructured interview and based on history taken from patient whenever possible, or their significant others/carers. the participating sites offered explicit guidance on applying mRS grades as a pre0stroke measure and final score was at the discretion of the assessor.

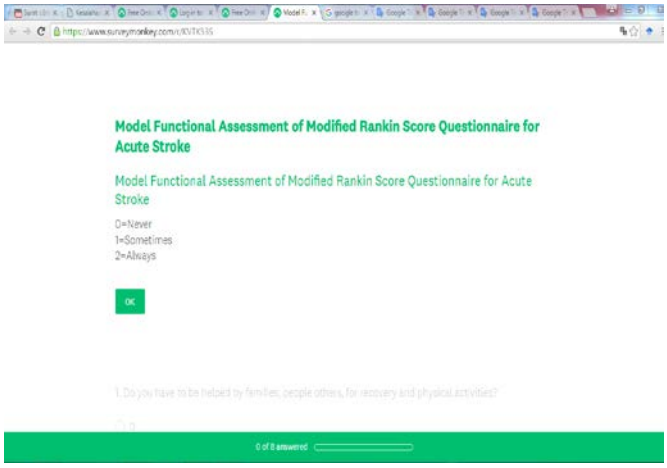

Figure 1. The mRS quisionare assssment

mRSq		Score
1.	Do you have any symptoms that are bothering you?	2
2.	Are you able to do the same work as before?	2
3.	Are you able to keep up with your jobs ?	2
4.	Do you need help with eating, going to the toilet, or bathing?	0
5.	Do you stay in bed most of the day and need constant nursing care?	2
6.	Are you able to arm move your self for ROM function in bed	2
7.	How many times have your Physical activity, arm function doing on the bed ?	2
8.	Are you able to visual problems after stroke?	2
9.	Are you able to manage or prevent fatigue?	2
10.	Are you able to improve balance, gait, and mobility?	0
11.	Do you have to be helped by families, people others, for recovery and physical activities?	0
12.	What role should the family do to help you overcome the problem of speaking ?	0
13.	Have you maintained your ties to friends and family?	0
14.	Do you need help making a simple meal, doing household chores, or balancing a checkbook?	0
15.	Do you need another person to help you walk?	2
16.	Do you need help with shopping or traveling close to home?	2
17.	Do you need to choose a beneficial exercise and fitness program in improvement function and improve quality of life ?	2
18.	Do you need to choose a beneficial exercise	2
		24

Figure 2. The mRSq assssment functional quisionare

3. Result

Data collection was from February to May 2019, stroke patients ceck-up in CSU. We involved the CSU-HAMGH clinical staff for interview patient and tick box a questionnaire. Those who responded and those who agreed to be interview tended to be younger (and consequently were men), had less previous disability, and had fewer communication and motor problems and thus shorter lengths of hospital stay than those who did not; however, none of these differences were statistically significant.

The modified Rankin questionnaire (mRSq), included 18 questions with Good, mid, No responses from which the mRS is derived. We compared the mRS obtained by these different methods. The mRS could be derived in 18 respondents (2%) and 53 respondents (90%) on the tick box and smRSq, respectively (difference in proportion, 7% [82% CI, 4–15].

Tables 1, 2 show the responses and agreement between the interview patient and tick box a questionnaire. The agreement with interview and tick box a questionnaire mRS was higher for the smRSq than for the tick box, but this was not statistically significant (difference in proportional agreement, 7% [82% CI, 4–15]).

Table 1. Agreement "Tick Box" mRSq and asked to choose the mRS in All 130 Who Completed Both Measures Successfully

Tick Box mRS	mRSq																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1	4	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	8
2	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
3	-	-	-	-	5	2	-	1	-	-	1	2	2	3	-	2	-	-	18
4	-	-	-	-	-	6	5	3	-	1	1	1	-	-	1	-	-	-	18
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
7	-	-	-	-	-	6	-	-	-	1	-	1	-	-	-	-	1	-	9
8	-	-	-	-	-	-	5	-	-	-	-	-	2	-	-	-	1	-	8
9	-	-	-	-	1	-	-	-	2	-	-	-	1	2	2	-	1	-	9
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
11	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	1	-	5
12	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	-	1	-	7
13	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	1	-	7
14	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	1	1	-	6
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	1	-	7
16	-	-	-	-	1	-	-	-	-	-	3	-	-	-	5	-	1	-	10
17	-	-	-	-	-	-	-	-	-	2	-	-	2	-	1	-	1	-	6
18	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	3
Total	6	5	-	1	7	15	11	4	6	5	5	7	11	11	18	3	14	1	130

Table 2. Agreement "Tick Box" mRSq and interview in All 130 Who Completed Both Measures Successfully

Tick Box mRS	mRSq																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Total
1	5	1	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	1	10
2	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
3	-	-	-	-	5	2	-	1	-	-	1	1	-	1	-	2	-	-	13
4	-	-	-	-	-	6	2	3	-	1	1	1	-	-	1	1	-	-	16
5	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	1	-	4
6	-	-	-	-	-	-	-	-	1	-	1	-	-	-	1	-	1	-	4
7	-	-	-	-	-	6	-	2	-	1	-	1	-	-	-	-	1	-	11
8	-	-	-	-	-	-	1	-	-	-	-	1	1	-	1	-	1	-	5
9	-	-	-	-	1	-	1	-	2	1	-	-	1	1	2	-	1	-	10
10	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	2
11	-	-	-	-	1	-	-	-	3	-	1	-	2	-	-	-	1	-	8
12	-	-	-	-	-	-	-	-	-	-	2	1	1	-	3	1	1	-	9
13	-	-	-	-	1	-	-	2	-	-	-	-	-	3	-	-	1	-	7
14	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	1	-	4
15	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	1	-	4
16	-	-	-	-	1	-	-	-	-	-	1	-	2	-	1	1	1	-	7
17	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	1	-	4
18	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1	-	1	-	4
Total	9	5	-	1	9	15	6	8	7	5	7	7	11	5	14	6	14	1	130

Validity of Pre-Stroke mRSq

We used basic descriptive statistics to describe baseline variables of included patients. As pre-stroke mRS was a key variable, we compared those with and without pre-stroke mRS against pre specied variables of age, sex, stroke type. We described concurrent validity of pre stroke mRSq by comparison with other baseline clinical and demographic variables that are known to be associated with physical function. Our chosen comparators were, age, comorbidity burden assessed by Charlson comorbidity index (18), mRSq at discharge, pre0stroke residence (categorized as: home, sheltered housing, rehabilitation center, care home), and receipt of formal care pre0stroke (categorized as: lives alone, lives with family, external

carers, sheltered housing, institutional care. We described association of pre-stroke mRSq with other variables using mean-square for proportional data and rank correlation for nominal data. We re-categorized pre-stroke residence as ‘own home’ or other (comprising any form of insti0tutional care) and calculated odds0ratios for each pre0stroke mRSq grade, see Fig 3.

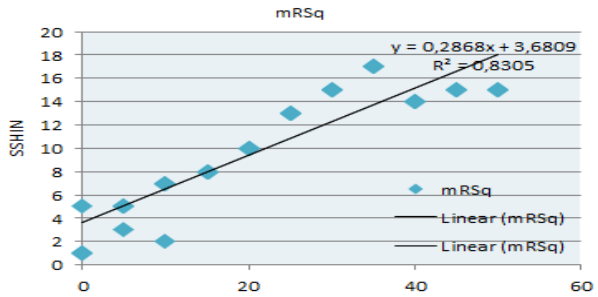

Figure 3. Correlation between the initial nihss score and the mrsq score in 53 stroke patients treated

The respondents were 130 patients registered, and 15 had the mRSq scored less than three months after stroke. The 45 analyzed, where patient had similar mean (SD) ages 55 - 67 (12) and 68-75 (33) years and median initial nihss scores (10 and 11, respec-tively). Among the analyzed patients, the time from stroke onset to the mrsq ranged 3–7 months and the median (interquartile range) mRSq score was 3 (1–6). Figure 1 shows the correlation between the initial nihss and the mRSq scores ($r = 0.911;0.287$, $r^2 = 0.830$, $p < 0.001$).
Overall, patients were categorized as more disabled on the tick box than interview, whereas there was less systematic difference between those derived from the tick box mRSq and the interview. To establish whether a strategy of using both tick box questionnaires might increase the proportional agreement with iterview.

4. Discussion

About 53 % of patients responded to a interview patient and tick box a questionnaire of the mRSq. There were fewer uninterpretable responses for the interview than for the tick box mRSq. Although a repeat interview is likely to increase this proportion of interview responders in a trial, an additional method of follow-up is needed; the most practical is a tick box mRS questionnaire. An mRS derived from the 18-mRSq by CSU-HAMGH clinical staff.

Our study has several limitations. We did not test construct or concurrent validity of the asked, interview face-to-face patient family to choose the mRSq. and nor did we assess the repeatability (or test-retest reliability) of the tick box mRSq. Although we included larger numbers than did most previous studies of mRS reliability, we had too few numbers to indicate reliably whether differences in agreement between measures, and the patients completing them, were statistically significant. Last, we only tested of interview patients and tick box a questionnaire of the mRSq.

Despite its widespread use in large randomized trials and observational studies, we have not identified any previous studies that have evaluated the tick box mRS.
The mRSq can be delivered when check-up in CSU. Based on our results, we recommend that studies in which face-to-face interviews are impractical might use a combination of a tick box mRSq and a interviews. This combination will result in the best completion rate and roughly equivalent scores with both methods; this minimizes the chance of bias resulting from nonresponse to asked, interview face-to-face patient family.

5. Conclusion

Based on our results, we recommend that studies in which face-to-face interviews are impractical might use a combination of a tick box mRSq and a interviews. This combination will result in the best completion rate and roughly equivalent scores with both methods

References

[1] Cote R, Hachinski Vc, Shurvell Bl, Et al. The canadian neurological scale: a preliminary study in acute stroke. Stroke 1986; 17:73107.

[2] Rankin J. Cerebral Vascular Accidents In Patients Over The Age of 60. Scott Med j 1957;2:200015.

[3] Jane E. Sullivan Beth E. Crowner Patricia M., et al.2013. Outcome Measures for Individuals with Stroke: Process and recommendations from the american physical therapy association neurology section task force. Physical therapy, volume 93, issue 10, 1 october 2013, pages 1383–1396, https://doi.org/10.2522/ptj.20120492.

[5] Aimie Nunn, Philip M. Bath, and Laura J. Gray. Analysis of the modified rankin scale in randomised controlled trials of acute ischaemic stroke: a systematic review stroke research and treatment, volume 2016, article id 9482876, 7 pages. Http://dx.doi.org/10.1155/2016/9482876.

[6] Quinn, T.J. , Dawson, J., Walters, M. And lees, k.r. (2009),reliability of the modified rankin scale: a systematic review. Reliability of the modified rankin scale: a systematic review. Stroke, 40(10), pp. 339303395. (doi:10.1161/strokeaha.109.557256).

[8] Aravind Ganesh, Ramon Luengo-Fernandez, Rose M. Wharton, et al. Ordinal vs Dichotomous Analyses of Modified Rankin Scale, 5-year outcome, and cost of stroke. October 19, 2018.

[9] Yannick Béjot, Christelle Blanc, Benoit Delpont, et al. Increasing Early Ambulation Disability In Spontaneous Intracerebral Hemorrhage Survivors. May 04, 2018.

[10] Bath, P. M. et al. Statistical analysis of the primary outcome in acute stroke trials. Stroke 43, 117101178, dOI:strokeaha.111.641456 [pii];10.1161/strokeaha.111.641456 [doi] (2012).

[11] Bath, P. M., Gray, L. J., Collier, T., Pocock, S. & Carpenter, J. Can we improve the statistical analysis of stroke trials? Statistical reanalysis of functional outcomes in stroke trials. Stroke 38, 191101915, dOI:strokeaha.106.474080 [pii];10.1161/strokeaha.106.474080 [doi] (2007).

[12] Baggio J.A.O, Santos-Pontelli T.E.G, Cougo-Pinto P.T, et.al. Validation of a structured interview for telephone assessment of the modified rankin scale in brazilian stroke patients. Cerebrovasc dis 2014;38:2970301. https://doi.org/10.1159/000367646.

[12] Zandieh AL, Kahaki ZZ, Sadeghian H, Pourashraf M, et.al. The Underlying Factor Structure Of National Institutes Of Health Stroke Scale: an exploratory factor analysis. int J Neurosci. 2012 Mar;122(3):14004. Doi: 10.3109/00207454.2011.633721. Epub 2011 nov 29.

[13] Patrick Lyden, MD; Lennart Claesson, PhD; Suzanne Havstad, PhD; et al. Factor Analysis Of The National Institutes Of Health Stroke Scale In Patients With Large Strokes. Arch Neurol. 2004;61(11):167701680. DOI:10.1001/Archneur.61.11.1677.

[14] Jeffrey L Saver, Day-90 Acute Ischemic Stroke Outcomes Can Be Derived From Early Functional Activity Level. Article in cerebrovascular diseases 29(1):5006, november 2009 with39 reads doi: 10.1159/000255974.

[15] Vora NA, Shook SJ, Schumacher HC, et al. A 5-item scale to predict stroke outcome after cortical middle cerebral artery territory infarction: validation from results of the diffusion and perfusion imaging evaluation for understanding stroke evolution (defuse) study. Stroke 2011; 42: 645–649.

[16] Yoo AJL, Barak ER, Copen WA, Kamalian S, Gharai LR, et.al. Combining acute diffusion0weighted imaging and mean transmit time lesion volumes with national institutes of health stroke scale score improves the prediction of acute stroke outcome. Stroke. 2010 aug;41(8):1728035. Doi: 10.1161/strokeaha.110.582874. Epub 2010 jul 1.

[17] Benjamin EJ, Blaha MJ, Chiuve SE, et al; American Heart Association Statistics Committee And Stroke Statistics Subcommittee. Heart disease and stroke statistics—2017 update: a report from the american heart association. Circulation. 2017;135(10):e229–e445.

[18] Lackland DT, Roccella EJ, Deutsch AF, et al; American Heart Association Stroke Council; Council On Cardiovascular And Stroke Nursing; Council On Quality Of Care And Outcomes Research; Council On Functional Genomics And Translational Biology. Factors influencing the decline in stroke mortality: a statement from the american heart association/american stroke association. Stroke. 2014;45(1):315–353.

[19] Goldstein LBL, Samsa GP. Reliability of the national institutes of health stroke scale. Extension to non0neurologists in the context of a clinical trial. . Stroke. 1997 feb;28(2):307010.

[20] Demaerschalk Bm1, Vegunta S, Vargas Bb, et.al. Reliability of real-time video smartphone for assessing national institutes of health stroke scale scores in acute stroke patients. Stroke. 2012 dec;43(12):327107. Doi: 10.1161/strokeaha.112.669150. Epub 2012 nov 15.

[21] Hankey GJ, Spiesser J, Hakimi Z, Bego G, Carita P And Gabriels. Rate, Degree, And Predictors Of Recovery From Disability Following Ischemic Stroke. Neurology 2007; 68: 1583–1587.

[22] Sapna Puri, Nilotpal Roy, Holger A, et.al. Replication confers β cell immaturity Nature communicationsvolume 9, article number: 485 (2018).

[23] Kwok cs, clark a, ford ga, et al. Association between prestroke disability and inpatient mortality and length of acute hospital stay after acute stroke. J am geriatr soc 2012; 60: 726–732.

[24] Eric S. Donkor. Stroke In The Century: A Snapshot Of The Burden, Epidemiology, And Quality Of Life. Stroke Research And Treatment, volume 2018, article id 3238165, 10 pages. Https://doi.org/10.1155/2018/3238165.