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SHORT COMMUNICATION

FUNCTIONAL ASSESSMENT OF STROKE PATIENTS

OCENA FUNKCJONALNA PACJENTÓW PO UDARZE MÓZGU

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ABSTRACT
Stroke is one of the leading causes of adult disability. As indicated by numerous studies, early rehabilitation may positively affect the reduction of dysfunctions resulting from a stroke.

A stroke can cause both mild and severe disabilities. In order to effectively help the patient and create a good rehabilitation program, the patient's functional state should be determined. Therefore, functional tests should be carried out before starting the rehabilitation process. Patients should be assessed in several areas. The most frequently used are functional scales (ADL scale, Barthel index), balance and gait tests (Timed Up & Go test, Berg balance scale, Tinetti test), and scales to assess motor functions (Fugl-Meyer Motor Assessment Scale). The analysis of the obtained results is necessary to determine the degree of functional deficits in a patient and establish short- and long-term treatment goals. The same tests should be repeated systematically during rehabilitation to monitor the patient's functional state improvement. The aim of the study was to describe selected functional scales and tests used in the rehabilitation process of patients after stroke.

Keywords: stroke, functional assessment, scale, ICF.

STRESZCZENIE
Udar jest jedną z głównych przyczyn niepełnosprawności dorosłych. Jak wskazują liczne badania, wcześnie rozpoczęta rehabilitacja może pozytywnie wpłynąć na zmniejszenie dysfunkcji wynikających z udaru.

Udar może być przyczyną zarówno niewielkiej jak i znacznej niepełnosprawności. Aby skutecznie pomóc pacjentowi i stworzyć dobry program rehabilitacji należy określić stan funkcjonalny pacjenta. Dlatego też przed rozpoczęciem procesu rehabilitacji należy przeprowadzić testy funkcjonalne. Pacjenci powinni być oceniani w kilku obszarach. Najczęściej wykorzystuje się skale funkcjonalne (skala ADL, wskaźnik Barthela), testy równowagi i chodu (test Timed Up & Go, skalą równowagi Berga, testem Tinetti) oraz skale do oceny funkcji motorycznych (Skala Oceny Motorycznej Fugl-Meyera). Analiza uzyskanych wyników jest potrzebna do określenia stopnia deficytów funkcjonalnych u pacjenta oraz ustalenia krótko- i długoterminowych celów leczenia. Te same testy powinny być systematycznie powtarzane w trakcie rehabilitacji, aby monitorować poprawę stanu funkcjonalnego pacjenta. Celem pracy było omówienie wybranych skal funkcjonalnych i testów stosowanych w procesie rehabilitacji chorych po udarze mózgu.

Słowa kluczowe: udar mózgu, ocena funkcjonalna, skale, ICF.

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Introduction

Strokes are the second leading cause of death and significantly contribute to adult disability worldwide (Donkor, 2018). Despite the advancement of medicine, they are still global health and social problems, and the situation is expected to worsen in the coming years with the aging population. Strokes also represent one of the leading causes of dependency and long-term disability in adults (Soto-Cámara *et al.,* 2020). The symptoms of stroke depend on which part of the brain is damaged. They usually include sudden weakness or paralysis along one side of the body, vision loss in one or both eyes, confusion, and trouble speaking or understanding speech (Wolfe *et al.,* 2011). The long-term complications and consequences of a stroke include urinary incontinence, cognitive impairment, musculoskeletal complications of a stroke (spasticity and hypertonicity), psychosocial complications of stroke (emotional lability, post-stroke depression) (Chohan *et al.,* 2019). Literature data indicate that the major deficit caused by stroke is motor impairment. These can be described as loss or reduction of muscle or movement control functions or reduced mobility. It typically affects the control of the face, upper and lower limb on one side of the body and occurs in approximately 80% of patients (Arienti *et al.,* 2019). As indicated by Astuti *et al.* (2020), post-stroke functional disability can be influenced by several factors, including older age, lower education, the severity of stroke symptoms at admission, depression, cognitive impairment at three months, and stroke recurrence within five years follow up.

The effects of stroke may range from mild to severe disabilities. It is not enough to know the diagnosis to effectively help the patient and create a good rehabilitation program adapted to the patient's functional state. The application of adequate numeric scales is essential for assessing a patient's condition and, next to, plan rehabilitation (Ślusarz *et al.,* 2015). The analysis of the obtained results is necessary to determine the degree of deficits in a patient and establish short- and long-term treatment goals. Often the same tests are repeated after rehabilitation has been performed to document improvement or no progress in the patient's condition.

As suggested by Harrison *et al.* (2013), the ideal scale would be easy and quick to administer, acceptable to patients and researchers, valid for its chosen purpose, reliable, and responsive to meaningful clinical change. As shown by literature data, there is no ideal stroke measure that fulfills all these criteria. In addition, no single scale is appropriate for the complete assessment of stroke patients (Alijanpour *et al.,* 2021). Variety instruments, both general and stroke-specific, for the functional evaluation and assessment of recovery were described. The following types of scale are used to assess the condition of patients with neurological diseases: deficit scales (The Glasgow Coma Scale (GCS)), functional scales (the modified Rankin Scale, the Katz Activities of Daily Living Scale, the Barthel Index, the Functional Independence Measure) and scales assessing the quality of life (SF-36, the WHOQOL-BREF questionnaire) (Ślusarz *et al.,* 2015; Mikołajewska, 2011).

Aim

The aim of this paper was to review the literature and present the most common tests used in clinical practice for functional assessment of patients after stroke.

Material and methods

The search for relevant studies in the PubMed database was conducted in May 2021. The authors have reviewed the literature using the following keywords: stroke, functional assessment, functional scales, balance test, gait.

Results

The group of functional scales can be divided, among others on functional scales to assess the patient's independence during daily activities, scales for the assessment of balance

and gait, and scales for the evaluation of motor functions of the upper and lower limbs. Several scales have proven reliability and validity in stroke trials, including the National Institutes of Health stroke scale (NIHSS), the modified Rankin scale (mRS), and the Barthel index (BI) (Kasner, 2006). The scales commonly used in assessing patients are described below.

The National Institutes of Health stroke scale (NIHSS)

It is the most frequently used score worldwide to assess the clinical severity of a stroke (Zöllner *et al.,* 2020). The NIHSS includes the following domains: level of consciousness, eye movements, the integrity of visual fields, facial movements, arm and leg muscle strength, sensation, coordination, language, speech, and neglect. Each impairment is scored, and scores are summed to a total score ranging from 0 to 42 (the higher the score, the more severe the stroke). As indicated by Kwah and Diong (2014), this scale has a strong ability to predict outcomes after stroke, helps clinicians provide accurate information to patients, set realistic goals for therapy, and plan for discharge. However, the scale does not measure muscle strength, and it does not provide information on the limitations of daily activities (difficulties in moving, sitting, standing, upper limb function), and therefore may not provide enough information to create exercise programs for patients (Kwah and Diong, 2014).

The modified Rankin scale (mRS)

The mRS score is a clinically-based measurement of global disability using a 7-point scale ranging from 0 (no symptoms) to 6 (dead). It covers the entire range of functional outcomes. Its categories are intuitive and easily grasped by clinicians, it is in agreement with other stroke scales, and its use has demarcated effective and ineffective acute stroke therapies (Lee *et al.,* 2020). Harrison *et al.* (2013) concluded that with a limited number of levels, the mRS might be less responsive to change than some other stroke scales, however, a single-point change on the mRS is clinically relevant.

The Barthel index (BI)

The Barthel index is a scale that allows measuring the ability to perform a selection of activities of daily living. The Barthel Index is one of the most commonly used outcome measures for disability. It is also useful to assess improvement in rehabilitation. This scale assesses 10 items such as feeding, bathing, grooming, dressing, bowel and bladder control, toileting, chair transfer, ambulation, and stair climbing. Total scores of BI ranging from 0 (worst mobility in activities of daily living) to 100 (full mobility in activities of daily living) (Musa and Keegan, 2018). Like other ADL instruments, the BI items possess a hierarchy of difficulty and yield ordinal intervals between adjacent scores. Therefore, as Yi *et al.* (2020) indicated, practitioners and researchers may have difficulty interpreting the clinical meaning of BI summary scores or changes in scores.

Motor assessment scale (MAS)

The MAS scale is designed to evaluate motor function in patients with stroke. The scale consists of 8 items assessing functions such as supine to side-lying onto the intact side, supine to sitting over the edge of a bed, balanced sitting, sitting to standing, walking, upper-arm function, hand movements, advanced hand activities. Each item is scored on a 7- point scale from 0 (patient cannot complete any part of a section) to 6 (indicates optimal motor behavior) and a total score ranging from 0 to 48 (Sobierajska-Rek and Hałoń 2016; Gor-García-Fogeda *et al.,* 2014). Sabari *et al.* (2014) indicated that the MAS uses a hierarchical scoring system that enables physiotherapists to efficiently assess a range of motor abilities required for stroke survivors to function in daily activities. They also suggested that it is a useful and efficient tool preferable to other assessments for evaluating a range of motor behaviors in stroke survivors.

The Fugl-Meyer Motor Assessment Scale (FMA)
The Fugl-Meyer motor scale is recommended highly as a clinical and research tool for evaluating changes in motor impairment following stroke (Gladstone *et al.,* 2002). It is widely used as the gold standard in stroke research (Amano *et al.,* 2020). The FMA comprises 5 different sections: motor function (voluntary movements, coordination, and reflexes of both limbs), balance, sensation, and passive joint motion and joint pain. The items are scored on a 3-grade ordinal scale, with 0 as minimum and 2 as maximum, and a maximum score of 226 (Gor-García-Fogeda *et al.,* 2014). Researchers indicated that the Fugl-Meyer Assessment had some limitations: it is lengthy to administer, can be criticized for being based on outdated theoretical constructs, and measures movement impairments exclusively, with no functional performance evaluation (Sabari *et al.,* 2014).

Berg Balance Scale (BBS)
It is one of the most popular and recognized balance measures for stroke patients in terms of reliability and validity (Jang *et al.,* 2017). It contains 14 items such as sitting unsupported, sit-to-stand, stand-to-sit, transferring, standing unsupported, standing with the eyes closed, standing with the feet together, reaching forward with an outstretched arm, turning to look behind, picking up an object from the floor, turning around, placing alternate feet on a stool, one foot forward, and a single-limb stance. Each task is rated between 0 (unable) to 4 (independent). A total score is the sum of all the scores ranging from 0 to 56 (Ordahan *et al.,* 2015). Unfortunately, BBS also has the floor & ceiling effect, so that it is hard to measure all stroke patients' balance ability only with the Berg Balance scale (Jang *et al.,* 2017).

Table 1 shows the scales used in the functional assessment of stroke patients, divided into functional scales, balance and gait tests, and scales for the assessment of motor functions of the upper and/or lower limbs.

Discussion

A stroke can cause many symptoms. Despite the same diagnosis, patients after a stroke often present a different functional state due to the different severity of the consequences of stroke. Due to the complexity of the disease symptoms, it is impossible to create one universal functional scale for all patients after stroke. Kasner (2006) suggested that no single outcome measure can describe or predict all dimensions of recovery and disability after acute stroke. For example, the NIHSS is useful for early prognostication and serial assessment, whereas the BI is useful for planning rehabilitative strategies, and mRS provides summary measures of outcome and might be most relevant to clinicians and patients considering early intervention (Kasner *et al.,* 2006). It is not easy to choose a scale to evaluate a patient from even one group of scales. For example, Gor-García-Fogeda *et al.* (2014) found many measurement scales available to assess gross motor function and suggested that they are not specific scales because they dedicate only 1 or more subsections to assess gross motor function.

There is no perfect scale, and each scale has its advantages and limitations. Some are prohibitively lengthy for routine clinical use (the Wolf Motor Function Test and Arm Motor Ability Test), some require the purchase of a costly test kit (ARAT), some do not have a cut-off point (BI), some do not show a slight improvement in functional efficiency (FMA), and some require accurate reflection by patients about daily activity patterns and may be most appropriate for individuals who have already completed the early stages of stroke rehabilitation (the Stroke Impact Scale and Motor Activity Log) (Sabari *et al.,* 2014). However, the scales can help assess the patient's current condition (patients' baseline performance), adjust the rehabilitation plan to the patient's functional deficits, monitor ongoing progress, assess the effectiveness of the interventions, and establish recommendations for

Table 1. Scales used for the functional assessment of patients after stroke.

Type of scale	Name of scale	Outcomes
Functional scales	The Katz Activities of Daily Living scale (ADL)	0–6 points
	The Lawton Instrumental Activities of Daily Living scale (IADL)	8–24 points
	Barthel index (BI)	0–100 points
	The Functional Independence Measure (FIM)	18–126 points
Balance and gait tests	Timed Up & Go test	time (s)
	Functional Reach Test (FRT)	range (cm)
	One-leg standing test	time (s)
	Berg Balance Scale	0–56 points
	Tinetti test	0–28 points
	The Step Test	repetition (number)
	6-minute walk test	range (m)
	Wisconsin Gait Scale (WSG)	13.35–42 points
Scales for the assessment of motor functions of the upper and/or lower limbs:	Fugl-Meyer Motor Assessment Scale (FMA)	0–226 points
	The Action Research Arm Test (ARAT)	0–57 points
	Motor assessment scale (MAS)	0–48 points
	Sollerman hand function test	0–80 points
	Rivermead motor assessment – RMA	0–38 points
	The Nine Hole Peg Test	time (s)
	The Brunnstrom recovery stage (BRS)	1–6 grade
	The modified Rankin Scale (mRS)	0–6 grade

follow-up care after discharge (Sabari *et al.,* 2014).

As described Taylor-Rowan *et al.* (2018) potentially useful way to categorize functional outcomes for patients after stroke is to consider the World Health Organization International Classification of Function (WHO-ICF). As suggested by Harrison *et al.* (2013), the ICF gives a conceptual framework that can aid the classification of the scales and help decide on the appropriate measure for a particular purpose. The WHO-ICF describes the function in terms of impairment, activity limitation (formerly called disability), and societal participation (formerly called handicap) (Taylor-Rowan *et al.,* 2018). The ICF classification makes it possible to combine neurological deficits with activity disturbance in certain activities of everyday life (Lucki *et al.,* 2021). Harrison *et al.* (2013) described that the WHO-ICF grades do not exist in isolation, but they interact and often create feedback loops. For example, an ischemic stroke (pathology) may cause hemianopia (impairment); this may lead to poor mobility (activity limitation) and may restrict the stroke survivor from driving (societal participation limitation). These problems may result in a fall with soft-tissue injury (impairment), and fear of falling may cause the stroke survivor to forgo usual hobbies and activities (societal participation limitation) (Harrison *et al.,* 2013). Silva *et al.* (2015) indicate that healthcare professionals can use this classification to record the disabilities and disadvantages that the patient faces in society, the impact on activities of daily living, movement limitations, body structures affected, degree of activity and social participation, environmental phenomena involved, as well as the need for intervention and technological assistance.

Conclusions

Many scales for assessing stroke patients have been described, but functional assessment is not easy due to the lack of a single recommended scale for assessing all stroke deficits. In clinical practice, various tests for functional assessment of the patients are used. The rehabilitation process of these patients takes a long time, and patients are often treated in different centers and assessed on different scales. Therefore, there is a need to recommend a standardized set

of tests to assess the most important dysfunctions of patients.

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