NEUROLOGICAL ASSESSMENT SCALES

CLINICAL AND RESEARCH PERSPECTIVES

Editors:
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Bentham Books

Neurological Assessment Scales: Clinical and Research Perspectives

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ISBN (Online): 979-8-89881-588-2

ISBN (Print): 979-8-89881-589-9

ISBN (Paperback): 979-8-89881-590-5

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First published in 2026.

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CONTENTS

PREFACE

The realm of neurology thrives at the intersection of science and humanity, where precise measurements of neurological function meet the unpredictable narratives of individual patients. Neurological assessment scales stand as the bridge between these two worlds, offering quantifiable, evidence-based insights while honoring the complexities of human experience. This book, ***Neurological Assessment Scales: Clinical and Research Perspectives,*** was born from the need to consolidate the vast landscape of these tools into a single, accessible resource for clinicians, researchers, and students alike.

Standardized assessment scales have revolutionized neurological practice by enabling clinicians to diagnose more effectively, monitor disease progression accurately, and evaluate treatment outcomes consistently. In research, these scales provide the rigor necessary for reproducibility and the comparability essential for global collaboration. Whether it is measuring spasticity with the Modified Ashworth Scale, evaluating coma recovery using the Glasgow Coma Scale, or assessing the quality of life with the SF-36, these tools form the backbone of both bedside care and benchside innovation.

This book brings together a diverse array of assessment scales spanning 15 chapters, each written by field experts. It offers an in-depth look at tools for evaluating conditions ranging from spasticity, coma, and vertigo to Parkinson's disease, multiple sclerosis, stroke, spinal cord injury, traumatic brain injury, and many more. The authors go beyond mere descriptions, presenting the clinical rationale, scoring, administration, interpretation, and psychometric properties of each scale. Also, the available modified version of the scales has been discussed. Readers will gain not only a reference guide but also a deeper understanding of how these tools shape decision-making in neurology.

Our aim is to make this book a cornerstone for those navigating the intricate pathways of neurological care and research. The content reflects a collaborative spirit, combining decades of clinical expertise and academic rigor. We hope this work will inspire confidence in its users, whether they are applying the tools in a bustling clinic, a quiet research lab, or a classroom filled with eager learners.

We extend our heartfelt gratitude to the contributors for their dedication to this endeavor and to Bentham Science Publishers for recognizing the significance of this compilation. We also thank the countless patients whose experiences have informed the creation and refinement of these scales; they remain the true focus of our collective efforts.

As neurology continues to evolve, so too will the tools we use to understand it. This book is not just a snapshot of the current state of neurological assessment but an invitation to future discoveries. We hope it serves as a trusted companion in your journey through the intricate world of neurological science.

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CHAPTER 1

Scales for Spasticity

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Abstract: Spasticity, a neurological condition characterized by increased muscle tone, is a common sequel of various neurological disorders. Accurate assessment of spasticity is crucial for effective management. This chapter provides an overview of three commonly used scales for spasticity assessment: the Modified Ashworth Scale (MAS), the Penn Spasm Frequency Scale (PSFS), and the Tardieu Scale. The MAS is a simple, clinician-administered scale that assesses passive range of motion resistance due to spasticity. It is widely used but has limitations in quantifying the velocity-dependent nature of spasticity. The Tardieu Scale addresses this limitation by evaluating spasticity at different speeds. It consists of three components: a reflex component, a tonic component, and a clonus component. The PSFS is a self-report measure that assesses the frequency and severity of muscle spasms. This chapter also discusses the psychometric properties of each scale, which are essential for ensuring their accuracy and usefulness in clinical practice.

Keywords: Catch, Cerebral palsy, Extension, Flexion, Grade, Movement, Multiple sclerosis, Muscle, Range of motion, Release, Reliability, Resistance, Scale, Spasm, Spasticity, Spinal cord injury, Stroke, Tone, Traumatic brain injury, Velocity.

INTRODUCTION

Spasticity is a complex motor disorder characterized by an abnormal increase in muscle tone and exaggerated reflexes, often resulting from upper motor neuron lesions. As the understanding of spasticity evolves, so too does the need for effective assessment tools that can accurately measure its severity and impact on

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patient function. This chapter explores the various scales used to assess spasticity, highlighting their development, application, and relevance in clinical practice. By understanding the characteristics and applications of these scales, healthcare professionals can make informed decisions regarding the diagnosis, prognosis, and treatment of spasticity.

MODIFIED ASHWORTH SCALE

The Modified Ashworth scale is among the most widely used clinical instruments for determining muscle spasticity, or more precisely, measures tonus abnormalities. The original Ashworth Scale was developed by Bryan Ashworth in 1964 to assess the effectiveness of anti-spasticity medications in patients with Multiple Sclerosis.

There are five possible grades on the scale between zero (no resistance) and four (a stiff limb in flexion or extension) [1]. In 1987, to improve the sensitivity of the measure and simplify scoring, Bohannon and Smith added the grade "1+" and suggested minor changes [2]. The Modified Ashworth Scale, as it was called after modification, has been considered the gold standard for measuring spasticity. In 2006, to improve reliability, grade “1+” was omitted and grade “2” was slightly redefined, resulting in the Modified Modified Ashworth Scale [3].

The comparison of the scores of available modifications of the Ashworth Scale has been depicted in Table **1**.

Table 1. Comparison of grades of ashworth, modified ashworth and modified modified ashworth scale.

Score	Ashworth Scale (Ashworth, 1964)	Modified Ashworth Scale (Bohannon & Smith, 1987)	Modified Modified Ashworth Scale (Ansari *et al*, 2006)
0	No increase in tone	No increase in muscle tone	No increase in muscle tone
1	Slight increase in tone, giving a catch when the limb was moved in flexion or extension.	Slight increase in muscle tone, with a catch and release or minimal resistance at the end of the range of motion when an affected part(s) is moved in flexion or extension.	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension.
1+	N/A	Slight increase in muscle tone, manifested as a catch, followed by minimal resistance through the remainder (less than half) of the range of motion.	N/A

(Table 1) cont.....

Score	Ashworth Scale (Ashworth, 1964)	Modified Ashworth Scale (Bohannon & Smith, 1987)	Modified Modified Ashworth Scale (Ansari *et al*, 2006)
2	More marked increase in tone, but the limb easily flexed.	A marked increase in muscle tone throughout most of the range of motion, but the affected part(s) are still easily moved.	Marked increase in muscle tone, manifested by a catch in the middle range and resistance throughout the remainder of the range of motion, but the affected part (s) easily moved.
3	Considerable increase in tone, passive movement difficult.	Considerable increase in muscle tone, and passive movement difficult.	Considerable increase in muscle tone, passive movement difficult.
4	The limb is rigid in flexion or extension.	Affected part(s) are rigid in flexion or extension.	Affected part(s) are rigid in flexion or extension.

Population:

- Stroke
- Spinal cord injury (SCI)
- Traumatic brain injury (TBI)
- Multiple sclerosis (MS)
- Cerebral palsy
- Pediatric hypertonia
- Central nervous system lesions

Administration

It is performed by first stretching the patient's limb from maximum flexion to maximum extension (the point at which the first gentle resistance is encountered). It is then evaluated while transitioning from extension to flexion [2].

It was reported that the upper-limb evaluation should occur when the client is in the supine position. The upper limbs should be aligned with the trunk, with extended elbows and neutral wrist positions, while the lower limbs are parallel to each other. There are specific adjustments for the shoulder extensors, where the arm should transition from extension to 90 degrees of flexion, and for the shoulder internal rotators, where the arm should move from a neutral position to the maximum external rotation [4].

For assessment of the lower limbs, it is recommended that the client assume a side-lying position. Specifically, for testing the soleus muscle, the hips and knees should be flexed to 45 degrees, and the ankle should be taken through the range of motion from maximum plantar flexion to maximum dorsiflexion. In case of the gastrocnemius muscle, the hips should be flexed at 45 degrees, the knees in

CHAPTER 2

Scales for Dizziness and Vertigo

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Abstract: Dizziness and vertigo are complex symptoms that can have a substantial influence on a person's quality of life. An accurate assessment of these symptoms is essential for appropriate diagnosis and therapy. This chapter provides a detailed review of the scales and questionnaires used to assess dizziness and vertigo, including the Dizziness Handicap Inventory (DHI), the Amer Dizziness Diagnostic Scale, the Vertigo Symptom Scale, the Visual Vertigo Analogue Scale, and the and Numeric Dizziness Scale. The chapter covers each scale's introduction, its method of use, and its psychometric features, and provides advice on choosing the best instrument for your clinical requirements and patient population. This chapter seeks to synthesize current research and therapeutic practices.

Keywords: Assessment tools, Dizziness, Dizziness handicap inventory, Vertigo, Vertigo symptom scale, Vestibular disorders.

INTRODUCTION

Dizziness is a broad term that encompasses sensations such as light-headedness, imbalance, or unsteadiness, whereas vertigo is a specific type of dizziness characterized by a false sense of movement or spinning. Both symptoms have a substantial impact on a patient's quality of life and can be caused by a variety of variables such as vestibular dysfunction, neurological problems, cardiovascular concerns, and psychological factors [1].

Because dizziness and vertigo are multidimensional, it is critical to have reliable and valid evaluation measures to determine the severity, frequency, and impact of these many scales and questionnaires have been designed to help clinicians evalu-

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ate patients with dizziness and vertigo, provide insights into their condition, and aid in diagnosis and therapy planning. These measures enable a consistent approach to evaluate dizziness-related impairments, disability, and health-related quality of life (HRQoL) [2].

DIZZINESS HANDICAP INVENTORY (DHI)

Introduction

The Dizziness Handicap Inventory (DHI) was developed by Jacobson and Newman in 1990 to measure the self-perceived level of handicap associated with dizziness. In addition to being used to assess subjective dizziness impairment, it has primarily been employed in patients with peripheral and central vestibular pathology in individuals who have severe brain injuries, chronic whiplash-related problems, severe anxiety disorders in the elderly, as well [1].

Number of Items

The DHI consists of 25 items with three response options, divided into three domains: functional, emotional, and physical.

- Functional (9 items): Assesses the impact of dizziness on everyday activities (*e.g.*, walking, reading).
- Emotional (9 items): Examines emotional responses to dizziness (*e.g.*, frustration, fear).
- Physical (7 items): Evaluates dizziness triggered by movement or physical actions (*e.g.*, looking up, bending over) [2].

Administration

Administering the questionnaires requires no additional training and takes only 5 to 10 minutes to complete. Scores for the Physical (28 points), Emotional (36 points), and Functional (36 points) subdomains are calculated (Table **1**).

Table 1. Dizziness handicap inventory (DHI) [1].

P1. Does looking up increase your problem?	Yes	Sometimes	No
E2. Because of your problem, do you feel frustrated?	Yes	Sometimes	No
F3. Because of your problem, do you restrict your travel for business or recreation?	Yes	Sometimes	No
P4. Does walking down the supermarket aisle increase your problems?	Yes	Sometimes	No
F5. Because of your problem, do you have difficulty getting into or out of bed?	Yes	Sometimes	No
F6. Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties?	Yes	Sometimes	No

(Table 1) cont.....

F7. Because of your problem, do you have difficulty reading?	Yes	Sometimes	No
P8. Does performing more ambitious activities, such as sports, dancing, or household chores (sweeping or putting dishes away), increase your problems?	Yes	Sometimes	No
E9. Because of your problem, are you afraid to leave your home without someone accompanying you?	Yes	Sometimes	No
E10. Because of your problem, have you been embarrassed in front of others?	Yes	Sometimes	No
P11. Do quick head movements make your problem worse?	Yes	Sometimes	No
F12. Because of your problem, do you avoid heights?	Yes	Sometimes	No
P13. Does turning over in bed make your problem worse?	Yes	Sometimes	No
F14. Because of your problem, is it difficult for you to do strenuous homework or yard work?	Yes	Sometimes	No
E15. Because of your problem, are you afraid people may think you are intoxicated?	Yes	Sometimes	No
F16. Because of your problem, is it difficult for you to go for a walk by yourself?	Yes	Sometimes	No
P17. Does walking down a sidewalk increase your problem?	Yes	Sometimes	No
E18. Because of your problem, is it difficult for you to concentrate?	Yes	Sometimes	No
F19. Because of your problem, is it difficult for you to walk around your house in the dark?	Yes	Sometimes	No
E20. Because of your problem, are you afraid to stay home alone?	Yes	Sometimes	No
E21. Because of your problem, do you feel handicapped?	Yes	Sometimes	No
E22. Has the problem placed stress on your relationships with members of your family or friends	Yes	Sometimes	No
E23. Because of your problem, are you depressed?	Yes	Sometimes	No
F24. Does your problem interfere with your job or household responsibilities?	Yes	Sometimes	No
P25. Does bending over increase your problem?	Yes	Sometimes	No

Scoring and Interpretation Total Score = 100

The following scores may be given to each item:

Score 0 = No; Score 2 = Sometimes; Score 4 = Yes. Hence, a score of 16-34 = mild handicap, 36-52 = moderate handicap, 54+ = severe handicap. The total possible score ranges from 0 (no handicap) to 100 (maximum handicap), with higher scores indicating greater perceived disability due to dizziness.

Indications

Vestibular Disorder, Multiple Sclerosis, Brain Injury, Older adults and Geriatric care, Movement and Gait Disorders [2].

CHAPTER 3

Scales for Coma

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Abstract: Coma is a state of profound unresponsiveness characterized by the inability to awaken or respond to stimuli, often resulting from severe brain injury, metabolic disturbances, or other critical medical conditions. Assessing the level of consciousness and potential recovery in comatose patients is essential for guiding treatment and rehabilitation strategies. Various scales are employed for this purpose, each providing unique insights into the patient's condition. The Glasgow Coma Scale (GCS) evaluates eye, verbal, and motor responses to determine the depth of coma and potential recovery. The Full Outline of Unresponsiveness (FOUR) scale combines neurological assessments and vital signs to provide a comprehensive overview of the patient's status. The Rappaport Disability Rating Scale (DRS) assesses overall functioning and disability in individuals recovering from coma, helping track rehabilitation progress. Lastly, the Western Neuro Sensory Stimulation Profile (WNSSP) evaluates sensory and motor responses, which can guide therapeutic interventions for those with significant cognitive impairments. Together, these scales form a robust framework for understanding and managing coma, aiding in both clinical decision-making and patient care.

Keywords: Assessment, Brain injury, Brainstem, Cognitive, Coma, Consciousness, Healthcare, Illness, Neuro, Reflexes, Rehabilitation, Respiration, Sensory, Treatment, Unconsciousness.

INTRODUCTION

A coma is a profound state of unconsciousness characterized by a lack of awareness of self and the environment, along with an inability to respond to stimuli [1]. This condition represents a critical medical emergency and can arise from various causes, including traumatic brain injuries, strokes, infections, metabolic imbalances, and drug overdoses. Understanding coma is essential not

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

only for medical professionals but also for families and caregivers grappling with the implications of such a severe condition [2].

When a person enters a coma, they exhibit no signs of wakefulness or awareness, which can be distressing for loved ones. Unlike sleep, a comatose state is prolonged and involves a significant disruption in normal brain function [3]. Comas are typically assessed using the Glasgow Coma Scale (GCS), a tool that evaluates a patient's responsiveness through eye, verbal, and motor responses. The depth and duration of a coma can vary widely, with some individuals emerging with full recovery, while others may transition into a vegetative state or suffer permanent neurological damage [4].

The underlying causes of coma are diverse, and prompt medical intervention is critical for improving outcomes. For instance, traumatic brain injuries from accidents can lead to swelling and pressure in the brain, while strokes may disrupt blood flow, affecting cognitive function [5]. Metabolic disorders, such as severe hypoglycaemia or liver failure, can also result in coma by altering brain chemistry. Identifying the cause is crucial, as targeted treatments can often prevent further damage [6].

The journey of recovery from a coma is highly individualized. Some patients may regain consciousness within days, while others may take weeks or even months. Rehabilitation plays a significant role in this process, as physical, occupational, and speech therapies help patients regain lost functions [7]. Families are often left to navigate an emotional landscape of uncertainty, hope, and despair, making support systems and resources essential [8].

In recent years, advances in neuroimaging and monitoring techniques have enhanced our understanding of coma, revealing the brain's potential for recovery and rehabilitation. As research continues to evolve, it is imperative to foster awareness and compassion around this complex condition, empowering families to advocate for the best possible care while promoting a deeper understanding of the human brain's resilience [9].

GLASGOW COMA SCALE (GCS)

Introduction

Glasgow Coma Scale (GCS) is a clinical scale that can be used to accurately gauge a person's level of consciousness following a head injury. It was first published in 1974 at the University of Glasgow by neurosurgery professors Graham Teasdale and Bryan Jennett [1]. It examines a person's capacity to speak, move their body, and perform eye movements.

Population

This score is used to provide emergency medical care following a brain injury (such as one sustained in a vehicle accident), as well as to monitor and track patients' level of awareness in hospitals [4, 11].

Description

The scale's three components—eye, verbal, and motor are made up of these three behaviours. The GCS scale runs from 3 (totally nonresponsive) to 15 for an individual. (Responsive) [10]. The Glasgow Coma Scale is reported as a combined score (ranging from 3 to 15) and the scores for each test (E for eye, V for Verbal, and M for Motor) (Table **1**). The best response should determine the value for each test that the subject can give.

Table 1. Glasgow Coma Scale (GCS).

Eye open	Spontaneously To speech To pain None	4 3 2 1
Verbal response	Oriented Confused Inappropriate words Incomprehensible sounds None	5 4 3 2 1
Motor response	Obey commands Localises to pain Withdraws from pain Flexion to pain Extension to pain None	6 5 4 3 2 1
Maximum score		/15

Time to Administration

Less than 5 minutes

Psychometric Properties

Sensitivity: 79 to 97% [10]; **Specificity:** 84-97% [11]

Advantage:

- Most commonly accepted conscious level scoring system in the world has face validity (seems to work).

CHAPTER 4

Scales for the Elderly

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Abstract: Ageing is a complex process characterised by progressive physiological changes that can affect mobility, mental health, and overall quality of life. As individuals age, they may experience a decline in physical function, cognitive abilities, and emotional well-being, necessitating effective assessment tools to monitor these changes. The Elderly Mobility Scale (EMS) evaluates functional mobility in older adults, helping identify those at risk for falls and mobility limitations. The Balance Outcome Measure for Elder Rehabilitation (BOOMER) assesses balance capabilities, guiding interventions to enhance stability and prevent injuries. The Karnofsky Performance Scale Index provides a standardised measure of functional status, enabling healthcare providers to evaluate a patient's ability to perform daily activities. The Geriatric Depression Scale screens for depressive symptoms, addressing mental health issues that are prevalent in the elderly population. Lastly, the Clinical Frailty Scale (CFS) offers a holistic view of frailty, helping to stratify risk and tailor care for older adults. Together, these scales facilitate a comprehensive assessment of age-related changes, guiding effective interventions and improving seniors' overall health and well-being.

Keywords: Ageing, Chronic illness, Cognitive, Elderly, Emergency, Health, Patients, Physical, Physiological, Population, Psychological, Quality of life, Treatment.

INTRODUCTION

Ageing is an intricate and universal process that every individual experiences, encompassing a myriad of biological, psychological, and social changes [1]. As populations around the globe continue to age due to advances in healthcare, nutrition, and overall living standards, understanding the implications of Ageing has become increasingly vital. The journey of Ageing is not merely a linear prog-

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

ression of years but a complex interplay of experiences that shape individuals and societies [2].

Biologically, Ageing is marked by a gradual decline in physiological functions, with cells and tissues undergoing changes that affect everything from skin elasticity to organ efficiency [3]. These changes can lead to age-related conditions, such as arthritis, cardiovascular diseases, and cognitive decline. However, the biological aspects of Ageing are accompanied by a range of psychological dimensions [4]. Ageing can bring about reflections on identity, purpose, and the legacy one leaves behind. It is often a time of introspection, where individuals reassess their life goals and relationships, leading to both challenges and opportunities for personal growth [5].

Socially, the Ageing population significantly influences economic structures, healthcare systems, and cultural norms. As societies age, they must adapt to ensure adequate support systems are in place, from pensions to healthcare services [6]. This demographic shift challenges stereotypes about Ageing, highlighting the capabilities and contributions of older individuals. Many remain active participants in their communities, engaging in volunteer work, mentorship, and even second careers [7].

Moreover, Ageing is often culturally constructed; perceptions of Ageing vary widely across different societies. In some cultures, older adults are revered and respected for their wisdom, while in others, they may face marginalisation. This cultural lens shapes the Ageing experience, influencing how individuals perceive their own Ageing and how they are treated by others [8].

In essence, Ageing is a multifaceted phenomenon that goes beyond physical decline to encompass emotional resilience, societal roles, and cultural narratives. By exploring these dimensions, we can foster a more nuanced understanding of Ageing, promoting a positive perspective that embraces the richness of the later stages of life. As we navigate the challenges and opportunities of Ageing, it becomes essential to cultivate environments that celebrate the contributions of older adults and enhance their quality of life [9].

ELDERLY MOBILITY SCALE (EMS)

Introduction

Through seven functional tasks, including bed mobility, transfers, and body response to disturbance, EMS assesses a person's mobility issues. Analysis is done on the sit-to-stand and walking speeds [10]. According to studies, walking pace

slows down with age; for healthy women over 75, the average walking speed is 1 metre per second [10, 11]. Walking speed will be further decreased when frailty increases.

Population

Older people in a hospital setting, either in a ward or in a day hospital.

Description

Table **1** shows that the Elderly Mobility Scale (EMS) is a 20-item, validated assessment tool for evaluating frail older adults. It is an ordinal scale [12].

Table 1. Elderly mobility scale score.

TASK		Score		
Lying to Sitting	2 Independent 1 Needs the help of 1 person. 0 Needs help of 2+ people			
Sitting to Lying	2 Independent 1 Needs the help of 1 person 0 Needs help of 2+ people			
Sitting to Standing	3 Independent in under 3 seconds 2 Independent in over 3 seconds 1 Needs the help of 1 person 0 Needs help of 2+ people			
Standing	3 Stands without support and able to reach 2 Stands without support, but needs support to reach 1 Stands but needs support 0 Stands only with the physical support of another person			
Gait	3 Independent (+ / - stick) 2 Independent with frame 1 Mobile with walking aid but erratic/unsafe 0Needs physical help to walk or constant supervision			
Timed Walk (6 metres)	3 Under 15 seconds 2 16 – 30 seconds 1 Over 30 seconds 0 Unable to cover 6 metres Recorded time in seconds.			
Functional Reach	4 Over 20 cm 2 10 - 20 cm. 0 Under 10 cm Actual reach			
		/20	**/20**	**/20**

CHAPTER 5

Scales for Ataxia

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Abstract: Ataxia refers to impaired coordination of voluntary movements. Historically, the term also encompassed disturbances of gait, overall mobility, and even cardiac rhythm. The condition arises when sensory or motor pathways of the central or peripheral nervous system are affected. Accurate assessment is crucial to understanding the patient's current functional status. This chapter provides an overview of commonly used clinical tools for ataxia evaluation, focusing on the Scale for the Assessment and Rating of Ataxia (SARA), the Brief Ataxia Rating Scale (BARS), and the International Cooperative Ataxia Rating Scale (ICARS). Each section outlines the background, application methods, psychometric properties, and clinical indications for these instruments.

Keywords: Ataxia, Cerebellar ataxia, Gait, Psychometrics, Scale for the Assessment and Rating of Ataxia (SARA).

INTRODUCTION

Ataxia may result from diverse pathological processes, making the identification of the underlying cause essential. It is clinically defined by poor coordination and postural instability, most often linked to damage within the cerebellum and its associated neural pathways. Both hereditary and acquired forms exist. Pure manifestations of ataxia are uncommon in acquired disorders, where other neurological signs typically accompany the condition. With the expanding spect-

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rum of hereditary degenerative ataxias, clinical focus should remain on identifying potentially reversible or treatable forms, particularly those that may pose serious risks to the patient's health [1]. The pathophysiology of ataxia has not been fully elucidated. Research in this field frequently investigates voluntary limb movements in patients with cerebellar pathology or peripheral neuropathy.

The pathophysiology of ataxia has not been fully elucidated. Research in this field frequently investigates voluntary limb movements in patients with cerebellar pathology or peripheral neuropathy. In those with cerebellar lesions, abnormalities are often documented using advanced motion analysis. Findings typically include: (a) reduced amplitude and prolonged activation of agonist muscles, resulting in impaired acceleration, and (b) delayed activation of antagonist muscles, causing slowed or incomplete deceleration [2].

The following sections review clinical questionnaires designed to quantify ataxia severity.

SCALES FOR ASSESSMENT AND RATING OF ATAXIA (SARA)

Introduction

The Scale for the Assessment and Rating of Ataxia (SARA) was developed by Schmitz-Hübsch and colleagues in 2006 to provide a concise and reliable clinical measure for cerebellar ataxia, particularly in patients with spinocerebellar ataxia [3]. Beyond spinocerebellar ataxia, the scale has also been applied in other rare conditions, including lysosomal storage disorders, where it demonstrated acceptable responsiveness and clinical relevance [4]. It is a short, semi-quantitative tool that enables clinicians to evaluate the severity of symptoms and track disease progression over time [3].

Items

The scale consists of eight performance-based tasks:

- **Gait (0–8 points):** Evaluates walking ability and distance covered.
- **Stance (0–6 points):** Measures stability while standing.
- **Sitting (0–4 points):** Assesses the ability to maintain upright sitting posture without foot support.
- **Speech disturbance (0–6 points):** Examines clarity and fluency of speech during conversation.
- **Finger chase (0–4 points):** Tests for dysmetria by having the patient follow the examiner's finger.

- **Nose–finger test (0–4 points):** Measures tremor and accuracy in reaching a target.
- **Fast alternating hand movements (0–4 points):** Evaluates dysdiadochokinesia.
- **Heel–shin slide (0–4 points):** Assesses lower-limb coordination and balance.

Items 5 to 8 are performed bilaterally.

Administration

The scale is straightforward to use, requires no specialised training, and typically takes about 22 minutes to administer (average patient time: 14.2 ± 7.5 minutes; average control time: 7.2 ± 2.6 minutes).

Scoring and Interpretation

The maximum possible score is 40. A score of **0** indicates no impairment, while **40** reflects the most severe form of ataxia. The minimal detectable change is < 3.5 ($p < 0.0001$).

Indications

SARA applies to patients with spinocerebellar ataxia, ataxic stroke, and Friedreich's ataxia.

Translations

Validated versions of SARA exist in multiple languages:

- **Brazilian Portuguese:** excellent internal consistency ($\alpha = 0.94$) [3]
- **Chinese:** good reliability ($\alpha = 0.78$) and criterion validity (0.9) [4]
- **Korean (K-SARA):** very high inter-rater reliability (ICC = 0.985, $p < 0.001$) and test–retest reliability (ICC = 0.997, $p < 0.001$) [5]

PSYCHOMETRIC PROPERTIES

- **Reliability:**
  - Test–retest reliability: excellent (Spinocerebellar ataxia: ICC = 0.90; Friedreich's ataxia: ICC = 0.99) [6]
  - Inter-rater reliability: high (Spinocerebellar ataxia: ICC = 0.98; Friedreich's ataxia: ICC = 0.80) [6]
  - Internal consistency: strong (Spinocerebellar ataxia: ICC = 0.94; Friedreich's ataxia: ICC = 0.89) [6]

CHAPTER 6

Scales for Parkinson's Disease

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Abstract: Parkinson's disease is a progressive neurodegenerative disorder primarily affecting motor function due to the loss of dopamine-producing neurons in the substantia nigra of the brain. This reduction in dopamine leads to common symptoms such as tremors, bradykinesia (slowed movement), muscle rigidity, and impaired balance. The disease also affects non-motor functions, contributing to symptoms like cognitive decline, mood disorders, sleep disturbances, and changes in speech and handwriting. While the exact cause of Parkinson's remains unknown, it is believed to involve a combination of genetic and environmental factors. Diagnosis is typically clinical, based on symptom presentation and physical examination. Treatment focuses on managing symptoms, often with medications such as levodopa to increase dopamine levels or dopamine agonists to mimic its effects. In advanced cases, surgical interventions like deep brain stimulation (DBS) may be considered. Although there is no cure, ongoing research seeks to understand the disease mechanisms better and develop more effective therapies to improve the quality of life for those affected by Parkinson's disease.

Keywords: Bradykinesia, Cognitive decline, Impaired balance, Rigidity, Tremors.

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

INTRODUCTION

Parkinson's disease (PD) is a progressive neurodegenerative disorder that impacts both motor and non-motor pathways within the basal ganglia. The loss of dopamine-producing neurons in the substantia nigra results in key motor symptoms of PD, including bradykinesia, muscle stiffness, resting tremors, and impaired postural reflexes. PD presents as a distinct clinical syndrome with various causes and symptom patterns. Its diagnosis relies solely on clinical evaluation, requiring the use of multiple assessment tools, such as scales and questionnaires, to determine the disease stage and related comorbidities [1].

Pathogenesis

A key pathological process in PD involves the misfolding and abnormal accumulation of α-synuclein, a presynaptic protein that assembles into toxic oligomers and fibrils. These aggregates lead to the development of Lewy bodies, the characteristic intracellular inclusions found in PD (1–3). The spread of α-synuclein pathology through interconnected brain regions supports the prion-like hypothesis, suggesting that misfolded proteins can trigger similar misfolding in adjacent healthy neurons. Other contributing mechanisms are mitochondrial dysfunction, particularly defects in Complex I of the electron transport chain, oxidative stress caused by excessive free radical accumulation, neuroinflammation driven by activated microglia releasing pro-inflammatory cytokines, Disruption of protein degradation systems, especially autophagy-lysosomal pathway dysfunction, and genetic influences, including mutations in the SNCA, LRRK2, PARK2, and GBA genes [2, 3].

Risk Factors

PD arises from a complex interaction between genetic susceptibility and environmental exposures. Established risk factors include [4]:

- Advancing Age: The most significant predictor of PD onset
- Exposure to environmental toxins, such as pesticides (*e.g.*, paraquat), herbicides, heavy metals, and certain industrial solvents.
- Recurrent head injuries: They elevate the risk of neurodegeneration.
- Genetic Predisposition: It involves both autosomal dominant and recessive mutations.
- Gender biases: Men show a higher incidence than women.

Note: Tobacco use and caffeine intake have been linked to a reduced risk of PD, though the biological mechanisms behind this protective effect remain unclear.

Symptom Spectrum (Non- Motor)

While PD is primarily defined by its motor manifestations, non-motor symptoms often emerge years before motor decline and profoundly affect quality of life. They are autonomic dysfunction, sensory disturbances, neuropsychiatric symptoms, sleep disturbances, and cognitive decline. Hyposmia and constipation are particularly notable, as they often represent the earliest detectable prodromal indicators of PD [2].

Treatment

PD treatment is tailored to disease stage, symptom profile, and patient characteristics. However, treatments primarily offer symptom control, as no therapy has yet demonstrated consistent disease-modifying effects. There are conservative treatment which included pharmacological management and physiotherapy regime and another line is the surgical treatment.

Pharmacological treatment: This includes Levodopa (the gold standard), Dopamine agonist (like ropinirole), MAO inhibitors (like selegiline), COMT inhibitors, and anticholinergic drugs [5].

Surgical Treatments: Deep Brain Stimulation (DBS) of the subthalamic nucleus or globus pallidus internus is reserved for advanced PD with medication-resistant motor fluctuations. Risks include infection, mood changes, and neuropsychiatric complications [2].

Critical Analysis and Integration of Advancement

PD rating scales are well-established and extensively validated; their use should be interpreted in light of recent advancements in PD research. These include developments in biomarker identification (such as α-synuclein seed amplification assays), trials exploring neuroprotective therapies, digital mobility assessment tools, and personalised treatment approaches. Adopting a more integrated and critical perspective enables clinicians and researchers to [3]:

- Recognise the strengths and limitations of existing assessment instruments
- Acknowledge the need for comprehensive, multidimensional evaluations given PD's clinical heterogeneity
- Understand how emerging technologies and imaging modalities can enhance traditional clinical scales.
- Anticipate how ongoing research may pave the way for earlier diagnosis and more tailored therapeutic strategies.

CHAPTER 7

Scales and Questionnaires to Assess Neuropathy

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Abstract: This chapter provides an in-depth review of six widely used scales for assessing neuropathy, including their interpretation, intended population, administration, and psychometric properties. The chapter covers the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS), Douleur Neuropathique 4 (DN4), Neuropathic Pain Questionnaire (NPQ), Overall Neuropathy Limitation Scale (ONLS), the Veterans Affairs Neuropathy Scale (VANS), and Utah Early Neuropathy Scale (UENS). Each scale is critically analysed for its clinical utility, with a focus on its target populations, such as patients with diabetic neuropathy, chemotherapy-induced neuropathy, or other neuropathic conditions. Practical details on the administration process, including time requirements and scoring methods, are discussed. Additionally, the chapter highlights the psychometric properties of each scale, such as validity, reliability, and sensitivity to change, providing clinicians and researchers with a comprehensive guide for selecting appropriate tools for neuropathy assessment in diverse patient populations.

Keywords: Neuropathy, Outcome measures, Peripheral neuropathy, Questionnaire, Scales.

INTRODUCTION

Peripheral neuropathy encompasses a variety of conditions involving damage to the peripheral nervous system and is one of the most prevalent neurological disorders. The peripheral nervous system is one of the most prevalent neurological disorders [1, 2]. It affects approximately 77 out of every 100,000 pe-

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

ople annually and occurs in 1-12% of the general population, with the prevalence rising to as high as 30% among older adults [2]. Peripheral neuropathy is most frequently observed in individuals with diabetes mellitus, Human Immunodeficiency Virus (HIV) infection, and dysproteinemic disorders, as well as in patients undergoing chemotherapy or radiotherapy [1]. The primary care physician faces three key challenges when managing patients with peripheral neuropathy: first, quickly screening asymptomatic patients (in under 2 minutes) for neuropathy, particularly when they have conditions like diabetes where neuropathy is common, second, clinically assessing patients with neuropathy symptoms to decide who needs specialist referral and what tests are suitable for those who do not, and third, managing the symptoms of painful peripheral neuropathy effectively [1]. These challenges highlight the need for specific tools and questionnaires to assist caregivers in evaluating the severity of symptoms and ensuring appropriate care is provided. Additionally, these tools can be valuable for quantifying symptoms for research purposes, contributing to a better understanding of peripheral neuropathy and its management.

DOULEUR NEUROPATHIQUE 4 (DN4)

Douleur Neuropathique 4 (DN4) was developed to evaluate sensory descriptors and symptoms of neuropathic pain (NP) besides sensory examination. DN4 has been extensively used in a variety of NP conditions with varied aetiology. The questionnaire was originally written in French, but the same team of developers immediately translated it into English. Since 2005, the scale has become increasingly popular due to its clarity and convenience. Neuropathic pain caused by central and peripheral lesions is usually evaluated using this approach [3].

Description

The questionnaire consists of four questions with 10 items. Questions 1 and 2 discuss the characteristics and symptoms associated with pain. They are marked based on an interview with the person. Questions 3 and 4 are marked based on a physical examination that assesses the perception of the stimulus and aggravating factors, as shown in Table **1**.

Table 1. Douleur neuropathique 4 questionnaire.

Interview with the patient		
Question 1: Does the pain have one or more of the following characteristics?		
1. Burning	○ Yes	○ No
2. Painful cold	○ Yes	○ No

(Table 1) cont.....

Interview with the patient		
3. Electric shocks	○ Yes	○ No
Question 2: Is the pain associated with one or more of the following symptoms in the same area?		
4. Tingling	○ Yes	○ No
5. Pins and needles	○ Yes	○ No
6. Numbness	○ Yes	○ No
7. Itching	○ Yes	○ No
Examination of the patient		
Question 3: Is the pain located in an area where the physical examination may reveal one or more of the following characteristics?		
8. Hypoesthesia to touch	○ Yes	○ No
9. Hypoesthesia to prick	○ Yes	○ No
Question 4: In the painful area, can the pain be caused or increased by:		
10. Brushing?	○ Yes	○ No

Note: Please complete this questionnaire by ticking one answer for each item.

Administration

It is a clinician-administered outcome measure and takes about 5 minutes to complete.

Scoring and Interpretation [3]

- Score 1 for each Yes answer
- Score 0 for each No answer
- If the score is 4 or higher, the pain is most likely neuropathic.
- If the score is less than 4, the pain is unlikely to be neuropathic.

Intended Population

Conditions that often have Neuropathic Pain [3]

1. Complex Regional Pain Syndrome (CRPS) Type 1
2. Lumbar or Cervical Radiculopathy
3. Brachial Plexus Injury
4. Peripheral Neuropathies
5. Central Nervous System Lesions (Stroke, Traumatic Brain Injury, Multiple Sclerosis)
6. Polyneuropathies

CHAPTER 8

Scales to Assess Spinal Cord Injury

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Abstract: Spinal cord injury (SCI) is a serious condition caused by trauma, disease, or degeneration of the spine, leading to a loss of motor and sensory function below the level of the injury. This damage disrupts communication between the brain and the rest of the body, often resulting in paralysis, sensory loss, and dysfunction of autonomic functions. The extent and location of the injury largely determine the severity of the impact, ranging from minor impairments to complete loss of movement and sensation. Spinal cord injury symptoms include paralysis, sensory loss, bladder/bowel dysfunction, sexual impairment, respiratory issues, chronic pain, and autonomic problems such as low blood pressure and temperature regulation difficulties. Severity varies by injury level. So, accurate assessment and re-assessment are necessary for rehabilitation and for measuring progress. This chapter covers key spinal cord injury (SCI) assessment scales: the ASIA Impairment Scale for determining motor and sensory impairment levels, the Spinal Cord Independence Measure (SCIM) for evaluating functional independence in daily activities, and the Spinal Cord Assessment Tool for Spastic Reflexes (SCATS) for assessing spasticity and reflex severity in SCI patients. Additionally, the Balance Error Scoring System (BESS) is used to assess balance, while the Mini-Balance Evaluation System Test (Mini-BESTest) measures balance and mobility. The SCI Spasticity Evaluation Tool (SCISET) assesses spasticity, and gait and ambulation are evaluated using the Walking Index for SCI (WISCI). WISCI also assesses hand function. Other important tools include the SCI-QOL, which measures the overall quality of life in SCI patients, and the SCI Pain. Lastly, the Spinal Cord Injury Functional Ambulation Inventory (SCIFAI) is used for assessing walking and functional ambulation.

Keywords: Chronic pain, Functional status, Muscle spasticity, Paralysis, Quality of life, Spinal cord injuries.

INTRODUCTION

Spinal cord injury (SCI) is a serious condition resulting from damage to the spinal cord, often caused by accidents like car crashes. While trauma is the most comm-

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

on cause, other factors like cancer and tuberculosis can also lead to SCI. The damage can cause permanent disability, affecting movement, sensation, and even breathing. Injuries to the upper part of the spinal cord can be particularly dangerous, as they may impact vital functions like heart and lung activity, requiring immediate medical attention. Many scales have been designed to comprehensively evaluate various aspects of SCI, such as motor function, sensory perception, and overall well-being [1, 2]. These scales offer valuable insights for healthcare professionals, enabling them to tailor treatment plans and monitor patient progress. By contributing to a deeper understanding of SCI, these tools can play a vital role in improving outcomes and enhancing the lives of individuals affected by this condition.

AMERICAN SPINAL INJURY ASSOCIATION IMPAIRMENT SCALE (ASIA)

Introduction

The American Spinal Injury Association created the International Standards for Neurological Classification of Spinal Injury, a grading and classification system used in the treatment of patients with spinal cord injuries that helps practitioners identify neurologic levels of injury. It is a standardised, careful, detailed documentation of spinal cord injuries that guides further radiographic assessment and treatment and determines whether injuries are complete or incomplete [3].

Description

The AISA examination consists of three examinations, as shown in Fig. (**1**), which are:

1. Myotomal examination is a Motor Examination
2. Dermatomal examination is a Sensory Examination
3. Anorectal Examination

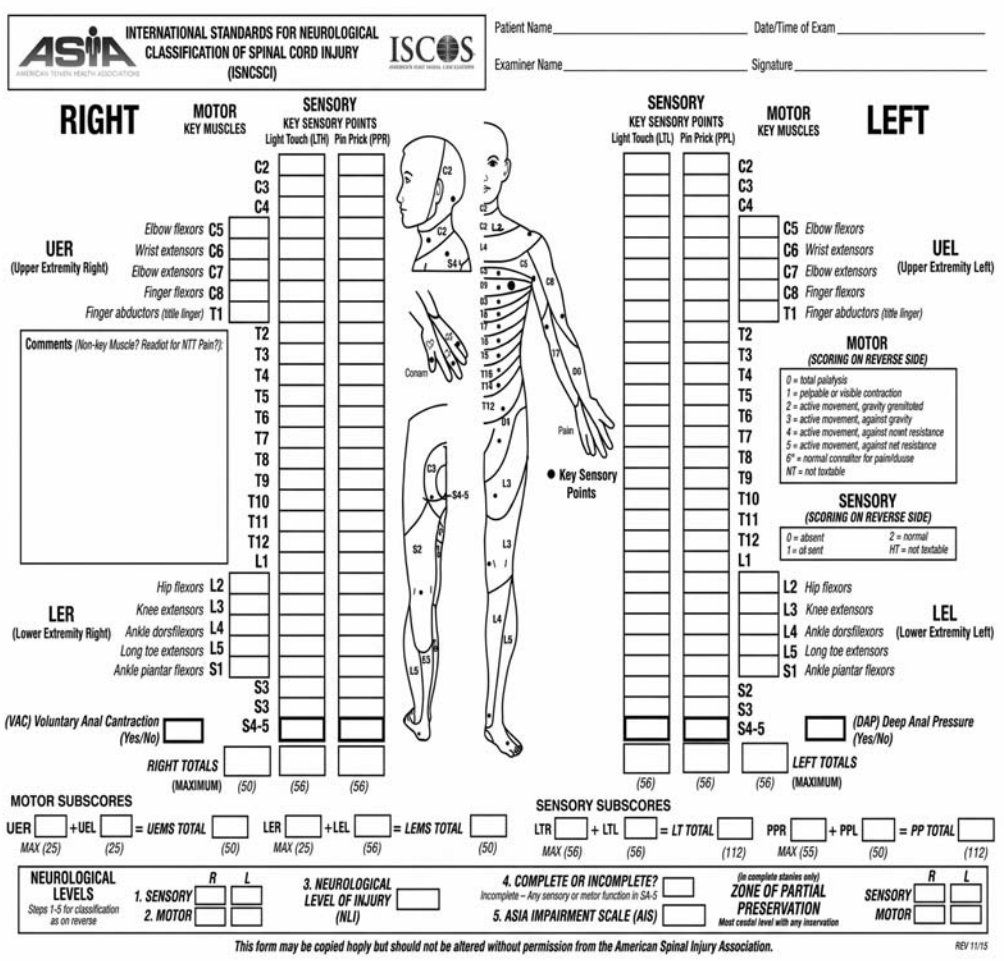

Fig. (1). American spinal injury association impairment scale.

The sensory evaluation assesses the light touch (usually a cotton piece) and pinprick (usually a clean safety pin) sensations bilaterally on 28 distinct dermatomes. Every aspect of the examination is documented for every dermatome and laterality. A score of 0 indicates no sensation, a grade of 1 indicates diminished or changed sensation, and a grade of 2 indicates normal experience. A typical unilateral sensory examination has 28 dermatomes, or 112 total points, each of which has 2/2 points for gentle touch and 2/2 points for pinprick. A bilateral sensory evaluation with a total score of 224 indicates full normalcy. A score of 0 is assigned for the inability to differentiate between light touch and pinprick sensation.

CHAPTER 9

Scales for Traumatic Brain Injury

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Abstract: Traumatic brain injury (TBI) is a complicated and diverse condition that impacts millions of people around the globe, with a variety of cognitive, emotional, and behavioural problems. The severity of TBI can vary greatly, from mild concussions to severe, life-altering injuries. Various scales, such as the Glasgow-Coma Scale, Rancho_Los_Amigos Scale, and National Institutes of Health-Stroke Scale, are used to assess the severity of TBI and guide treatment decisions. TBI can result in cognitive, emotional, and behavioural changes, impacting daily life and relationships. Proper diagnosis and evaluation are essential for creating effective treatment strategies and enhancing patient outcomes. Cognitive deficits can include memory loss, attention problems, and difficulty with problem-solving, while emotional changes can include depression, anxiety, and mood swings. Behavioural changes can include impulsivity, irritability, and aggression. Early and accurate diagnosis, as well as comprehensive treatment and rehabilitation, are essential for maximising recovery and enhancing the quality of life for those with TBI.

Keywords: Behavioural deficits, Brain injuries, Cognition, Cognitive dysfunction, Coma, Consciousness, Glasgow-coma scale, Neurological deficits, Stroke, Traumatic-brain injury.

INTRODUCTION

Traumatic-Brain Injury (TBI), a complex and diverse condition that affects millions of people worldwide, is identified as a variety of brain injuries that take place when an abrupt trauma inflicts damage on the brain. Prevalence rate of TBI

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

varies widely depending on the population and the criteria used to define TBI, with approximately 1.7 million instances of traumatic brain injury occurring annually in America, culminating in 52,000 fatalities, 275,000 inpatient admissions, and 1.3 million urgent care centre visits [1]. To assess the severity and outcome of TBI, several scales are used, including the Glasgow Coma Scale (GCS), Rancho Los Amigos Scale, Functional Independence Measure (FIM), and Glasgow Outcome Scale (GOS). These scales are important because they help healthcare professionals diagnose, monitor, and treat TBI patients effectively, enabling accurate diagnosis, effective treatment, monitoring of progress, and research and development [2].

RANCHO LOS AMIGOS SCALE (RLAS)

Rancho_Los_Amigos Scale (RLAS), commonly recognised healthcare measurement utilised to characterise behavioural-cognitive outlines observed among individuals with brain injury. RLAS can be used throughout the recovery period. Rancho_Los_Amigos Scale was initially developed to evaluate patients' recovery from coma through ("The Head Injury Team" at "Rancho_Los_Amigos National Rehabilitation Centre in Downey, California") by Dr. Chris Hagen and team in 1972. Original RLAS has 8 levels, which denote the level of function. Later, 2 levels were added to develop a more detailed 10-point system known as the Rancho_Los_Amigos-Revised Scale (RLAS-R) [3].

ICF Domain: Cognition

Number of items: 1

Instructions for Administration and Scoring

Administration

- Clinician administered
- The assessor performs a qualitative evaluation of the individual's conduct [4].

Level_[I]: No-Response: Total-Assistance

- Lack of reaction to outside stimuli

Level_[II]: Generalized-Response: Total-Assistance

- Reacts unpredictably and aimlessly to external stimuli
- Reactions are frequently identical regardless of the stimulus

Level_[III]: Localized-Response: Total-Assistance

- Reacts unpredictably and specifically to external stimuli
- Reactions are directly connected to the stimulus; for instance, the patient may withdraw or vocalise in response to painful stimuli
- Shows greater responsiveness to familiar individuals (friends and family) compared to unfamiliar ones.

Level_[IV]: Confused/Agitated: Maximal-Assistance

- The person is in a state of heightened activity, exhibiting strange and aimless behaviour.
- Displays restless actions that stem more from internal disorientation than from the surrounding environment
- Lacks short-term memory

Level_[V]: Confused-Inappropriate_Non-Agitated: Maximal-Assistance

- Exhibits improved consistency in following and reacting to basic instructions.
- Reactions are aimless and erratic to more complicated commands.
- Actions and speech are frequently unsuitable, and the individual seems disoriented and often fabricates information.
- Memory is significantly compromised, making it challenging to acquire new knowledge.
- Distinct from level IV in that the individual does not display agitation in response to internal stimuli; however, they may exhibit agitation in reaction to unpleasant external stimuli.

Level_[VI]: Confused-Appropriate: Moderate-Assistance

- Consistently adheres to basic instructions.
- Capable of remembering how to perform familiar activities they did before the injury (such as brushing teeth or washing their face), but struggle to learn new tasks.
- Shows heightened awareness of themselves, their circumstances, and their surroundings, yet lacks awareness of particular deficits and safety issues
- Reactions may be inaccurate due to memory deficits, but are suitable for the context.

CHAPTER 10

Scales for Multiple Sclerosis

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Abstract: Multiple sclerosis (MS) is a chronic, autoimmune disease that affects the central nervous system, leading to demyelination and neurodegeneration. Depending on the extent and location of the demyelination, these symptoms might range from minor sensory disturbances to severe physical and cognitive impairments. Symptoms of MS include motor and sensory impairments, fatigue, cognitive dysfunction, and visual disturbances. The progression of MS differs significantly between individuals; some may undergo relapsing-remitting phases, while others might develop a more steadily advancing form of the disease. MS is usually diagnosed through a combination of clinical assessments, imaging methods such as MRI, and analysis of cerebrospinal fluid *via* lumbar puncture. Multiple Sclerosis (MS) is evaluated using various scales that assess disease progression, symptom intensity, and its impact on the patient's quality of life. The most widely used instruments, the Expanded Disability Status Scale (EDSS) and the Hauser Ambulation Index (HAI), focus on mobility, physical disability, and Ambulation. While the Scripps scale assesses more general neurological deficits, the Multiple Sclerosis Spasticity Scale (MSSS-88) is intended to measure the degree and impact of spasticity on daily activities in MS patients. Another useful instrument for assessing illness progression is the Troiano Scale, which focuses on motor and sensory deficiencies. These scales work together to support clinicians in tracking the course of diseases, customising treatment regimens, and assessing treatments.

Keywords: Autoimmune diseases, Central nervous system, Cognitive dysfunction, Comprehensive clinical tool, Humans, Magnetic resonance imaging, Multiple sclerosis, Neurological scale, Quality of life, Spasticity.

INTRODUCTION

Multiple sclerosis (MS) is a complicated autoimmune disease of the central nervous system [1]. It affects around 2.8 million people worldwide, with a preva-

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

lence of 35.9 per 100,000. It is more frequent in North America and Europe, where rates can reach 200 per 100,000 people, and less common in Asia and Africa. In India, the prevalence is lower, estimated at 8-20 per 100,000 people. Women are more affected than men, with a ratio of about 3:1 [2]. To effectively manage and track the progression of this condition, healthcare professionals and researchers rely on various assessment scales. These scales provide objective measurements of the disease's numerous components, including physical disability, cognitive impairment, and overall quality of life [3]. Using these standardised methods, clinicians and therapists may evaluate therapy efficacy, track changes over time, and make educated decisions about patients' care. MS scales are critical for identifying the various ways the disease affects patients, enabling more individualised treatment and better clinical outcomes.

Expanded Disability Status Scale (EDSS)

The Expanded Disability Status Scale (EDSS) is a neurological scale widely employed to quantify disability in individuals with multiple sclerosis (MS) [4]. Originally developed by John Kurtzke in 1983, the EDSS has become a standard tool for assessing the extent of neurological impairment in MS patients. It assesses coordination, gait, mental health, vision, and perception. EDSS was later converted into the FSS [5].

It evaluates various functional systems, including ambulation, pyramidal, cerebellar, brainstem, sensory, bowel and bladder, visual, and mental functions, as shown in Table **1**. The composite score provides a comprehensive overview of MS's impact on an individual's daily life [4].

IFC Domain

Physical functioning and disability

Number of Items: 8

Instructions for Administration and Scoring

Administration

- Administered by a neurologist, the EDSS involves a detailed examination of different functional domains.
- The EDSS includes a single grading scale, while the FSS evaluates eight items.
- It takes 15 to 30 minutes to administer.

Table 1. Expanded Disability Status Scale (EDSS).

Expanded Disability Status Scale (EDSS)
0.0: No neurological evaluation (all FS scores are 0).
1.0: No disability; slight signs in 1 FS (1 grade).
1.5: No disability; mild signs in multiple FS (more than one grade 1).
2.0: Mild disability in 1 FS (one grade 2, others 0 or 1).
2.5 Mild disability in 2 FS (two grade 2, others 0 or 1).
3.0: Fully ambulatory with moderate disability in 1 functional system (grade 3) or mild disability in three or four FS (grade 2), with others at grade 0 or 1.
3.5: Able to walk independently but has moderate disability in 1 FS (grade 3) along with one or 2 FS at grade 2, or 2 FS at grade 3, or 5 FS at grade 2, while the rest remain at grade 0 or 1.
4.0: Fully ambulatory, independent, and active for about 12 hours daily despite severe disability (1 FS at grade 4 or a combination exceeding previous levels); can walk 500 meters without aid or rest.
4.5: Fully ambulatory, and active most of the day, and able to work but may have some limitations (1 FS at grade 4 or a combination exceeding previous levels); can walk 300 meters without aid.
5.0: Able to walk 200 meters unassisted but has severe disability limiting full daily activities, such as working a full day without accommodations; typically 1 FS at grade 5 or a combination exceeding step 4.0.
5.5: Able to walk 100 meters unassisted but has severe disability and impair full daily activities; typically 1 FS at grade 5 or a combination exceeding step 4.0.
6.0: Requires intermittent or one-sided assistive support (cane, crutch, or brace) to walk about 100 meters, with or without rest; typically involves more than 2 FS at grade 3 or higher.
6.5: Requires constant bilateral support (canes, crutches, or braces) to walk about 20 meters without rest; typically involves more than 2 FS at grade 3 or higher.
7.0: Mostly wheelchair-dependent, unable to walk beyond 5 meters even with aid; can self-propel and transfer independently, staying active in a wheelchair for about 12 hours daily; typically involves multiple FS at grade 4 or higher.
7.5: Limited to a wheelchair, able to take only a few steps; needs help to transfer; can self-propel but not for a full day; requires a motorised wheelchair; typically involves multiple FS at grade 4 or higher.
8.0: Primarily confined to bed or wheelchair but may be up for much of the day; retains many self-care abilities and generally has functional arm use; typically involves multiple FS at grade 4 or higher.
8.5: Mostly confined to bed but can use arms and perform some self-care. Typically involves multiple FS at grade 4 or higher.
9.0: Completely bedridden but able to communicate and eat. Most functional systems are severely affected (mostly grades 4+).
9.5: Fully dependent and bedridden, with severe communication difficulties and inability to eat or swallow. Nearly all functional systems are profoundly impaired (all grades +4).
10.0: Mortality due to multiple sclerosis [4].

EDSS levels ranging from 1.0 to 4.5 relate to individuals with MS who can walk independently. These levels are determined by assessing disability across eight distinct functional systems [5]. These systems include:

- Pyramidal, which indicates muscle weakness or mobility issues.
- Cerebellar, characterised by ataxia, balance difficulties, coordination problems, or tremors.
- Brainstem, which involves challenges with speech, nystagmus, and swallowing.

CHAPTER 11

Scales for Guillain-Barré Syndrome

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Abstract: Guillain-Barré syndrome (GBS) is a life-threatening autoimmune disorder that requires immediate care. Proper assessment is necessary to give the best possible treatment. The most commonly and widely used tools for the assessment of GBS patients are the GBS Disability Score, the Erasmus Guillain-Barré Syndrome Respiratory Insufficiency Score, and the Modified Erasmus Guillain-Barré Syndrome Outcome Score. The domains covered by these scales are severity of symptoms, respiratory function, motor function, and the ability of the patient to walk independently. Each scale has its own scoring criteria, which give us insight into the severity and progression of the disease, as well as into treatment.

Keywords: Autoimmune neuropathy, Disability score, Functional recovery, Guillain-Barré syndrome, Motor assessment, Respiratory function.

INTRODUCTION

Guillain-Barré syndrome (GBS) is an autoimmune condition that causes inflammation and destruction of the peripheral nerves. It is characterised by symmetrical motor weakness of limbs, sensory involvement (may or may not be present), cranial nerve involvement, and respiratory paralysis, which may eventually result in death. Assessment of this condition is important for understanding the progression and severity of the disease, which will help provide the most appropriate treatment [1].

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

In this chapter, we have included the most used outcome measures for GBS patients, focusing on the severity of the disease, respiratory function, and the ability to walk independently.

ERASMUS GBS RESPIRATORY INSUFFICIENCY SCORE (EGRIS)

The Erasmus Guillain-Barré Syndrome Respiratory Insufficiency Score (EGRIS) is a predictive measure for predicting respiratory failure in patients with Guillain-Barré Syndrome. It specifically anticipates the likelihood of requiring mechanical ventilation within the first week of hospital admission. The assessment is based on facial/bulbar weakness, period from onset to admission, and Medical Research Council (MRC) sum score at admission [1].

Number of Items

There are three predictors for assessing the Erasmus GBS Insufficiency Score (Table **1**):

Table 1. Erasmus GBS respiratory insufficiency score [2].

Predictor	Categories	Score
Time from onset of weakness to hospital admission, days	>7	0
	4-7	1
	<3	2
Facial and or bulbar weakness at hospital admission	Absent	0
	Present	1
MRC sum score at hospital admission	51-60	0
	41-50	1
	31-40	2
	21-30	3
	<20	4
EGRIS total score		0-7

- Time from onset of weakness to hospital admission
- Facial and/or bulbar weakness at hospital admission
- MRC sum score at hospital admission

Scoring and Interpretation

- The EGRIS total score ranges from 0 to 7.
- A higher score indicates a greater risk of respiratory failure within the first week of hospitalisation.
- The score corresponds to an estimated risk of respiratory failure ranging from 1% to 90% [1].

THE MODIFIED ERASMUS GBS RESPIRATORY INSUFFICIENCY SCORE (MEGRIS)

The mEGRIS assesses four clinical aspects at admission (Table **2**):

Table 2. The modified EGRIS score [3].

The modified EGRIS score		
Predictor	**Categories**	**Score**
Bulbar weakness	Yes	5
	No	0
Time from weakness- admission (days)	0	7
	1	6
	2	5
MRC sum score at hospital admission	3	4
	4	3
	5	2
	6	1
	>7	0
Neck flexion MRC score (0-5)	0	10
	1	8
	2	6
	3	4
	4	2
	5	0

CHAPTER 12

Scales for Balance and Coordination

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Abstract: Balance and coordination are critical components of functional mobility, particularly in populations with neurological and musculoskeletal impairments. This chapter provides a comprehensive overview of widely used clinical scales designed to assess these parameters, including the Forward Reach Test, Timed Up and Go (TUG) Test, Berg Balance Scale, and the Modified Clinical Test of Sensory Interaction in Balance (MCTSIB). Each scale is explored in terms of its methodology, clinical utility, and the specific aspects of balance and coordination it measures. The Forward Reach Test assesses an individual's stability and limits of forward reach. The TUG Test evaluates functional mobility and fall risk, requiring participants to rise from a chair, walk, and return within a timed window. The Berg Balance Scale provides a multidimensional assessment of static and dynamic balance through 14 tasks, each targeting everyday activities. Lastly, the MCTSIB examines postural control under varying sensory conditions, highlighting the individual's ability to maintain balance with visual, proprioceptive, and vestibular input. This chapter emphasises the importance of these scales in clinical practice and research, outlining their relevance for diagnosing balance deficits, guiding rehabilitation, and tracking progress in patients with various disorders.

Keywords: Balance, Berg balance scale, Coordination, Forward reach test, Modified clinical test of sensory interaction in balance, Timed up and go test.

INTRODUCTION

Balance and coordination are essential components of motor control that allow individuals to maintain postural stability and perform everyday activities. Deficits in these areas can result from a wide range of neurological or musculoskeletal conditions, including stroke, Parkinson’s disease, essential tremor, and balance disorders. Assessing balance and coordination through standardised scales is crucial for identifying impairments, tracking progress, and guiding rehabilitation strategies.

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

Several clinical scales and tests have been developed to evaluate balance and coordination. These scales provide objective measures that can help healthcare professionals assess the severity of impairments, evaluate the effectiveness of interventions, and make informed clinical decisions. Commonly used scales include the Forward Reach Test (FRT), which measures dynamic stability; the Timed Up and Go (TUG) Test, which assesses mobility and fall risk; the Berg Balance Scale (BBS), which evaluates static and dynamic balance in older adults; and the Modified Clinical Test of Sensory Interaction in Balance (MCTSIB), which assesses the integration of sensory inputs for balance control.

Each of these tools provides valuable insights into different aspects of balance and coordination, helping to create individualised rehabilitation plans that address specific deficits. By using these scales, clinicians can monitor patient progress over time and adapt interventions to optimise functional outcomes.

FUNCTIONAL REACH TEST

The Functional Reach Test is a test developed as a quick screen for balance problems in older adults to determine a person's ability to reache forward [1]. In 1990, Pamela Duncan and colleagues first developed the Functional Reach test [2 - 4].

ICF Domain

Body Function
Activity

Target Population

- Older adults
- Individuals at risk of falls
- Parkinson's disease patients
- Frail or low-mobility individuals

Clinical Setting

- Community screening programs
- Outpatient physiotherapy clinics
- Geriatric assessment centres

Instructions for Administration and Scoring

Administration

- The patient is instructed to stand next to, but not touching, a wall and to position the arm closest to the wall at 90 degrees of shoulder flexion with a closed fist.
- The assessor records the starting position at the 3rd metacarpal head on the yardstick.
- Instruct the patient to "Reach as far as you can forward without taking a step."
- The location of the 3rd metacarpal is recorded.
- Scores are determined by assessing the difference between the start and end position, which is the reach distance, usually measured in inches.
- Three trials are done, and the average of the last two is noted.

MODIFIED FUNCTIONAL REACH TEST (MFRT)

The FRT was originally designed as a simple reach test to assess standing balance. This modified version is designed to assess sitting balance in individuals with SCI (*i.e.*, modified FRT). The MFRT mimics a highly functional activity required in daily living. It can distinguish between individuals who have abdominal and back extensors (*i.e.*, high tetraplegia/high paraplegia *versus* low paraplegia), but not between individuals with high lesions. Its psychometric properties are mentioned in Table **1**.

Table 1. Psychometric property summary of mFRT [2].

Property	Metric	Value
Reliability	Agreement (ordinal level tests)	100% agreement
	Intra-class Correlation Coefficient (ICC)	0.93 – 0.99
	Correlation with comparator tests	$r = 0.32 – 0.74$ ($p \leq 0.05$)
	Test–retest reliability	$r = 0.89$
	Inter-rater agreement	0.98
Validity	Sensitivity	76%
	Accuracy	46%
	Specificity	34%
	Positive Predictive Value (PPV)	33%

CHAPTER 13

Scales to Assess Myasthenia Gravis

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Abstract: Myasthenia gravis (MG) is the most common uncommon neuromuscular condition. The hallmark clinical characteristic of MG is marked, variable weakness that is limited to voluntary muscles. Interestingly, this myasthenic weakness is made worse by physical exercise. Despite being a widespread illness, localised weakness is frequently how it first manifests. Most patients have ocular muscule weakness at the beginning, which results in symptoms like ptosis (drooping of the eyelids) and diplopia (double vision). "Ocular myasthenia" is the word used to describe weakness that is limited to the ocular muscles. Patients who suffer from oropharyngeal weakness may find it difficult to masticate, deglutinate, and articulate. The proximal muscle groups of the limb girdle often exhibit greater weakness than the distal muscle units in patients with generalised myasthenia gravis. The inability to breathe and difficulties swallowing can lead to a myasthenic crisis, a severe and potentially fatal worsening of myasthenia gravis. Patients with myasthenia gravis are generally affected by this in terms of quality of life. Four general assessment scales are provided in this chapter to gauge patients' quality of life. Scales like Myasthenia Gravis Quality of Life (MG-QOL), Myasthenia Gravis Impairment Index, Myasthenia Gravis Composite Score (MGC Score), and Myasthenia Gravis Quality of Life 15-Items Revised (MG-QOL15r) are included in this chapter.

Keywords: Disease severity assessment, Neuromuscular disorders, Patient-reported outcome measures, Psychometric validation, Quality of life.

INTRODUCTION

Myasthenia gravis (MG) is an autoimmune neuromuscular disorder characterized by fluctuating muscle weakness that worsens with exertion and improves with

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rest. The condition primarily affects voluntary muscles, including those in the eyes, face, throat, and limbs [1]. In approximately two-thirds of patients, initial symptoms manifest as weakness of the extrinsic ocular muscles, leading to issues such as drooping eyelids (ptosis) and double vision (diplopia).

As the disease progresses, it can extend to other bulbar muscles and limb musculature, resulting in generalised myasthenia gravis (gMG), which may involve significant fatigue and difficulties with swallowing and breathing. Symptoms typically fluctuate in intensity, often being more pronounced later in the day or after physical activity. While there is no cure for MG, various treatments are available to manage symptoms effectively [1, 2]. A thorough assessment is needed to evaluate Myasthenia Gravis.

MYASTHENIA GRAVIS IMPAIRMENT INDEX

Introduction

The Myasthenia Gravis Impairment Index (MGII) is a novel tool for measuring MG-related impairments. It focuses on the impairments that matter to individual patients and has a patient-centered approach [1, 2].

ICF Domain

Body Functions: Muscle strength, respiratory function, ocular and facial muscle weakness, swallowing, and speech issues

Activities and Participation: Ability to perform daily activities like eating, dressing, and mobility. Impact on social participation, work, and communication.

Environmental factors: Support systems, availability of assistive devices, and healthcare services. Barriers in the physical environment.

Number of Items

The MGII consists of 12 items, carefully designed to capture a broad spectrum of impairments associated with Myasthenia Gravis [2].

Instructions for Administration

Administration

Clinicians administer the MGII during routine clinical examinations, focusing on specific impairments associated with Myasthenia Gravis. The assessment involves a combination of physician observations and patient self-reports [2].

Equipment

No specific equipment is required for the MGII, making it a practical tool that can be utilized in various healthcare settings. A well-equipped examination room facilitates a comprehensive evaluation.

Scoring

Each item in the MGII is scored on a scale from 0 to 4, with 0 indicating no impairment and 4 indicating severe impairment. The total score ranges from 0 to 48, with higher scores indicating greater impairment due to Myasthenia Gravis [1].

Interpretability

MCID (Minimal Clinically Important Difference)

The MCID for the MGII is considered to be a change of 3 points.

This represents a clinically meaningful alteration in a patient's Myasthenia Gravis-related impairments [1].

SEM (Standard Error of Measurement)

The SEM for the MGII is ±2 points, indicating the expected range within which an individual's true score lies with 68% confidence [1]. Table **1** details the other measuring properties.

Table 1. Psychometric properties [1 - 3].

Category	Measure	Value	Confidence Interval
Reliability	Internal consistency (Cronbach's alpha)	0.87	-
Reliability	Test-retest reliability (intraclass correlation coefficient)	0.92	95% CI: 0.79–0.94
Reliability	Interrater reliability (intraclass correlation coefficient)	0.81	95% CI: 0.79–0.94
Correlations	MGII with MG–activities of daily living	R=0.91	-
Correlations	MGII with MG-specific quality of life (15-item scale)	R=0.78	-

MDC (Minimal Detectable Change)

The MDC for the MGII is 5 points, suggesting that a change of 5 points or more is required to confidently infer a real change in a patient's impairment status [1].

CHAPTER 14

Scales for Cognition

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Abstract: This chapter provides an overview of widely used cognitive assessment tools, with emphasis on their clinical application, target populations, psychometric strengths, and ease of use. It reviews the Mini-Mental State Examination (MMSE), Montreal Cognitive Assessment (MoCA), Saint Louis University Mental Status Examination (SLUMS), Mini-Cog, Rowland Universal Dementia Assessment Scale (RUDAS), Cognitive Assessment of Stroke Patients (CASP), and the Parkinson's Disease–Cognitive Rating Scale (PD-CRS). Each instrument is described in terms of purpose, administration, scoring, and reliability, highlighting its applicability across neurological and geriatric populations, such as dementia, stroke, Parkinson's disease, and other neurocognitive disorders. The chapter aims to guide clinicians and researchers in selecting the most appropriate cognitive screening tool for different patient groups.

Keywords: Cognition, Cognitive screening, Dementia, Neurocognitive disorders, Parkinson's disease, Psychometric properties, Stroke.

INTRODUCTION

Cognition refers to the dynamic interactions among neurons, astrocytes (the predominant type of glial cells), and other supportive cells such as microglia within the central nervous system. These neural connections are continuously shaped by an individual's engagement with their environment, influencing how information is processed and applied in daily life [1].

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Nidhi Sharma, Simranjeet Kaur & Parveen Kumar (Eds.)

Cognitive functioning spans a broad spectrum of higher-order skills, including executive abilities (planning, organizing, problem-solving, and judgment), attentional control, memory, processing speed, language, decision-making, and psychomotor coordination [1].

Memory itself is multifaceted, comprising declarative, episodic, semantic, procedural, prospective, verbal, and visual components, each supported by distinct neural circuits. When these circuits are disrupted by disease or injury, specific aspects of cognition may be impaired. Evidence from epidemiological and clinical studies shows that chronic conditions such as hypertension, cardiovascular disease, and diabetes mellitus adversely affect cerebral function, leading to measurable declines in cognition [2]. For instance, hypertension-related white matter lesions often compromise frontal lobe integrity, resulting in diminished executive function and slower reasoning capacity [3]. Such impairments can also disturb emotional regulation, leading to difficulties with impulse control, frustration tolerance, and adaptive problem-solving.

Cognitive decline can present as subtle, temporary deficits or as more severe, progressive impairments that interfere with independence and quality of life. A comprehensive neuropsychological evaluation is therefore essential, enabling clinicians to detect early signs of dementia, Alzheimer's disease, or mild cognitive impairment. Effective assessment must explore multiple domains—memory, language, abstract reasoning, attention, visuospatial ability, and processing speed—while also considering patient history and clinical examination findings [4]. Because individuals with cognitive deficits often struggle to accurately describe their difficulties, input from caregivers or family members can provide critical insight into functional abilities.

In clinical and research settings, practitioners rely on validated screening instruments to identify cognitive impairment. Widely used tools include the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA), both of which offer rapid and reliable evaluation of multiple cognitive domains [5, 6]. These brief instruments remain central to routine practice, though alternative measures are available to address specific populations or contexts, ensuring that clinicians select the most appropriate tool for both the patient and the administrator [7].

SCALES AND QUESTIONNAIRES TO ASSESS COGNITION

Mini-Mental State Examination (MMSE)

Description

The Mini-Mental State Examination (MMSE) is one of the most widely adopted tools for assessing global cognition in clinical and research contexts. It evaluates multiple domains, such as orientation, registration, attention, recall, language, and visuospatial construction, with a maximum score of 30, exhibiting normal cognition [2].

The tool consists of 11 questions under 7 domains. The 7 cognitive domains covered under the MMSE are orientation to time, orientation to place, registration of 3 words, attention and calculation, recall of 3 words, language, and visual construction. The administrator asks or describes the questions to the patient and scores are given based on the answers and performance of the patient. Administration typically requires 5–10 minutes, making it practical for routine use [2].

Materials and preparation

- Plain paper and pen/pencil.
- A quiet, well-lit room free of distractions.
- A watch/pen (for naming stimuli) and a simple drawing stimulus (two intersecting pentagons or equivalent).
- Record sheet or form to score items immediately.
- Ensure patient has sensory aids (glasses, hearing aid) if needed.

Before starting, explain briefly: "I'm going to ask you some questions and have you do a few short tasks that help us understand how your thinking and memory are doing." Confirm patient's ability to hear/see and obtain verbal consent.

Intended Population

1. Brain Injury
2. Dementia
3. Stroke
4. Alzheimer's Disease
5. Parkinson's Disease
6. Older adults and the geriatric population

CHAPTER 15

Miscellaneous Scales

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Abstract: Functional assessment scales are tools used to evaluate an individual's ability to perform daily activities in medical, rehabilitation, and psychological settings, measuring physical abilities, cognitive function, social skills, and emotional well-being. These scales provide a standardised way to evaluate an individual's capabilities, level of function, and ability to perform everyday tasks and requirements of living, allowing healthcare professionals to track patient progress, create personalised treatment plans, and identify areas of risk, such as fall risks in older adults or cognitive decline in patients with neurological conditions. In physical rehabilitation, these scales closely examine mobility, basic activities of daily living (ADLs), Instrumental activities of daily living (IADLs), work, and recreation, enabling clinicians to develop targeted intervention protocols and evaluate the effectiveness of treatments, therapies, or rehabilitation programs. Additionally, scales for infection of the brain assess the severity and impact of neuroinflammatory conditions, such as meningitis and encephalitis, allowing healthcare professionals to monitor disease progression, evaluate treatment effectiveness, and identify potential biomarkers for early diagnosis and intervention. These scales enable healthcare professionals to gain a comprehensive understanding of an individual's functional abilities and neurological health, ultimately leading to more effective interventions and improved patient outcomes.

Keywords: Activities of daily living (ADLs), Brain, Caregivers, Cognitive dysfunction, Disease progression, Encephalitis, Healthcare, Meningitis, Social skills, Treatment outcome.

INTRODUCTION

Functional assessment scales are tools used to evaluate an individual's ability to perform daily activities in medical, rehabilitation, and psychological settings.

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Functional assessment tools are essential to determine a patient's strengths and weaknesses in daily activities. By using functional assessment tools, we can assess a patient's ability to perform basic activities of daily living (ADLs) like bathing and dressing, and instrumental activities of daily living (IADLs), such as driving, cooking, and managing finances. This information helps us understand the level of support and care the patient may need. Chronic conditions related to neurological, musculoskeletal, and other conditions result in physical decline, leading to a loss of ability to perform ADLs and IADLs. Around 3% of the elderly reported severe ADL disability, and 6% reported severe IADL disability. There are many functional assessment tools that demonstrate good reliability and validity for evaluating ADLs and IADLs of an individual, such as the Barthel Index, Katz Index, Functional Independence Measure (FIM), and Sickness Impact Profile. Functional assessments help create treatment or rehabilitation plans based on the specific needs of the patient. The limitations of individual help from clinicians, therapists, and caregivers in developing a standardised intervention protocol that focuses on areas needing improvement or support [1]. Meningitis and encephalitis are complex and potentially life-threatening neurological infections that require accurate and reliable assessment tools to evaluate patient outcomes. Scales and scoring systems play a crucial role in this process, providing a standardised framework for healthcare providers to assess patient outcomes, monitor disease progression, and evaluate treatment effectiveness [2].

BARTHEL INDEX

The Barthel Index (BI) is the most widely used functional assessment tool. It was first developed by Mahoney and Barthel in 1965 and later modified by Collin, Wade, Davies, and Horne in 1988. This tool measures functional independence in the domains of personal care and mobility in patients with neurological disorders, such as those who have experienced stroke, brain injury, or Parkinson’s disease, as well as in patients with other neuromuscular or musculoskeletal disorders, patients admitted to the Intensive Care Unit (ICU), general oncology patients, and older adults experiencing a decline in activities of daily living (ADL) performance [3].

ICF Domain

Activity

Measurement Domain

Activities of Daily Living

Motor

Number of Items

10

Instructions for Administration

Administration

BI does not require training and is equally reliable when administered by skilled and unskilled individuals. The BI can also be self-administered. However, for patients older than 75 years of age, it is not recommended that the BI be administered as a self-report measure [3, 4]. One study suggests that the scale can be administered reliably over the telephone [5].

Equipment

To administer the BI, one only needs a pencil and the test items.

Time to Administer

Self-Report: 2-5 minutes

Direct Observation: 20 minutes

Languages

English [6], Spanish [7], Greek [8], German [9], Italian [10], Turkish [11], Persian [12], Chinese [13], and French [14].

Clinical Considerations

The original 10-item Barthel Index has two modified versions: Collin and Shah. All three versions assess the same ten activities of daily living and mobility tasks (Table **1**). It assesses the level of assistance needed and the time it takes to complete each task. A numerical score is assigned to each task based on its difficulty. The final score is calculated by adding up all the individual task scores, providing a quantitative measure of the patient's functional disability. Scores for the Barthel Index can be determined through direct observation, interviews with the patient, family, or staff, or using the examiner's clinical judgment. A higher score indicates greater independence in performing activities of daily living and a higher likelihood of returning home after hospital discharge, with varying levels of assistance. A lower Barthel Index score indicates greater dependence on others for activities of daily living and a greater need for specialised care upon discharge [3, 4].

SUBJECT INDEX

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W

Nidhi Sharma

Nidhi Sharma, Chief Editor, has shaped physiotherapy research and education for 17 years. Her record includes a 2025 Ph.D. on children's gait norms (Shodhganga: hdl.handle.net/10603/633451), 68 Scopus/PubMed/WoS publications (h-index 5, 248 citations), 8 Indian patents, 74 copyrights, 13 ISBN book chapters, and a submitted Elsevier proposal. Now a Professor at Amity University, Noida (since Oct 2025), she previously led the Neurological Physiotherapy OPD/lab at Maharishi Markandeshwar (Deemed to be University) (2018–2025), conducting CMEs and workshops, and headed Adhunik Institute's department (2009–2018), overseeing curricula, examinations, and clinical training. From her BPT (2006, 65%, clinical distinction) and MPT in Neurology (2009, 78%), with ICU rotations at Indraprastha Apollo Hospital, Delhi, she blends academic excellence with real-world rehabilitation impact.

Simranjeet Kaur

Simranjeet Kaur, Associate Editor, has spent nearly 7 years balancing clinical work and teaching. She is now a full-time Consultant Physiotherapist at Pal Physiotherapy and Rehabilitation Centre in Ambala, managing OPD since December 2024. Earlier, she served as Assistant Professor at Maharishi Markandeshwar Institute (2021–2024) and Adesh University, Bathinda (2018–2021), leading patient rounds, training undergraduate and postgraduate students, conducting examinations, and guiding clinical trials. Her research includes 43 Scopus/PubMed-indexed papers, 6 Indian patents, 58 copyrights, and 10 ISBN book chapters on orthopedics, rehabilitation methods, and affordable treatments. With an MPT in Orthopedics (2018) and a BPT (2015) from Baba Farid University, Faridkot, she delivers results in real-world settings across both bedside and classroom.

Parveen Kumar

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