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Official Title : Impact of early cognitive rehabilitation on functional outcomes following moderate traumatic brain injury

BY

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Chapter I

Introduction

Traumatic brain injury occurs from violent blows or objects, causing physical and psychological effects. Signs may appear immediately or days later, affecting the brain's function and functioning (Plass et al ., 2019) . Traumatic Brain Injury (TBI) impacts health and quality of life, with unpredictable prognosis. Exercise is crucial for neuroplasticity and brain rewiring (Kiwanuka et al .,2023).

Moderate to severe traumatic brain injuries may cause physical symptoms such as loss of consciousness, persistent headaches, vomiting, nausea, seizures, eyelid dilation, and coordination issues. Cognitive symptoms include profound confusion, unusual behavior, slurred speech, and coma. These symptoms may appear within hours or days of the injury (Breting et al., 2023).

Intensive care unit (ICU) hospitalization saves lives but often costs ICU survivors, who often experience cognitive impairment and physical and functional disabilities. Early physical rehabilitation improves chances of regaining pre-hospital functional status, but early cognitive rehabilitation for these patients remains unexplored (Muradov et al ., 2021)

The Glasgow Coma Scale, published in 1974, measures impaired consciousness in acute medical and trauma patients using eye-opening, motor, and verbal responses. It provides a clear, communicable picture of a patient's state (Yee et al., 2023).

The Rancho Los Amigos Scale (RLAS) is a medical assessment tool for individuals recovering from closed head injuries, including traumatic brain injuries. It evaluates cognitive and behavioral presentations as they emerge from coma, comparing patients' state of consciousness and reliance on assistance (Palatinus , 2018).

The Functional Independence Measure (FIM) is an 18-item assessment tool for evaluating patients' functional status in rehabilitation after stroke, traumatic brain injury, spinal cord injury, or cancer. It evaluates self-care, continence, mobility, transfers, communication, and cognition, with each item rated 1-7 (Lee et al ., 2022).

Passive range of motion exercises are very important if you have to stay in bed or in a wheelchair. ROM exercises help keep joints and muscles as healthy as possible. Without these exercises, blood flow and flexibility (moving and bending) of the joints can decrease. Passive ROM exercises help keep joint areas flexible (Hosseini et al ., 2019).

Statement of the problem:

Is there an effect of early cognitive rehabilitation on length of stay and functional outcomes in patients following moderate traumatic brain injury. Purpose of the study:

The aim of this study is to detect the impact of early cognitive rehabilitation on functional outcomes and length of stay with patients following moderate traumatic brain injury

Significance of the study:

Neurocognitive consequences can last for months to years and possibly become chronic, affecting survivors' quality of life (QOL). However, neurocognitive deficits following intensive care unit (ICU) admission have only lately attracted scholarly and therapeutic attention. The purpose of cognitive rehabilitation following a TBI is to improve the person's ability to receive and interpret information, as well as to perform mental activities (Ramnarain et al., 2013).

Cognition covers all aspects of perception and action. As a result, cognition displays itself in system behaviour. Cognition influences behaviour. The cognitive apparatus and brain are shaped through behaviour (Kaufman et al ., 2020).

Bender et al (2014) proposed an early interval rehabilitation programme to improve Functional Independence Measure (FIM) at discharge, which is translated into improved daily activities.

Rehabilitation has been shown to play a key role in enhancing functional outcomes following discharge. According to previous research, the FIM is the most often used functional assessment instrument for inpatient rehabilitation (Stuck et al ., 2022) .

Hypothesis:

There is significant difference of early cognitive rehabilitation on functional outcomes and length of stay with patients following moderate traumatic brain injury.

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Basic assumptions:

It will be assumed that:

Safety precautions and environmental aspects will be the same for all patients duringthe study.

Delimitations:

This study will be delimited to:

1. **Thirty four patients with moderate traumatic brain injury of both sex.**
2. **The age over 18 years old.**
3. **Patient's with GCS (9-12).**

Chapter II

Review of literature

A traumatic brain injury (TBI) can be caused by a forceful bump, blow, or jolt to the head or body, or from an object that pierces the skull and enters the brain. Not all blows or jolts to the head result in a TBI.Some types of TBI can cause temporary or short-term problems with normal brain function, including problems with how the person thinks, understands, moves, communicates, and acts. More serious TBI can lead to severe and permanent disability, and even death. Some injuries are considered primary, meaning the damage is immediate. Other outcomes of TBI can be secondary, meaning they can occur gradually over the course of hours, days, or appear weeks later. These secondary brain injuries are the result of reactive processes that occur after the initial head trauma (Overman ., 2022).

A traumatic brain injury (TBI) can cause problems with consciousness, awareness, alertness, and responsiveness. Generally, there are four abnormal states that can result from a severe TBI : Minimally conscious state—People with severely altered consciousness who still display some evidence of self-awareness or awareness of one's environment (such as following simple commands, yes/no responses).Vegetative state—A result of widespread damage to the brain, people in a vegetative state are

unconscious and unaware of their surroundings(Joshua et al ., 2022).

However, they can have periods of unresponsive alertness and may groan, move, or show reflex responses. If this state lasts longer than a few weeks, it is referred to as a persistent vegetative state. Coma—A person in a coma is unconscious, unaware, and unable to respond to external stimuli such as pain or light. Coma generally lasts a few days or weeks after which the person may regain consciousness, die, or move into a vegetative state. Brain death—The lack of measurable brain function and activity after an extended period of time is called brain death and may be confirmed by studies that show no blood flow to the brain (Gosseries et al., 2022).

Traumatic brain injuries may be emergencies. In the case of more-severe TBIs, consequences can worsen rapidly without treatment. Doctors or first responders need to assess the situation quickly (Lulla et al., 2023) . Glasgow Coma Scale ; This 15-point test helps a doctor or other emergency medical personnel assess the initial severity of a brain injury by checking a person's ability to follow directions and move their eyes and limbs. The coherence of speech also provides important clues. Abilities are scored from three to 15 in the Glasgow Coma Scale. Higher scores mean less severe injuries (Basak,et al .,2023).

A moderate or severe TBI is caused by a bump, blow, or jolt to the head or by a penetrating injury (such as to the head. In the United States, severe TBIs are linked to thousands of deaths each year. For those who survive, a moderate or severe TBI may lead to long-term or life-long health problems that may affect all aspects of a person's life. These health problems have been described as being similar to the effects of a chronic disease (Kraus et al., 2023).

Computerized tomography (CT) scan. This test is usually the first performed in an emergency room for a suspected traumatic brain injury. A CT scan uses a series of X-rays to create a detailed view of the brain. A CT scan can quickly visualize fractures and uncover evidence of bleeding in the brain (hemorrhage), blood clots (hematomas), bruised brain tissue (contusions), and brain tissue swelling (Yue et al ., 2023).

The Rancho Los Amigos Scale (RLAS), also known as the Ranchos Scale, is a widely accepted medical scale used to describe the cognitive and behavioral patterns found in brain injury patients as they recover from injury. It was originally developed by the head injury team at the Rancho Los Amigos Hospital in Downey, California to assess patients emerging from a coma (Joshua et al ., 2022). It is often used in conjunction with the Glasgow Coma Scale during the initial assessment of a brain

injury patient. However, unlike the Glasgow Coma Scale, it is used throughout the recovery period and not limited to the initial assessment. It takes into account state of consciousness as well as their reliance on assistance to carry out their cognitive and physical functions. This activity describes the clinical use of the Ranchos Los Amigos scale to assess patients with a head injury (Margagliotti ., 2023).

The Functional Independence Measure (FIM) was developed to address the issues of sensitivity and comprehensiveness that were criticized as being problematic with the Barthel Index (another measure of functional independence). The FIM was also developed to offer a uniform system of measurement for disability based on the International Classification of Impairment, Disabilities and Handicaps for use in the medical system in the United States (McDowell & Newell, 1996). The level of a patient's disability indicates the burden of caring for them and items are scored on the basis of how much assistance is required for the individual to carry out activities of daily living. The FIM assesses six areas of function (Self-care, Sphincter control, Transfers, Locomotion, Communication and Social cognition), which fall under two Domains (Motor and Cognitive) (Manik et al ., 2022).

Shiel et.al., 2001 in his study emphasis that increase in rehabilitation reduces the length of stay in hospital (Level 1b

evidence). There is Level 4 evidence that patients with a long length of stay who receive high-intensity rehabilitation fair better on the Rancho Los Amigos Scale at discharge than those who receive low-intensity rehabilitation(Goodwin et al ., 2016).

Passive exercises are largely preventive in nature and are used to; maintain range of motion, maintain joint and connective tissue mobility, minimizes the effects of and the formation of contractures, enhances synovial movement, maintain mechanical elasticity of muscles, assist circulation and vascular dynamic and help maintain the patient's awareness of movement (Alaparthi et al., 2021).

Chapter III

Subjects, materials and methods

Study Design:

Randomized Control Trial Pre-test- post-test control study design.

Subjects:

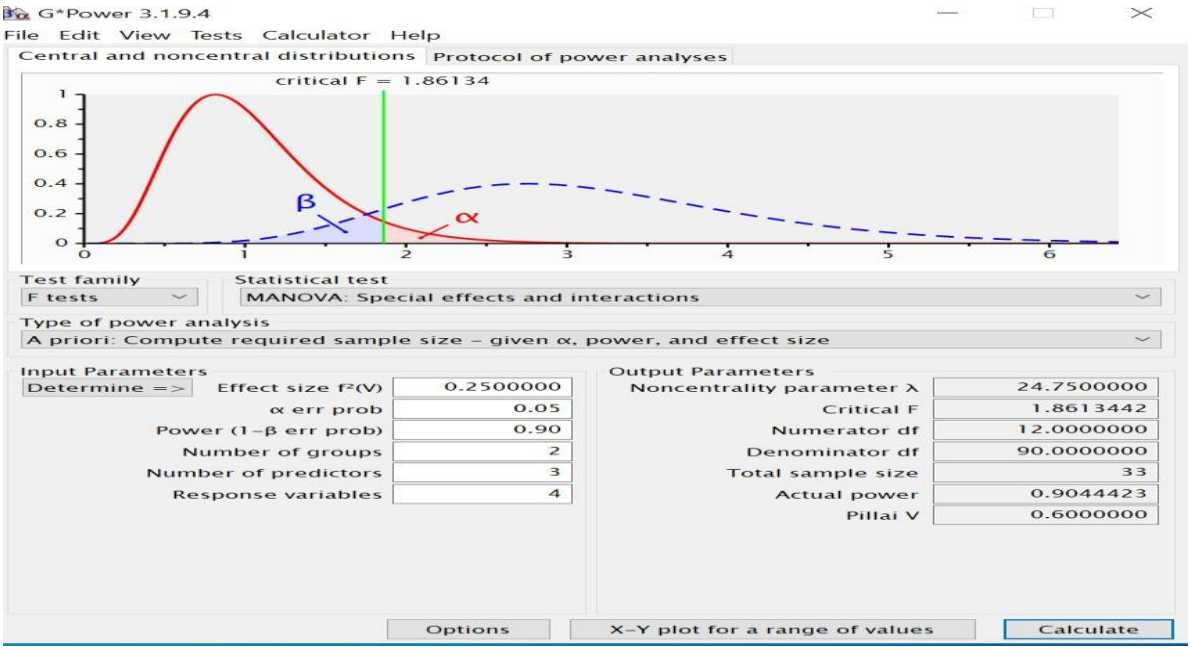
Subjects selection:

Thirty four patients of both sex medically diagnosed with moderate traumaticbrain injury using CT and GCS.

The patients will be divided randomly into two groups:

- **Study group: Seventeen Patients in study group will receiveearly cognitive therapy program in addition to Control group: Seventeen Patients in control group will receive selected physiotherapy program only (Chest care exercise, passive movement of the four limbs).**

G*Power and sample size calulations



Inclusion criteria:

1. **Both Genders.**
2. **Moderate traumatic brain injury patients will be included with GCS score 9-12.**
3. **Patients' age 18 years old and more .**
4. **All patients must be medically stable post trauma.**

Exclusion Criteria:

1. children under 18 years old .

2.Previous cerebral infarction and intracranial space-occupying lesions.

3.Patients with cancer and major underlying illnesses.

4.Patients with diffuse axonal damage.

5. Incomplete clinical and imaging data

6.Patient with other neurological deficits or orthopedic

abnormalities that causing disability.

7.Patients with serious psychiatric pathology or mentally.

Materials:

Clinical history will be taken and data collection (Name, Age, , job, mechanism of injury, vital signs , head injury severity , GCS , CT scan findings, Intensive Care Unit (ICU) length of stay (LOS)).

Place of application:

Patient will be assessed and treated in Neurotrauma ICU in emergancy hospital kasr alaini medical school.

Evaluation Methods and Procedure:

Each patient will be evaluated three times; pre-treatment, post first week and post tow weeks of ICU stay.

A. Glasgow Coma Scale:

The patient's level of consciousness will assessed with the GCS, and 9 - 12 points indicates moderate injury as indicated in (APPENDIX I) .

B. Rancho Los Amigos Revised Scale (RLAS-R) (Tölli et al ., 2019)

The RLA Scale measures the levels of awareness, cognition, behavior, and interaction with the environment after TBI. Level I – no response (total assist) to Level X – purposeful,

appropriate (modified independent) as indicated :

Level I: No Response: Total Assistance

- **No response to external stimuli**

Level II: Generalized Response: Total Assistance

- **Responds inconsistently and non-purposefully to external stimuli**
- **Responses are often the same regardless of the stimulus.**

Level III: Localized Response: Total Assistance

- **Responds inconsistently and specifically to external stimuli**
- **Responses are directly related to the stimulus, for example, patientwithdraws or vocalizes to painful stimuli**
- **Responds more to familiar people (friends and family) versusstrangers**

Level IV: Confused/Agitated: Maximal Assistance

- **The individual is in a hyperactive state with bizarre and non-purposeful behavior**
- **Demonstrates agitated behavior that originates more from internalconfusion than the external environment**
- **Absent short-term memory**

Level V: Confused, Inappropriate Non-Agitated: Maximal Assistance

- **Shows increase in consistency with following and responding tosimple commands**
- **Responses are non-purposefuland random to more complexcommands**
- **Behavior and verbalization is often inappropriate, and individual appears confused and often confabulates**
- **If action or tasks is demonstrated individual can perform but doesnot initiate tasks on own**
- **Memory is severely impaired and learning new information is difficult**
- **Different from level IV in that individual does not demonstrateagitation to internal stimuli. However, they can show agitation to unpleasant external stimuli.**

Level VI: Confused, Appropriate: Moderate Assistance

- **Able to follow simple commands consistently**
- **Able to retain learning for familiar tasks they performed pre-injury (brushing teeth, washing face) however unable to retain learning for new tasks**
- **Demonstrates increased awareness of self, situation,**

and environment but unaware of specific impairments and safety concerns

- **Responses may be incorrect secondary to memory impairments but appropriate to the situation**

Level VII: Automatic, Appropriate: Minimal Assistance for Daily LivingSkills

- **Oriented in familiar settings**
- **Able to perform daily routine automatically with minimal to absentconfusion**
- **Demonstrates carry over for new tasks and learning in addition to familiar tasks**
- **Superficially aware of one's diagnosis but unaware of specificimpairments**
- **Continues to demonstrate lack of insight, decreased judgment andsafety awareness**
- **Beginning to show interest in social and recreational activities instructured settings**
- **Requires at least minimal supervision for learning and safetypurposes.**

Level VIII: Purposeful, Appropriate: Stand By Assistance

- **Consistently oriented to person, place and time**
- **Independently carries out familiar tasks in a non-**

distractingenvironment

- **Beginning to show awareness of specific impairments and how they interfere with tasks, however, requires standing by assistance tocompensate**
- **Able to use assistive memory devices to recall daily schedule**
- **Acknowledges other's emotional states and requires only minimalassistance to respond appropriately**
- **Demonstrates improvement of memory and ability to consolidate thepast and future events**
- **Often depressed, irritable and with low frustration threshold**

Level IX: Purposeful, Appropriate: Stand By Assistance on Request

- **Able to shift between differenttasks and complete them independently**
- **Aware of and acknowledges impairments when they interfere with tasks and able to use compensatory strategies to cope**
- **Unable to independently anticipate obstacles that may secondary to impairment**
- **With assistance able to think about consequences of**

actions anddecisions

- **Acknowledges the emotional needs of others with stand by-assistance.**
- **Continues to demonstrate depression and low frustration threshold**

Level X: Purposeful, Appropriate: Modified Independent

- **Able to multitask in many different environments with extra time ordevices to assist**
- **Able to create own methods and tools for memory retention**
- **Independently anticipates obstacles that may occur as a result ofimpairments and take corrective actions**
- **Able to independently make decisions and act appropriately but may require more time or compensatory strategies**
- **Demonstrate intermittent periods of depression and low frustrationthreshold when under stress**
- **Able to appropriately interact with others in social situations.**

C. <u>Functional Independence Measure (FIM)(Figure 2)(Naghdi, et al ., 2016).</u>

The FIM scores are a combined physical and cognitive measure which ranges from 18 to 126. It evaluates 18 items (13

motor and 5 cognitive) with 1 point (total assistance) to 7 points [fully independent]). The difference between FIM at admission and FIM at discharge from inpatient rehabilitation is the actual functional gain or FIM gain and is a measure of functional recovery.

FIM efficiency is defined as FIM gain divided by number of days in hospital. It reflects the mean gain in scores per day. The functional limitations based on FIM Score have been divided into three groups as high (FIM score <40), moderate (FIM 40–79), and low (FIM ≥80)

<u>Treatment Methods and Procedure:</u>

- **All these exercises for each group were given to patients for around 30-45 minutes every six days .**
  - **Control group: Fifteen patients in control group will receive selected physiotherapy program only (Chest care exercise, passive movement of the four limbs).**
  - **Study group: Patients in study group will receive early cognitive therapy program in addition to selected physical therapy program (Chest care exercise, passive movement of the four limbs).**

A. <u>Passive range of movement for all four limbs and positioning for head injury patients (Osti et al ., 2017).</u>

- **The patient was placed in a comfortable position with a head-up position to increase venous drainage and a head-up position that is a semi-recumbent position of 30 degrees to reduce increased intracranial pressure.**
- **The patients who are unable to keep the head upright was stabilized by hard cervical collar (ambulance collar) but also saw to that it is not causing venous obstruction.**
- **The therapist took an appropriate position and effective stance , the area has been freed from restrictive closures, linen, splints and bandages and the patient was flexed and covered as necessary.**
- **All range of motion exercises were performed smoothly and gently. We never force, shake, or over-extend the muscles.**
- **The range of motion exercise for each limb was repeated from 5 to 10 repetitions, with a time rate equal to the performance time and the rest time, according to the patient's condition and response, in order to give the patient an opportunity to respond.**

B . Chest clearance intervention (Ntoumenopoulos et al ., 2018).

- **The chest care included percussion and positional drainage.**

.C.Procedure for cogntive therapy

❖ **All these exercises had given to patients with study group around 20-30 minutes six days /weak .**

1.The coma stimulation incorporated with cognition training such as :

i. **Multimodal Sensory stimulation, research suggests that sensory modalities are more effective when in concert with each other (Norwood et al ., 2023) including :**

   a. **Visual- Administered by using a flashlight, bright-colored objects, a mirror, and pictures of various shapes and sizes. The patient is encouraged to track these objects.**

   b. **Auditory- Uses taped voice recordings of family and friends, favorite music, or sounds from nature.**

   c. **Olfactory- Uses perfume, spices, or the aroma of food items.**

   d. **Gustatory- Spices, popsicles. Swabs of appropriate items can be touched on the patient's tongue to stimulate the taste sensation.**

e. **Tactile- Administered by rubbing different textures like satin, silk, fur, smooth metal, sandpaper, or cool or warm items over the patient's body surfaces.**

ii. **Calling out their names, using patient's relatives help for transferring etc were used for improving the cognition and conscious levels.**

2.Kinesthetic Stimulation (Thomas et al ., 2018)

a. **Passive movements to prevent contractures, deformities and to maintain muscle properties, active assisted exercises and facilitation techniques to improve the muscle tone. Positional changes from supine to sit, sitting in chair and standing with support/tilt table given to improve the arousal mechanism.**

b. **Joint approximation by weight bearing on hands, leg support on high stools, positioning changes, slow rocking in high sitting position, tactile stimulation by tapping on muscle bellies to facilitate movements, quick stretches to initiate muscle contractions all Should be added to improve the brain stem arousal.**

- **Each movement two times, allowing 1 minute to respond. This will be performed either on bed or on wheelchair, one extremity at a time.**

☒ **Red flags :**

Patients who are not maintained the systolic pressure of more than or equal to 110 and SPo2 below 90% must We prevent patients from sitting upright and the chair mobilization(Thomas et al ., 2018).

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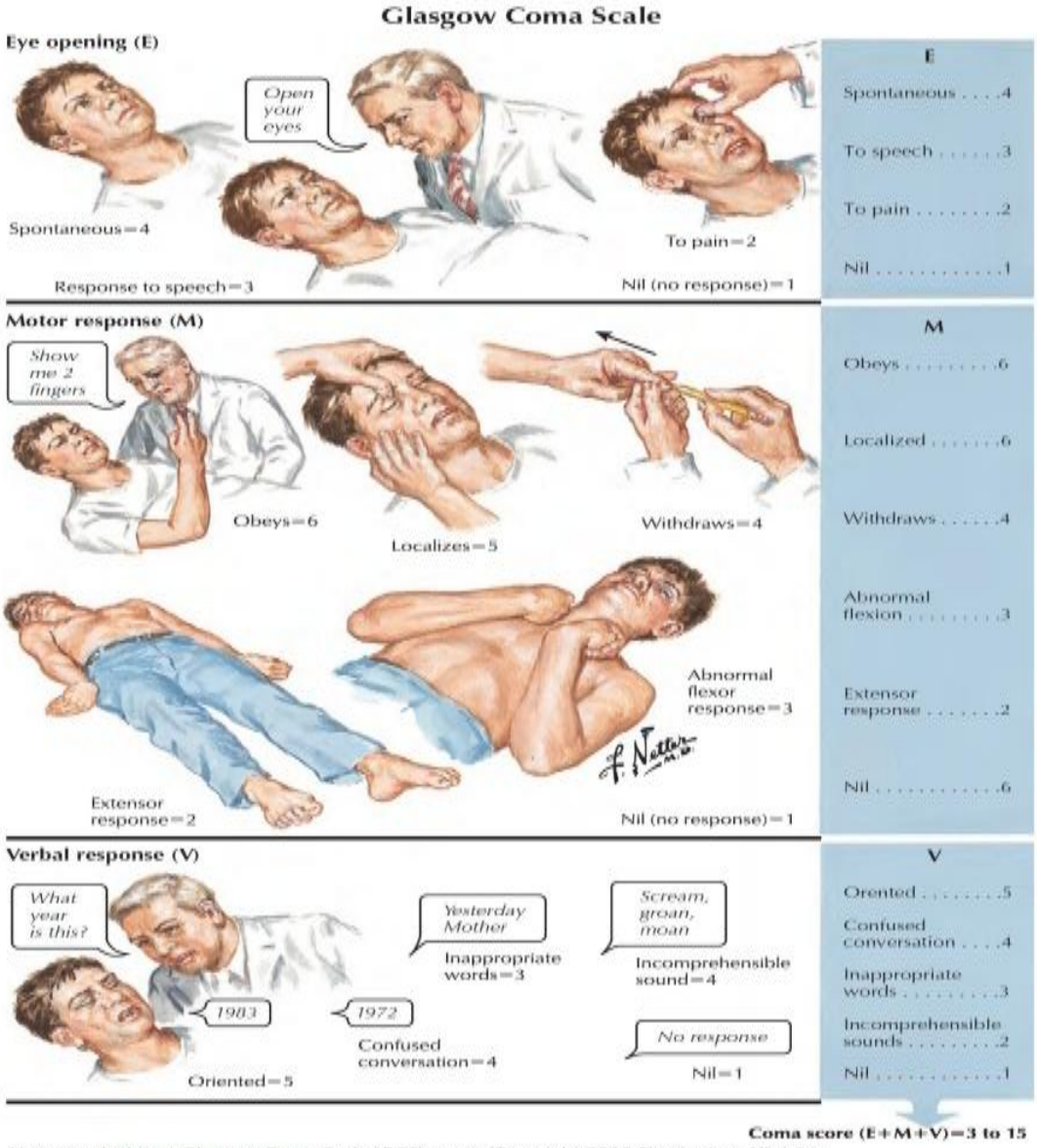
Appendix (II)



How to calculate a Glasgow Coma Scale (GCS) score. (Copyright 2016 Elsevier Inc. All rights reserved. www.netterimages.com.)

Glasgow Coma Scale (Reith et al ., 2016).

Appendix (III)

FIM™ - Functional Independence Measure

MOTOR ITEMS

SELF-CARE

1. Eating
2. Grooming
3. Bathing
4. Dressing-upper body
5. Dressing-lower body
6. Toileting

SPHINCTER CONTROL

7. Bladder management
8. Bowel management

MOBILITY / TRANSFER

9. Bed-chair-wheelchair
10. Toilet
11. Tub-shower

LOCOMOTION

12. Walk-wheelchair
13. Stairs

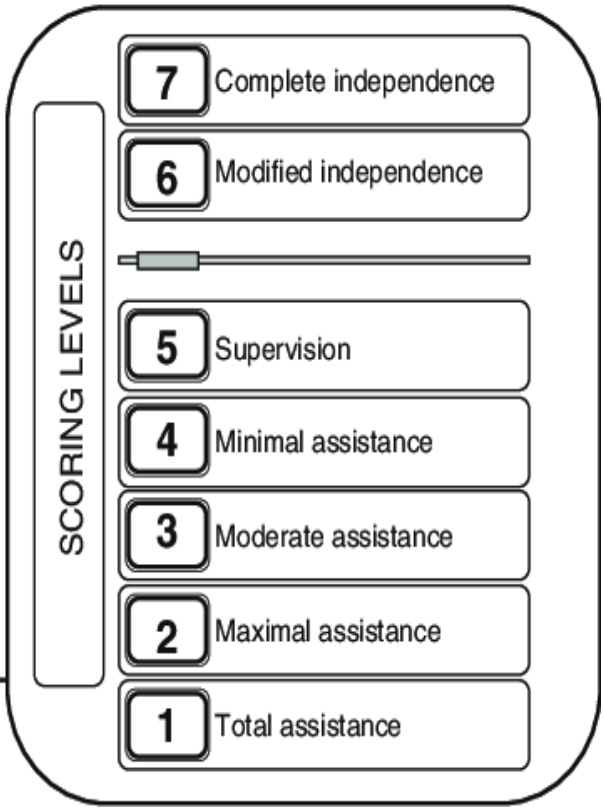
COGNITIVE ITEMS

COMMUNICATION

14. Comprehension
15. Expression

SOCIAL COGNITION

16. Social interaction
17. Problem solving
18. Memory



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Statistical Analysis:

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In Department Of Physical Therapy For Neurology

Faculty Of Physical Therapy

Cairo University

2023

Statistical Analysis:

- **Data will be statistically analyzed to compare the differences between the groups. The statistical package for social sciences (SPSS) will be used for data processing. Data will be statistically analyzed.**
- **Descriptive statistics: including the number and percentage for all variables.**
- **MANOVA: to compare between the different changes in GCS and Rancho los amigos cognitive scale through the three tested periods.**
- **ANOVA: to compare between two distinctive testing periods.**
- **Significant level: All statistical analyses were significant at $P \leq 0.05$.**

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Consent form

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2023

Consent form

I acknowledge /

My relationship to the patient/

I agree to share the patient / In the research program under the direction of the researcher/ Amany S.H. Mobarez .

A through description of the procedures has been explained and I understand that, I may withdraw my consent and discontinue participation in this research at any time without prejudice to me.

Date : / / 202

Participant: