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Impact of Sensory Stimulation Techniques on Selected Responses among Patients with Cerebrovascular Stroke

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ABSTRACT

Background: Sensory dysfunctions are common symptoms associated with cerebrovascular stroke (CVS) that can have a significant impact on patient's quality of life. Sensory deficits may include vision problems such as blurred vision or double vision, visual field cuts; hearing loss; numbness in the face or extremities; balance issues as dizziness, tingling sensations; pain; temperature sensitivity, and decreased sensitivity to touch.

Aim: The aim of the study was to evaluate the impact of sensory stimulation techniques on selected (visual and tactile) responses among patients with cerebrovascular stroke.

Research design: Pretest posttest nonequivalent quasi-experimental design was utilized in the study.

Subjects: A non-probability purposive sample of 60 male and female adult patients with a confirmed diagnosis of cerebrovascular stroke was recruited. The sample was equally assigned randomly to study and control groups.

Setting: The study was conducted in stroke unit at Al Manial University Hospital affiliated to Cairo University.

Tools: Three tools were used to collect pertinent data as follows: a- Personal and Medical Data Form (PMDF); Glasgow Coma Scale (GCS); Western Neuro Sensory Stimulation Profile (WNSSP).

Results: More than half of study and control groups were males between 40 to 60 years old. The WNSSP visual and tactile subscale scores for the subjects in the study group improved after implementation of sensory stimulation techniques.

Conclusion: The implementation of sensory stimulation techniques is an effective strategy to improve visual and tactile responses among patients with CVS.

Recommendations: Sensory stimulation should be an integral part of the total management of patients with CVS. Further study should be conducted on larger probability sample at different geographical areas for generalization of the findings.

Keywords: *Sensory Deficits - Stroke - Sensory Stimulation Techniques- GCS – WNSPP*

INTRODUCTION

Stroke is a prominent cause of mortality and disability globally and is typically defined as an acute neurological sign or symptom owing to localized brain infarction or bleeding in adults. Heart disease, hypertension, and diabetes mellitus are known to increase the risk of stroke. In addition, smoking, obesity, emboli, arteriosclerosis, and persistent hypertension can also increase the risk of stroke [Price et al., (2018):, Hankey, (2020)] .

Globally, stroke is the second leading cause of death after heart disease and the third leading cause of disability; each year, there are approximately 16,000,000 new cases of stroke, with as many as 5,700,000 deaths. In the absence of population growth and adequate interventions, the annual number of stroke cases is estimated to increase to 23,000,000 by 2030 as reported by Faozi et al., (2021).

Cerebrovascular stroke comes in two primary pathologic varieties: ischemic and hemorrhagic stroke. An ischemic stroke is brought on by a disruption in the blood supply to a specific region of the brain; about 85% of all acute strokes are caused by ischemic stroke. A blood vessel burst is the primary cause of hemorrhagic strokes, which account for close to 15% of acute strokes. Intracerebral hemorrhage (ICH) and subarachnoid hemorrhage, which account for around 5% of all strokes, are the two main kinds of hemorrhagic stroke (Freytes et al., 2021).

The physiological impact of stroke can be divided into two categories: primary and secondary effects. Primary effects are those that occur directly as a result of the stroke itself, such as cell death and tissue damage (Morente-Oria et al., 2020). Secondary effects which include physical impairments, as paralysis or weakness, can be accompanied by cognitive and sensory d ysfunctions, such as problems with memory, lan guage, attention, perception, and executive funct ioning. Memory problems are one of the most c ommonly reported cognitive deficits after a stro ke, and they can include difficulties recalling rec ent events or information, learning new informat ion, or retrieving previously learned information (Verdelho et al., 2021).

Sensory and cognitive dysfunction is another common symptom associated with stroke that can have a significant impact on patient's quality of life. Sensory deficits may include vision problems such as blurred vision or double, vision visual field cuts; hearing loss; numbness in the face or extremities; balance issues as dizziness; tingling sensations; pain; temperature sensitivity and decreased sensitivity to touch (Gandhi, Sebastian, & Bhanot, 2021).

According to Li et al., (2020) sensory stimulation techniques are an application of a strategy that is tailored in intensity and frequency to an individual's threshold consisting of auditory, visual, tactile, olfactory in an attempt to increase arousal and awareness and elicit meaningful, behavioral responses from the patient; the stimulation techniques vary from single stimuli of a single sense (unimodal stimulation) to stimulation of all senses using various stimuli (multimodal stimulation) (Zuo et al., 2021). Providing sensory stimulation to the patient may potentially stimulate affected neural networks, accelerate brain plasticity, and avoid a sensory deprivation that could slow down the patient's consciousness recovery. Sensory stimulation techniques are used to help patients in a coma regain consciousness as reported by Gosseries and Laureys, (2022).

By simultaneously targeting several senses that can stimulate reticular activating system (RAS), interventions can increase patient awareness and prevent ischemic brain cell damage (Gorji, Araghiyansc, Jafari, Gorgi, & Yazdani, 2014; Megha, Harpreet, & Nayeem, 2013). The provision of proper and safe sensory stimuli can establish synaptic links, provide sufficient stimuli for RAS, and improve consciousness.

One effective strategy that nurses can integrate into their care for stroke patients is sensory stimulation techniques. As sensory stimulation is a minimally invasive, harmless, inexpensive, and easy to apply, it has high potential as a method for increasing awareness (Abbate, Trimarchi, Basile, Mazzucchi, & Devalle, 2014). These techniques involve using sensory stimulation to help awaken and activate the brain of a patient who is in a coma or a state of reduced consciousness. By incorporating these

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techniques into their care plan, nurses can help improve the patient's level of arousal, promote cognitive and physical function, and ultimately facilitate their recovery. This approach can be particularly useful during the early stages of stroke when patients may be at risk of developing complications such as pneumonia or pressure sores due to prolonged immobility. By utilizing sensory stimulation techniques, nurses can help prevent these complications and improve overall outcomes for their patients (Ashcraft et al., 2021). Therefore, the aim of this study was to evaluate the impact of sensory stimulation techniques on selected (visual and tactile) responses among patients with cerebrovascular stroke.

Significance of the study

Stroke including ischemic stroke and hemorrhagic affects 13.7 million people globally per year and is the second leading cause of death, with 5.5 million deaths per year. An estimated 1 in 4 adults will experience a stroke in their lifetime and there are more than 80 million survivors of stroke globally. These stroke survivors represent a high-risk population and are the focus of secondary prevention strategies [Campbell et al., (2019):, Zhang et al., (2019)].

Egypt is the most populated nation in the Middle East with 102,327,319 inhabitants on September 7, 2021 and an annual rate of increase of population of 1.9 %. In Egypt, the overall crude prevalence rate of stroke is high (963/100,000 inhabitants), and the incidence of stroke annually is approximately 150,000–210,000. The official national statistics indicate that diseases of the circulatory system, including stroke, are the primary causes of death in Egypt, where stroke accounts for 6.4% of all deaths and ranks third after cardiovascular and gastrointestinal diseases (Aref et al., 2021). The last available annual statistics of newly diagnosed patients with cerebrovascular stroke who admitted to Al Manial University Hospital at Al Kasr El Einy Hospital for three previous years (2018, 2019, 2020) were 512, 276, 192 respectively (Statistics and Medical Records Department, June 2021).

The physiological impact of stroke can be devastating for both individuals affected and their families. It is important for healthcare providers to understand the potential long-term consequences of stroke so that they can provide appropriate care and support for those affected by it (Pont et al., 2020). Stroke has the economic burden with direct costs associated with medical care and indirect costs associated with lost productivity and reduced quality of life for patients, families, and communities. In addition to the financial burden of medical expenses, stroke can also lead to lost wages due to disability or death. This can have a significant impact on a patient’s ability to support themselves or their family financially (Rochmah et al., 2021).

A review of available literature revealed that a few studies are carried out regarding sensory stimulation techniques including Egypt. The researcher observed that nurses provided unstructured sensory stimulation in the form of sensory sounds, namely by calling out the patient’s name and simulating touch by holding the patient’s hand and face during providing the care, but without any attention to the intensity, duration, form of stimulation, or assessment of its effects on the patient’s level of awareness. Based on the phenomenon of the problem and review of literature regarding the sensory stimulation intervention, the researcher developed an interest in determining how sensory stimulation technique would affect patients in stroke.

The researcher hope that the study findings might be beneficial in providing the health care providers especially nurses with evidence-based data regarding stroke patients with sensory function impairments, empowering the standard of care, lessening the impact of coma on sensory functions and decreasing the length of hospital stays, as well as the negative clinical and financial effects on patients and the healthcare system. Moreover, the research findings might be used as an instrument in developing new teaching and learning strategies for nursing students in dealing with those groups of patients.

Aim of the study

The aim of the study was to evaluate the impact of sensory stimulation techniques on selected (visual and tactile) responses among patients with cerebrovascular stroke.

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Research hypothesis

To fulfill the aim of the current study the following hypotheses were postulated.

H1: The post total mean score of visual subscale of Western Neuro Sensory Stimulation Profile of patients who receive sensory stimulation techniques will be higher than the score of patients who receive routine hospital care.

H2: The post total mean score of tactile subscale of Western Neuro Sensory Stimulation Profile of patients who receive sensory stimulation techniques will be higher than the score of patients who receive routine hospital care.

H3. The post total mean score of Western Neuro Sensory Stimulation Profile of patients who receive sensory stimulation techniques will be higher than the score of patients who receive routine hospital care.

Theoretical framework

Cue-response conceptual framework which originated from coma cue response theory used to constitute the conceptual framework for this study. This framework is developed by Olson and Graffagnino (2005) to be a nursing framework for care of patients with acquired brain injury (ABI) then modified by Olson and Ortega-Pérez, (2019).

The Cue-response conceptual framework is a useful tool for understanding how individuals respond to different stimuli. This framework can be applied to a stroked patient receiving sensory stimulation to better understand their response to the treatment. Sensory stimulation is a common intervention used in stroke rehabilitation to improve sensory function and promote recovery. Cue refers to the stimulus or trigger that initiates a response. In the case of sensory stimulation, the cue could be any type of sensory input, such as touch, sound, smell or light. The response refers to the reaction or behavior that follows the cue (Ashcraft et al., 2021).

Based on this framework nurses assess patients with brain injury and develop a plan of care by interpreting meaning from physiologic and observational or behavioral cues. These interpretations form the basis for optimizing the timing of discrete nursing interventions; the outcome of which influences the trajectory toward recovery or toward secondary brain injury. In addition cue-response theory applies specifically for nurses' use to determine which interventions should be used and when those interventions should be carried out (Olson & Ortega-Pérez, 2019).

In the current study, the researcher assessed the sensory functions of the patient with stroke and developed nursing interventions that improve sensory functions of those patients. Accordingly, nursing assessment in the current study was conducted to measure and monitor the sensory responses including the physical and behavioral cues utilizing Glasgow Coma Scale and Western Neuro Sensory Stimulation Profile. A complete neurologic assessment was performed initially that include evaluation for the following: level of consciousness, pupillary reaction, motor and sensory dysfunction, cranial nerve deficits (extraocular eye movements, facial droop, presence of ptosis), speech difficulties and visual disturbance, headache, nuchal rigidity and /or other neurologic deficits. Any changes in the patient's condition require reassessment and thorough documentation as documented by Ashcraft et al., (2021).

Ashcraft et al., (2021) emphasized that timing of nursing interventions is a crucial aspect of the cue-response theory's conceptual framework. The researcher followed cues and assessed them to perform a specific intervention within a limited time frame to improve sensory functioning. This approach emphasizes the importance of timely nursing interventions in enhancing patients' sensory responses during stroke recovery. Moreover, optimal timing of stimulation may provide an opportunity for the brain to reestablish balance.

So, the researcher analyzing the baseline data, then a plan was formulated to enhance the sensory response of those patients. Several sensory stimulation techniques, including auditory, visual, tactile, and olfactory methods, are available for this purpose. The selection of techniques should be based on the patient's deficits and goals. For the sake of this study, the researcher designed sensory stimulation techniques including visual and tactile methods; in addition, a booklet that contains information

about stroke and selected sensory stimulation techniques to assist in implementing these methods was handed to the patients of study group.

Operational definitions

Sensory stimulation techniques

They were conducted in the current study through application of visual and tactile stimulation techniques and monitored by Western Neuro Sensory Stimulation Profile (Ansell & Keenan, 1989).

Selected responses

In the current study, they include visual and tactile responses and were monitored by Western Neuro Sensory Stimulation Profile (Ansell & Keenan, 1989).

Cerebrovascular stroke

In the current study, it refers to all adult patients with stroke regardless of its type admitted to the selected setting with stable vital signs and their conscious level between 9 and 12 measured by Glasgow Coma Scale (Teasdale & Jennett, 1974).

METHODS

Research Design

Pretest-posttest nonequivalent control group quasi-experimental research design was utilized in the study, it involves the collection of outcome data at multiple time point before and after an intervention (Handley, Lyles, McCulloch & Cattamanchi, 2018).

Setting

The current study was carried out at stroke unit located in Al Manial University Hospital affiliated to Cairo University. The unit consists of two sides; one side is an inpatient unit consisting of eight rooms for stable stroke patients while the other side is an intensive care unit for critically ill stroke patients. The average duration for hospitalization of patients with stroke ranged from two to three weeks depending on stability of their medical status.

Subjects

A non-probability purposive sample of 60 male and female adult patients with confirmed diagnosis of cerebrovascular stroke who fulfilled the inclusion criteria were included in the study over six consecutive months to achieve the study aim from February 2022 to August 2022. The study subjects were randomly assigned through a coin to allocate subjects to study or control group (30 for each group).

Inclusion Criteria

Age ranging from 18-60 years old, hemodynamically stable (heart rate – respiration – blood pressure and temperature within the normal range), the patient score on Glasgow Coma Scale (GCS) is between 9 and 12 as this value denotes moderate head injury, in which sensory stimulation techniques are essential to improve sensory functions of those patients (Hoseinzadeh, Shan,Vakili & Kazemnejad, 2017; Faozi et al., 2021).

Exclusion Criteria

Patients who have seizure, recurrent stroke, deafness or reduced auditory functions and / or blindness were excluded from the study sample.

Data Collection Tools: Three tools were used to collect data pertinent to this study

Tool I: Personal and Medical Data Form (PMDF)

It is composed of two parts: Part 1: Demographic data, includes patient's age, gender, level of education, occupation, marital status, ……, etc. Part 2: Medical data, including patient's past and present medical history; family history in addition to risk factors for the current illness (stroke) ……, etc.

Tool II: Glasgow Coma Scale

This scale was developed by Teasdale and Jennett, (1974) to assess neurological function

and level of arousal. The scale is based on the numerical value assigned to an individual's eye opening, verbal, and motor responses. Each response is scored separately and then totaled. Total scores ranged from 3 to 15, with score 3-8 indicating severe neurological deficits 9-12 moderate neurological deficit and score 13- 15 representing no deficits (awake, alert, and oriented), (Teasdale et al., 2014).

Tool III: Western Neuro Sensory Stimulation Profile (WNSSP)

The Western Neuro Sensory Stimulation Profile (WNSSP) was developed by Ansell and Keenan, (1989), to assess brain function in impaired head-injured adults as well as to monitor sensory functions and predict change over time. Western Neuro Sensory Stimulation Profile presents items with a hierarchy of weighted scores in which higher levels of function receive higher scores suggestive of a recovery sequence.

The WNSSP has 33 items and is composed of 9 subscales: Arousal attention (4 items: arousability; wakefulness ; eye contact ; attention to task), auditory response (2 items: voice and sound), auditory comprehension (6 items: hand shaking; open and close mouth ; tongue sticking out; eyes opening and closing; raising eyebrows and moving body part), expressive communication (3 items: vocalization; facial/gestural expression for communication; yes/no response), visual responses (7 items: horizontal mirror; horizontal individual; horizontal picture; horizontal object; horizontal mirror; vertical picture and vertical object). Visual comprehension (5 items: open and close mouth; tongue sticking out; eyes opening and closing; raising eyebrows and moving body part), tactile response (2 items: touch and oral stimulation), object manipulation (3 items: manipulation comb; manipulation spoon and manipulation pencil), and olfactory response (1 item: pleasant and unpleasant response).

Scoring is based on type of stimulation (general or specific), the total scores ranged from zero to 113 by summing response score of each tool item where lower scores indicate poorer function responses, and higher scores indicate better function responses.

Validity and Reliability

Face and content validity of Arabic version of the study tools were reviewed by a panel of three experts of Medical Surgical Nursing for comprehensiveness, clarity, relevance and simplicity. Based on experts' recommendations the necessary modifications were made.

Consistency and reliability of GCS assessments by different observers has varied in different reports. Thus, observer agreement has been reported to range from high (.57) to low (.50) with kappa indices ranging from 0·85 to 0·32.58 When studied separately, the motor response usually shows higher interobserver reliability than do the verbal or eye responses. Overall, reliability has been summarized as "good if no untestable feature present and if user is experienced" Reliability is affected by training and by consistency in assessment technique (Teasdale et al., 2014).

In addition, agreement between GCS component and sum scores recorded by 2 researchers ranged from 89.5% to 95.9% (P = .001). Significant agreement among nurses and the 2 researchers was found for eye response (73.8%), motor response (75.0%), verbal response (68.1%), and sum scores (62.4%) (all P = .001). Significant agreement among nurses and the 2 researchers (55.2%) was also found for sum scores of patients with sum scores of 10 or less (P = .03). Although the study showed near-perfect agreement between the 2 researchers' GCS, agreement among nurses and the 2 researchers. Accurate Glasgow Coma Scale evaluation requires nurses to have adequate knowledge and skills (Kebapçı, Dikeç, & Topçu, 2020).

Regarding WNSSP, internal consistency reliability which was established by Cusick, Lannin, Hanssen and Allaous, (2014) was very high $\alpha = 0.93$ indicating that the WNSSP is a strong measure of a construct, so, therapists can have confidence when using this assessment that it is targeting a defined domain of performance postulated to represent neural recovery.

Ethical Considerations

An official permission to conduct the study was obtained from the Scientific Research Ethics

Committees, Faculty of Nursing Cairo University (RHDIRB2019041701) and from hospital director and the director of the stroke unit that data collection was carried out at Al Manial University Hospital at Kasr al Einy hospital to conduct the study. Written informed consent obtained from each patient after explaining the nature and purpose of the study. The researcher emphasized to patients that participation in the study is entirely voluntary, and anonymity and confidentiality of the data is assured also, no harm on the patient status occurred from application of the sensory stimulation techniques. Moreover, patients were informed that the data will not be reused in another research without their permission, also the patient have the right to withdraw from the current study at any time without any penalties.

Procedure

Once official permission was granted from the appropriate authoritative personnel in the Faculty of Nursing and in the hospital, the proposed study was proceeded and conducted through the following four phases.

Preparatory phase

The researcher developed sensory stimulation techniques after extensive literature review. The study subjects who met the inclusion criteria were interviewed individually -face to face- to explain the nature and purpose of the current study. Then, the researcher obtained written consent from the patients who were willing to participate in the study.

Assessment phase

in this phase the researcher collected demographic and medical data using tool number (I) as well as assessing the eligibility for inclusion through assessing patient's level of consciousness using Glasgow Coma Scale (tool II) and using Western Neuro Sensory Stimulation Profile (tool III) to assess patients' sensory functions pre intervention as a baseline data.

Implementation phase

Data was collected from the patient in control group first to prevent contamination, and then data from study group was collected. Patients in the control group received routine hospital care. On the other hand during hospitalization, the visual and tactile sensory stimulation techniques were applied by the researcher three times per week for patients in the study group for two consecutive weeks in the presence of family member (Cheng et al., 2018) as follows:

Visual stimulation. The researcher performed visual stimulation by using familiar faces objects and photographs of family members, a mirror or colored paper show these items to the patient for five minutes, twice with three seconds of break in between each stimulus in front of patient's eyes then move object to upper and lower quadrant within visual field. This part took approximately not more than 20 minutes.

Tactile stimulation. The touched patient's shoulder outside the patient's visual field with a soft brush and applied to various body parts. The patient's lips, around the top and bottom, were touched with the tip of a pen or spoon. This part took approximately 10 minutes.

Follow up phase

It was done for study group along two consecutive weeks of SSTs application; posttest 1 was done at the end of 1st week of SSTs application and posttest 2 was done at the end of 2nd week of SSTs application using (tool III). In regard to the control group posttest 1 and 2 were carried out after one and two weeks of hospital routine care respectively.

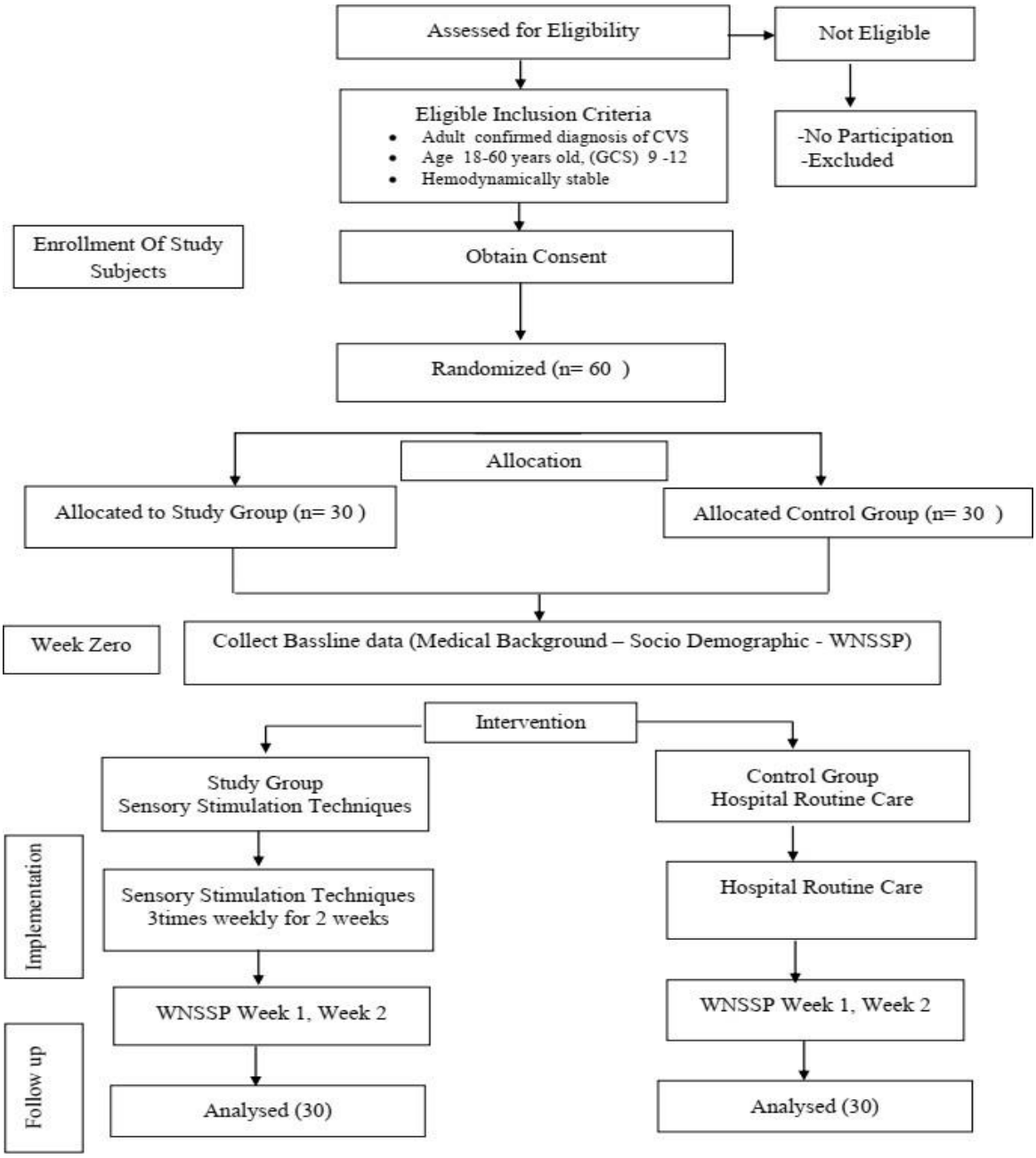

FIGURE 1: Schematic diagram of participants' distribution and application of sensory stimulation techniques

Analysis of Data

Upon completion of data collection, data was analyzed using IBM SPSS program version 20 (Lee, 1958-. (2013). Relevant statistical analysis was used to test the obtained data. Descriptive and inferential statistics were done such as frequency, percentage, mean and standard deviations and independent t test. The researcher adopted a level of significance at (0.05).

RESULTS

The statistical findings of the current study are presented in the following order: The first section

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is devoted to personal medical background data among studied subjects. The second section delineated the study hypotheses testing for being supported or not.

Participants' Characteristics

Table 1 presented that 90% of the study group and 80% of the control group are within the age range between 40 to 60 years, with the mean age of 49.7± 10.01and 49.53 ± 9.1 years respectively. Concerning gender 53.3% of the study group and 56.7% of the control group were males and 70 % of study group and 76.7 % of control group were married. For residence 53.3% of study group and 60% of control group were living in rural areas. Regarding education 56.7% of the study group and 60 % of the control group reached secondary school. In relation to the occupation 50% of the study group were workers and 40% of the control group were housewives. Regarding smoking status 70 % of the study sample was nonsmoker and 56.7 % of control group were smokers. There were no statistically significant differences between the two groups regarding all the demographic characteristics.

TABLE 1: Frequency and Percentage Distribution of Demographic Characteristics among the Study Subjects (N=60).

Variable	Study Group N	%	Control Group N	%	Test	P
Age						
21- 30	2	6.7 %	1	3.3%	X^2=3.2	0.35
31- 40	2	3.3 %	5	16.7%		
41-50	10	33.3%	10	33.3 %		
51- 60	16	56.7%	14	46.7 %		
Mean± SD	49.7± 10.01		49.53 ± 9.1			
Gender						
Male	18	53.3%	17	56.7%	X^2=0.069	0.74
Female	12	46.7%	13	43.3%		
Marital Status						
Married	21	70%	23	76.7%	X^2=0.12	0.54
Single	6	20%	3	10%		
Divorced	3	10%	4	13.3%		
Residence:						
Rural	16	53.3%	18	60 %	X^2=0.271	0.62
Urban	14	46.7%	12	40 %		
Level of Education						
Can't read and write	5	16.7%	3	10%	X^2=0.862	0.93
Read and write	7	23.3%	7	23.3%		
Secondary school	17	56.7 %	18	60%		
University	1	3.3 %	2	6.7%		
Occupation						
Manual Labor Work	15	50%	8	26.7%	X^2=0.37	0.15
Official Work	3	10%	10	33.3%		
Housewife	12	40%	12	40%		
Smoking						
Smoker	9	30%	13	56.7%	X^2=0.14	0.28
None- smoker	21	70%	17	13.3%		

Significant at $p \leq 0.05$

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Medical data

Table 2 indicated that 63.3% and 60 % of study and control subjects were diagnosed for ischemic and hemorrhagic stroke respectively. In relation to family history 90 % and 93.3% of the study group and control group had no family history of stroke respectively. 86.7% of study group and 90% were suffering from chronic diseases as hypertension 40%, 53.3 %, and renal disease 13.3 %, 6.7 for study and control group respectively. Additionally, 40% of study group and 33.3% of control group were suffering from Left hemiparesis and 20% of study group and 23.3% of control group were suffering from right hemiparesis. There were no statistically significant differences between the two groups regarding all the medical data.

TABLE 2: Frequency and Percentage Distribution of Medical data among the Study Subjects (N=60).

Variable	Study Group N	%	Control Group N	%	Test	P
Type of Stroke						
Ischemic stroke	19	63.3%	18	60%	X^2=.071	0.79
Hemorrhagic stroke	11	36.7%	12	40%		
Family history of Stroke						
Yes	3	10%	2	6.7%	X^2=1.017	0.32
No	27	90%	28	93.3%		
Chronic Disease						
Yes	26	86.7%	27	90%	X^2=.162	0.69
No	4	13.3%	3	10%		
Comorbidities						
Diabetes mellitus	6	20%	5	16.7%		
Hypertension	12	40%	16	53.3%	X^2=1.39	0.71
Cardiovascular diseases	8	26.7 %	7	23.3%		
Renal Diseases	4	13.3 %	2	6.7%		
Motor ability						
No Weakness	12	40%	13	43.3 %		
Rt hemiparesis	6	20%	7	23.3 %	X^2=.229	0.86
Lt hemiparesis	12	40%	10	33.3%		

Significant at $p \leq 0.05$

Comparison of mean score of visual subscale of Western Neuro Sensory Stimulation Profile

Table 3 showed that the mean score of visual response was increased among subjects in the study group from baseline assessment after application of sensory stimulation techniques in posttest 1and posttest 2. There were significant statistical differences between posttest 1 and posttest 2 among study and control group regarding the visual response ($t = 4.1$ at $p \leq .000$, and $t = 5.1$ at $p \leq .000$) respectively.

TABLE 3: Mean scores' comparison of visual response between study and control group along the study (N= 60).

Assessment	Study Group Mean ± SD	Control Group Mean ± SD	t	P
Baseline	23.6± 5.1	22.7 ± 5.1	.687	0.49
Posttest 1	26.4± 4.3	20.6 ± 6.3	4.1	.00**
Posttest 2	30.3±5.1	22.6 ± 6.3	5.1	.00**

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of Baseline assessment.
- Posttest 2: after 2 weeks of Baseline assessment.

Table 4 showed that there are significant statistical differences between the baseline assessment and posttest 1, and between baseline assessment and posttest 2 regarding the total mean score of visual response among study group (t = 3.4 at p ≤ .002, and t = 7.6 at p≤ .000) respectively.

TABLE 4: Mean scores' comparison of visual response at baseline, posttest 1 and posttest 2 among the study subjects (n=30).

Variable	Pretest (X)	Posttest (X)	t(p)
From Baseline to posttest1	23.6± 5.1	Posttest 1 (26.4± 4.3)	3.4(.002) *
From Baseline to posttest2	23.6± 5.1	Posttest 2 (30.3±5.1)	7.6(000) *

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of first assessment-
Posttest 2: after 2 weeks of first assessment

Table (5) illustrated that the mean score of tactile response was increased among subjects in the study group from baseline assessment after application of sensory stimulation techniques in posttest 1and posttest 2. There were significant statistical differences between posttest 1 and posters 2 among study and control group regard to tactile response (t = 6.5 at p ≤ .000, and t = 7.8 at p≤ .000) respectively.

TABLE 5 : Mean scores' comparison of tactile response between study and control group along the study (N= 60).

Assessment	Study Group Mean ± SD	Control Group Mean ± SD	t	p
Baseline	9.3 ± 0.9	10.23 ± 1.4	1.16	0.24
Posttest 1	11.9± 1.9	8.83 ± 1.68	6.5	.000*
Posttest 2	13.4± 1.5	9.2 ± 2.4	7.8	.000*

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of baseline assessment.
- Posttest 2: after 2 weeks of baseline assessment.

Table (6) showed that there are significant statistical differences between the baseline assessment and posttest 1, and between baseline assessment and posttest 2 in regard to total mean score of tactile response (t = 7.2 at p ≤ .00, and t = 12.9at p≤ .00) respectively.

TABLE 6: Mean scores' comparison of tactile response at baseline, posttest 1 and posttest 2 amongthe study subjects n=30

Variable	Preintervention (X)	Posttest (X)	t
From Baseline to posttest1	9.3 ± 0.9	Posttest 1 (11.9± 1.9)	7.2 (.00) *
From Baseline to posttest2	9.3 ± 0.9	Posttest 2 (13.4± 1.5)	12.9 (.00) *

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of baseline assessment.
- Posttest 2: after 2 weeks of baseline assessment.

Table (7) revealed that total mean score of WNSSP was increased among subjects in the study group from baseline assessment after application of sensory stimulation techniques in posttest 1and posttest 2. There were significant statistical differences between posttest 1 and posters 2 among study and control group regard to total mean score of WNSSP (t = 3.9 at p ≤ .000, and t = 6.6 at p≤ .000) respectively.

TABLE 7: Mean scores' comparison of total WNSSP between study and control group (N= 60).

Assessment	Study Group Mean ± SD	Control Group Mean ± SD	t	p
Baseline	58.9± 10.62	63.43 ±11.56	1.5	0.12
Posttest 1	68.1± 8.6	55.3± 15.27	3.9	.000*
Posttest 2	77.3± 9.4	58.91± 15.31	6.6	.000*

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of baseline assessment.
- Posttest 2: after 2 weeks of baseline assessment.

Table (8) clarifies that there are significant statistical differences between the baseline assessment and posttest 1, and between baseline assessment and posttest 2 of total mean score of WNSSP (t = .606 at p ≤ .000, and t = 13.6 at p≤ .000) respectively.

TABLE 8: Mean scores' comparison of WNSSP at baseline, posttest 1 and posttest 2 among thestudy subjects (n=30).

Variable	Preintervention (X)	Posttest (X)	t (p value)
From Preintervention to posttest1	58.9± 10.62	Posttest1 (68.1± 8.6)	6.6(0.00) *
From Preintervention to posttest2	58.9± 10.62	Posttest2 (77.3± 9.4)	13.6)0.00) *

*Significant at the p≤ 0.05 probability level.

Posttest1: after one week of baseline assessment.
- Posttest 2: after 2 weeks of baseline assessment.

DISCUSSION

The findings of the current study will be presented in two sections; the first section is devoted the demographic characteristics and medical related data; the second section is devoted to study hypotheses testing.

Subjects' characteristics

The current study revealed that more than three quarters of subjects in the study and control group were within age range between 40 to 60 years, with the mean age of 49.7± 10.01and 49.53 ± 9.1 respectively. This reflected that age is a major risk factor for stroke as the arteries become stiffer and less elastic, making them more prone to blockages. Additionally, the risk of high blood pressure, diabetes, and other conditions that can lead to stroke increases with age (Polivka et al., 2019).

This findings were supported by Murphy and Werring, (2020) research study entitled "Stroke: Causes and Clinical Features", which found that older adults are at greater risk for stroke than younger adults and reported that age is contributor to stroke risk, and the incidence doubles for each decade after age 55 years. However, a study carried out by Faozi et al., (2021) entitled "Effects of a Multimodal Sensory Stimulation Intervention on Glasgow Coma Scale Scores in Stroke Patients with Unconsciousness", found that the mean age of the studied patients was 56.42±9.07 years old. Also a study conducted by Park et al.,(2021) entitled "Effects of a Rehabilitation Program Using a Wearable Device on the Upper Limb Function, Performance of Activities of Daily Living, and Rehabilitation Participation in Patients with Acute Stroke", reported that the mean age of study sample is 60.59 ± 18.12 years.

Regarding gender, the current study showed that more than half of study sample were males which reflects that male is at higher risk for developing CVS than females, these results might be related to the positive effects of estrogen on the cerebral circulation as lifetime exposure to ovarian estrogens may protect against ischemic stroke; moreover, male are exposed to special work circumstances and carried out strenuous and hazardous activity, in addition, smoking in males is higher than in females (Peters et al., 2020).

This finding is consistent with a study findings conducted in Egypt by Alam et al., (2016) entitled "Effect of Sensory and Motor Stimulation Program on Clinical Outcomes of Patients with Moderate Head Injury", who found that 70.0% of the study and control group' subjects were male. Similarly, a systematic review by Norwood et al., (2022) entitled "Efficacy of Multimodal Sensory Therapy in Adult Acquired Brain Injury: A Systematic Review" reported that the majority of the study sample were males of the total samples. In addition Murphy and Werring, (2020) and Park et al., (2021) concluded that more than half of the study sample were males.

However, Murphy and Werring, (2020) revealed that because of the risks of pregnancy and oral contraceptive use the premenopausal women have a stroke risk that is as high as or higher than the risk in men and at older ages stroke rates are slightly higher in men. On contrary, results by Kharbach et al., (2020) showed that the majority of the study sample were females which support that female gender could be higher risk for strokes than males.

Regarding marital status approximately three fourth of subjects in study and control groups were married; as the majority of the study participants age is more than 40 years, so, it is expected to be married according to Egyptian culture. Soto-Cámara et al., (2020) who conducted study entitled "Knowledge on Signs and Risk Factors in Stroke Patients", and Kharbach et al., (2020) reported that more than half of the study sample were married, also, Moattari et al., (2016) found in their study that 80% of study sample were married.

In relation to residence, more than half of subjects in the study and control groups were living in rural areas, This could be due reputation of the hospital that attract attendants to come from rural areas, additionally, the rural areas may have fewer resources available for stroke prevention and treatment. This result is consistent with a Moroccan study conducted by Kharbach et al., (2020) who found that more than half of the study sample were from rural areas. In contrast, a study conducted in an Egyptian study by El Nahas et al., (2019) entitled "Urban versus Rural Egypt: Stroke Risk Factors and Clinical Profile: Cross-Sectional Observational Study", found that the majority of study sample were from urban areas.

In relation to education, more than half of the subjects in the study and control groups were

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reached to secondary school this could be related to their residency in rural regions where this level of education was prevalent, Abo Elazayem et al., (2020) findings illustrated that completing education is considered to be one of the most important problems facing the Egyptian society in general and the rural areas especially in elder people.

This results were similar to an Egyptian study conducted by Osama et al., (2019) entitled "Public Knowledge of Warning Signs and Risk Factors of Cerebro-Vascular Stroke in Ismailia Governorate, Egypt", who revealed that approximately half of study sample reaching secondary school, however, low education levels could lead to lack of knowledge and loss of concern about the treatment of the CVS risk factors and appropriate lifestyle changes, which could increase the incidence of stroke and morbidity among stroke survivors. Furthermore, Lindmark et al., (2022) mentioned that half of the study sample reached primary school and 25% was in secondary school which is congruent with the finding of the previous study that low educational level could increase the risk for CVS.

In relation to occupation, half of the subjects of the study group were manual laborers workers, which matched with their residency in rural areas. It could be explained that stroke patients who are manual laborers may be more likely to experience a stroke than those who are not. This is likely because manual labor often involves long hours of physical exertion, which can increase the risk of stroke. Additionally, manual laborers may have less access to healthcare and preventive measures, such as regular check-ups and lifestyle modifications, which can further increase their risk of stroke (Becher et al., 2016).

On the same line, Gao et al., (2019) in a study entitled "Effects of Occupation on Intracerebral Hemorrhage-related Deaths in Inner Mongolia" found that men aged 45-64 years old, those who worked as farmers or agricultural workers are more likely to experience a stroke than those who did not. Similarly, a study conducted in South Korea entitled "Association between Adult Height, Myocardial Infarction, Heart Failure, Stroke and Death: A Korean Nationwide Population-based Study" by Park et al., (2018) found that among men aged 40-59 years old, those who worked as farmers or fishermen are more likely to experience a stroke than others .

Regarding smoking status, one third of subjects in the study group were smokers and more than half of them in the control group were smokers. Smoking is linked with CVS by increasing the buildup of plaque in the arteries, which can lead to a blood clot. Smoking also increases blood pressure and decreases oxygen levels in the blood, both of which can increase the risk of stroke. In addition, smoking can damage and weaken blood vessels, making them more likely to rupture or burst (World Stroke Orgaization, 2021).

The current study finding is supported by El Nahas et al., (2019) who found that half of the study sample were smokers after an acute ischemic stroke. Furthermore, the results was supported by Matsuo et al., (2020) in a study entitled "Smoking Status and Functional Outcomes After Acute Ischemic Stroke" revealed that current and recent smoking is associated with an increased risk of unfavorable functional outcomes at three months after acute ischemic stroke.

Medical related data

Regarding to type of stroke approximately two thirds of subjects in the study and control groups have ischemic stroke, and the rest is hemorrhagic, it goes hand in hand with the literature as ischemic stroke is more common than hemorrhagic type (Cho et al., 2021). This data is in the same line with the findings across a study by Abdu et al., (2021) entitled "Comparison of Ischemic and Hemorrhagic Stroke in the Medical Ward of Dessie Referral Hospital, Northeast Ethiopia: A Retrospective Study" who revealed that 65.4% of patients are admitted due to ischemic stroke. Also, Salvadori et al., (2020) found in their study that 65% of study samples were ischemic and 35 % of them were hemorrhagicstroke.

Regarding medical history less than half of the subjects in the study group had hypertension and approximately one quarter had either diabetes

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mellitus or cardiovascular disease, the majority of subjects in control and study groups has no family history of stroke. This result is similar to a study finding of Abdu et al., (2021) who found that less than half of study sample are diagnosed with HTN and about 10 % percent with DM and more than three quarters of study sample hadn't family history of stroke.

In relation to motor ability, more than half of the subjects in the study and control groups are suffering from hemiparesis, this could be related to the fact that stroke involves damage to specific areas of the brain responsible for controlling movement and sensation on one side of the body. The most common area affected is the motor cortex, which controls voluntary movements of muscles on the opposite side of the body, so, damage to this area can result in weakness (hemiparesis) or paralysis (hemiplegia) on one side of the body (Dantes et al., 2020).

This finding is consistent with a study conducted by Bindawas et al., (2017) entitled "Functional Recovery Differences after Stroke Rehabilitation in Patients With Uni- or Bilateral Hemiparesis" and Dantes et al., (2020) in a study entitled "Tele-Rehabilitation of Upper-Extremity Hemiparesis after Stroke: Proof-of-Concept Randomized Controlled Trial of in-Home Constraint-induced Movement Therapy" who found that about half of study subjects were suffering from right and left hemiparesis.

Data related to study hypotheses testing

According to the results there is an increase of total mean score of visual response along the study period for patients in the study group after application of sensory stimulation techniques, on the other hand the baseline assessment and posttest for subjects in control group who received the routine hospital care almost not changed, consequently there were significant statistical differences between the baseline assessment, posttest 1 and posttest 2 of total mean score of visual response of subjects in the study group, which support study hypothesis number 1. This could be attributed to the effect of the sensory stimulation technique which decreased the resting metabolic rate of the comatose patients (Upadhyay & Verma, 2021). In addition, the provision of appropriate and safe sensory stimulation can build synaptic connections to provide sufficient stimulation for RAS.

These results are congruent with a study conducted by Alam et al., (2016) who found a significant increased visual responses mean score in study group compared to control group after application of visual stimulation through stimulating the usual attention and tracking eyes to visual stimulus. Also, the results are consistent with a study conducted by Deshpande et al., (2019) who reported that pre and post WNSSP for visual stimulation after application of sensory stimulation was 17.8 and 42.7 respectively. The result showed that significant increase of visual response between pre and post WNSSP for visual subscale. Moreover, a randomized controlled clinical trial study was conducted to evaluate the effect of a structured sensory stimulation program on the sensory function of patients with stroke induced disorder of consciousness by Kavanagh, (2022) revealed that sensory stimulation program improves the visual function of stroke patients.

In relation to tactile response, the study findings revealed an increase of total mean score of tactile response along the study period for subjects in the study group after application of sensory stimulation techniques, on the other hand the total mean score of tactile subscale decreases along the study period for patients in the control group who received the routine hospital care, in addition there were significant statistical differences between the baseline assessment, posttest 1 and posttest 2 of total mean score of tactile response of patients in the study group which support study hypothesis number 2.

Ayoobi et al., (2021) illustrated that as touch deprivation is common in hospitalized stroke patients, so, the use of tactile stimuli can be helpful for increasing the level of consciousness (LOC) and sensory stimulations can promote brain plasticity and recovery in injured brains. It is associated with changes in cortical thickness, neuron size, and the number of connections. Repetitive stimulation program is beneficial in improving the sensory and motor function in stroke patients; tactile stimulation could cause improvement in sensory and motor function,

increase synaptic efficacy and enhance the primary motor cortex excitability.

The result is consistent with Adineh et al., (2022) who carried out tactile stimulation in a study entitled "Impact of A Sensory Stimulation Program Conducted by Family Members on the Consciousness and Pain Levels of ICU Patients: A Mixed Method Study" on patients with brain injury through hand pressure, massage, and rubbing of the limb skin, first on one side of the body and then on the other side, the results revealed an improved tactile response for study group.

Li et al., (2020) carried out systematic study in which subjects in study group underwent sensory stimulation program. The sensory stimulation program consisted of auditory, visual, tactile, olfactory, and gustatory stimulation and was applied in two sessions/day while each session lasted for 15 minutes. The findings were congruent with study results as they reported that the experimental group had a higher sensory response as well as better arousal and orometer response. In the same line an Egyptian study's results entitled "Outcomes of Family-Centered Auditory and Tactile Stimulation Implementation on Traumatic Brain Injured Patients" conducted by Ahmed et al., (2022) support the study results; it revealed that early organized tactile stimulation is an effective and feasible nursing strategy in improving level of consciousness (LOC) and sensory functions among comatose patients.

The current study results revealed that there is increase in the total score of WNSSP along the study period for subjects in study group after application of sensory stimulation techniques, on the other hand the baseline assessment and posttest for subjects in control group almost not changed, consequently there are significant statistical differences between the baseline assessment, posttest 1 and posttest 2 of total mean score of sensory responses of subjects in the study group which support the study hypothesis number 3.

Zuo et al., (2021) reported that to avoid sensory deprivation and promote recovery, the sensory stimulation, including hearing, touch, vision, taste, and olfaction, which is non-invasive, economical, and simple is beneficial in improving arousal, consciousness, neural response, motor function, and brain function, shortening hospital stay, and reducing disability rate.

This result is similar to study by Upadhyay and Verma,(2021) entitled "Effect of Sensory Stimulation in Comatose Patients: an Evidence Based Review of Literature" who documented that two sessions of sensory stimulation per day for at least 15 min of each stimulation could give more significant improvement in sensory in the recovery of comatose patients. The result is congruent with an Egyptian study entitled "Effect of Integrative Nursing Practices on Cognitive Recovery among Severe Traumatic Brain Injury Patients" conducted by Othman et al., (2020), who found a significant improvement of WNSSP score between first score and end score of study group compared to control group.

In contrast, a conclusion made by Cheng et al., (2018) in a study entitled "Do Sensory Stimulation Programs Have an Impact on Consciousness Recovery?" applied on stroke patients who received sensory stimulation programs (SSP) as a treatment for disorders of consciousness for three times weekly, the result revealed that SSP may not be sufficient to restore consciousness, it might nevertheless lead to improved behavioral responsiveness in stroke patients.

CONCLUSION

The present study is designated to evaluate the effectiveness of sensory stimulation techniques to improve the visual and tactile responses in stroke patients. The application of sensory stimulation techniques on visual and tactile responses of patients with stroke had significant effects on improving visual and tactile function. Nurses in special stroke units can incorporate sensory stimulation into existing interventions, especially for patients with decreased consciousness. Sensory stimulation technique can be used both as an independent nursing intervention and in collaboration with the patient's family.

RECOMMENDATIONS

Based upon the findings of this study, the following recommendations were made.

Application of sensory stimulation as feasible nursing instructions to patients with stroke in cooperation with their families to promote continuity of care.

A further study should be conducted on a larger probability sample from different geographical areas in Egypt to generalize the findings.

A Further longitudinal study to evaluate sensory stimulation techniques for accurate evidence.

REFERENCES

1. Abbate C, Trimarchi PD, Basile I, Mazzucchi A, Devalle G. (2014). Sensory stimulation for patients with disorders of consciousness: from stimulation to rehabilitation. Frontiers in Human Neuroscience, 8:616. https://doi.org/10.3389/fnhum.2014.00616
2. Abdu, H., Tadese, F., & Seyoum, G. (2021). Comparison of Ischemic and Hemorrhagic Stroke in the Medical Ward of Dessie Referral Hospital, Northeast Ethiopia: A Retrospective Study. Neurology Research International, 2021, 9996958. https://doi.org/10.1155/2021/9996958
3. Abo Elazayem, M. G. M., El Agroudy, N., Shafiq, F. A., & Mansour, T. G. (2020). Challenges Facing Dissemination of Dialogue Values in the Egyptian Rural Society and Methods of Confrontation. Egyptian Journal of Agronomy, 42(3), 225–234.
4. Adineh, M., Elahi, N., Molavynejad, S., Jahani, S., & Savaie, M. (2022). Impact of a sensory stimulation program conducted by family members on the consciousness and pain levels of ICU patients: A mixed method study. Frontiers in Medicine, 9, 931304. https://doi.org/10.3389/fmed.2022.931304
5. Agustin Wulandari, R. (2020). The Effect of Family-Centered Affective Stimulation on Brain-Injured Comatose Patient's Level of Consciousness Randomized Controlled Trial: A Literature Review. D'Nursing and Health Journal (DNHJ), 1(1 SE-Articles), 7–12. https://doi.org/10.36835/dnursing.v1i1.107
6. Ahmed, F. R., Attia, A. K., Mansour, H., & Megahed, M. (2022). Outcomes of family-centred auditory and tactile stimulation implementation on traumatic brain injured patients. Nursing Open.
7. Alam, Z. A., Elsaay, O. E., Weheida, S. M., Elazazy, H. M., & Ahamed, E. (2016). Effect of sensory and motor stimulation program on clinical outcomes of patients with moderate head injury. J Nurs Health Sci, 5(5), 24–36.
8. Ansell, B. J., & Keenan, J. E. (1989). The Western Neuro Sensory Stimulation Profile: a tool for assessing slow-to-recover head-injured patients. Archives of Physical Medicine and Rehabilitation, 70(2), 104–108.
9. Aref, H., Zakaria, M., Shokri, H., Roushdy, T., El Basiouny, A., & El Nahas, N. (2021). Changing the Landscape of Stroke in Egypt. Cerebrovascular Diseases Extra, 11(3), 155–159. https://doi.org/10.1159/000521271
10. Ashcraft, S., Wilson, S. E., Nyström, K. V, Dusenbury, W., Wira, C. R., & Burrus, T. M. (2021). Care of the patient with acute ischemic stroke (prehospital and acute phase of care): Update to the 2009 comprehensive nursing care scientific statement: A scientific statement from the American Heart Association. Stroke, 52(5), e164–e178.
11. Ayoobi, F., Khalili, P., Azin, H., Shahrokhabadi, S., & Azin, M. (2021). Effects of tactile stimulation on the sensory, motor and cognitive function in people with multiple sclerosis. Clinical Neurology and Neurosurgery, 205, 106643. https://doi.org/10.1016/j.clineuro.2021.106643
12. Becher, H., Palm, F., Aigner, A., Safer, A., Urbanek, C., Buggle, F.,... Grau, A.J. (2016). Socioeconomic conditions in childhood, adolescence, and adulthood and the risk of ischemic stroke. Stroke, 47(1), 173–179. https://doi.org/10.1161/STROKEAHA.115.011523
13. Bindawas, S. M., Mawajdeh, H. M., Vennu, V. S., & Alhaidary, H. M. (2017). Functional recovery differences after stroke rehabilitation in patients with uni- or bilateral hemiparesis. Neurosciences (Riyadh, Saudi Arabia), 22(3), 186–191. https://doi.org/10.17712/nsj.2017.3.20170010
14. Campbell, B. C. V, De Silva, D. A., Macleod, M. R., Coutts, S. B., Schwamm, L. H., & Davis, S. M. (2019). Ischaemic stroke. Nature Reviews Disease Primers, 5(1), 70. https://doi.org/10.1038/s41572-019-0118-8
15. Cheng, L., Cortese, D., Monti, M. M., Wang, F., Riganello, F., Arcuri, F., & Schnakers, C. (2018). Do sensory stimulation programs have an impact on consciousness recovery? Frontiers in Neurology, 9, 826.
16. Cho, S.-M., Premraj, L., Fanning, J., Huth, S., Barnett, A., & Whitman, G. (2021). Ischemic and hemorrhagic stroke among critically ill patients

with coronavirus disease 2019: An international multicenter coronavirus disease 2019 Critical Care Consortium Study. Critical Care Medicine, 49(12), e1223.
17. Cusick, A., Lannin, N. A., Hanssen, R., & Allaous, J. (2014a). Validating the W estern N euro S ensory S timulation P rofile for patients with severe traumatic brain injury who are slow-to-recover. Australian Occupational Therapy Journal, 61(4), 276–283.
18. Cusick, A., Lannin, N. A., Hanssen, R., & Allaous, J. (2014b). Validating the Western Neuro Sensory Stimulation Profile for patients with severe traumatic brain injury who are slow-to-recover. Australian Occupational Therapy Journal, 61(4), 276–283. https://doi.org/10.1111/1440-1630.12128
19. Dantes, E., Axelerad, S. D., Stroe, A. Z., Axelerad, D. D., & Axelerad, A. D. (2020). The rehabilitation of hemiparesis after stroke. Ovidius University Annals, Series Physical Education & Sport/Science, Movement & Health, 20(1).
20. Deshpande, S. D., Varadharajulu, G., & Kanase, S. (2019). Effect of Choice-Based Sensory Stimulation as a Coma Stimulation Technique on Traumatic Brain Injury. SCOPUS IJPHRD CITATION SCORE, 10(7), 94.
21. Dwivedi, C. (2019). A study of selected-response type assessment (MCQ) and essay type assessment methods for engineering students. Journal of Engineering Education Transformations, 32(3), 91–95.
22. El Nahas, N. M., Shokri, H. M., Roushdy, T. M., Aref, H. M., Hamed, S. M., Shalash, A. S., … Georgy, S.S. (2019). Urban versus rural Egypt: Stroke risk factors and clinical profile: Cross-sectional observational study. Journal of Stroke and Cerebrovascular Diseases, 28(11), 104316.
23. Faozi, E., Fadlilah, S., Dwiyanto, Y., Retnaningsih, L. N., & Krisnanto, P. D. (2021). Effects of a Multimodal Sensory Stimulation Intervention on Glasgow Coma Scale Scores in Stroke Patients with Unconsciousness. Korean Journal of Adult Nursing, 33(6), 649–656.
24. Freytes, I. M., Sullivan, M., Schmitzberger, M., LeLaurin, J., Orozco, T., Eliazar-Macke, N., & Uphold, C. (2021). Types of stroke-related deficits and their impact on family caregiver's depressive symptoms, burden, and quality of life. Disability and Health Journal, 14(2), 101019.
25. Gandhi, D. B. C., Sebastian, I. A., & Bhanot, K. (2021). Rehabilitation of Post Stroke Sensory Dysfunction—A Scoping Review. Journal of Stroke Medicine, 4(1), 25–33.
26. Gao, L., DU, M., Li, J., Zhao, N. J., Yang, Y., Dong, C., … Sun, J. (2019). Effects of occupation on intracerebral hemorrhage-related deaths in Inner Mongolia. Industrial Health, 57(3), 342–350. https://doi.org/10.2486/indhealth.2018-0057
27. Gorji, M.A.H., Araghiyansc, F., Jafari, H., Gorgi, A.M.H., & Yazdani, J. (2014). Effect of auditory stimulation on traumatic coma duration in intensive care unit of Medical Sciences University of Mazandarn, Iran. Saudi Journal of Anesthesia. 2014;8(1):69-72. https://doi.org/10.4103/1658-354X.125940
28. Gosseries, O., & Laureys, S. (2022). Severe Brain Damage: Coma and Related Disorders of Consciousness. In Neuroscience in the 21st Century: From Basic to Clinical (pp. 3757–3790). Springer.
29. Handley, M. A., Lyles, C. R., McCulloch, C., & Cattamanchi, A. (2018). Selecting and improving quasi-experimental designs in effectiveness and implementation research. Annual Review of Public Health, 39, 5–25.
30. Hankey, G. J. (2020). Population impact of potentially modifiable risk factors for stroke. Stroke, 51(3), 719–728.
31. Hoseinzadeh, E., Shan, G. R. M., Vakili, M. A., & Kazemnejad, K. (2017). Effect of auditory stimulation on consciousness in coma patients with head injury: A randomized clinical trial. Journal of Nursing and Midwifery Sciences, 4(3), 82.
32. Kebapçı, A., Dikeç, G., & Topçu, S. (2020). Interobserver reliability of glasgow coma scale scores for intensive care unit patients. Critical Care Nurse, 40(4), e18-e26.
33. Kapral, M. K., Austin, P. C., Jeyakumar, G., Hall, R., Chu, A., Khan, A. M.,… Silver, F.L. (2019). Rural-urban differences in stroke risk factors, incidence, and mortality in people with and without prior stroke: The CANHEART stroke study. Circulation: Cardiovascular Quality and Outcomes, 12(2), e004973.
34. Kavanagh, N. (2022). The effects of sensory stimuli on the rehabilitation of behaviourally low Glasgow Coma Scale patients. British Journal of Neuroscience Nursing, 18(4), 176–181.
35. Kharbach, A., Obtel, M., Achbani, A., Bouchriti, Y., Hassouni, K., Lahlou, L., & Razine, R. (2020). Level of knowledge on stroke and associated factors: A Cross-sectional study at primary health care centers in Morocco. Annals of Global Health, 86(1), 83. https://doi.org/10.5334/aogh.2885
36. Kushwaha, G., Subin, S., Agrawal, A., & Siddiqui, S. S. (2022). Effectiveness of coma arousal techniques to improve the sensory stimulation in unconscious patient's. Annals of

the Romanian Society for Cell Biology, 26(01), 3594–3613.
37. Lee A. K., 1958-. (2013). A simple guide to IBM SPSS statistics for versions 20.0 & 21.0. Australia ; Belmont, CA :Wadsworth,
38. Li, J., Cheng, Q., Liu, F.-K., Huang, Z., & Feng, S. S. (2020). Sensory stimulation to improve arousal in comatose patients after traumatic brain injury: a systematic review of the literature. Neurological Sciences, 1–10.
39. Lindmark, A., Eriksson, M., & Darehed, D. (2022). Socioeconomic status and stroke severity: Understanding indirect effects via risk factors and stroke prevention using innovative statistical methods for mediation analysis. PloS One, 17(6), e0270533.
40. Matsuo, R., Ago, T., Kiyuna, F., Sato, N., Nakamura, K., Kuroda, J., … Kitazono , T. (2020). Smoking status and functional outcomes after acute ischemic stroke. Stroke, 51(3), 846–852. https://doi.org/10.1161/STROKEAHA.119.027230
41. Megha M, Harpreet S, & Nayeem Z. (2013). Effect of frequency of multimodal coma stimulation on the consciousness levels of traumatic brain injury comatose patients. Brain Injury, 27(5):570-7. https://doi.org/10.3109/02699052.2013.767937
42. Moattari, M., Alizadeh Shirazi, F., Sharifi, N., & Zareh, N. (2016). Effects of a Sensory Stimulation by Nurses and Families on Level of Cognitive Function, and Basic Cognitive Sensory Recovery of Comatose Patients With Severe Traumatic Brain Injury: A Randomized Control Trial. Trauma Monthly, 21(4), e23531. https://doi.org/10.5812/traumamon.23531
43. Morente-Oria, H., Ruiz-Montero, P. J., Chiva-Bartoll, Ó., & González-Fernández, F. T. (2020). Effects of 8-weeks concurrent strength and Aerobic training on body composition, physiological and cognitive performance in older adult women. Sustainability, 12(5), 1944.
44. Murphy, S. J. X., & Werring, D. J. (2020). Stroke: causes and clinical features. Medicine, 48(9), 561–566. https://doi.org/https://doi.org/10.1016/j.mpmed.2020.06.002
45. Norwood, M. F., Lakhani, A., Watling, D. P., Marsh, C. H., & Zeeman, H. (2022). Efficacy of multimodal sensory therapy in adult acquired brain injury: A Systematic review. Neuropsychology Review, 1–21.
46. Olson, D. M., & Ortega-Pérez, S. (2019). The Cue-Response Theory and nursing care of the patient with acquired brain injury. Journal of Neuroscience Nursing, 51(1). https://journals.lww.com/jnnonline/Fulltext/2019/02000/The_Cue_Response_Theory_and_Nursing_Care_of_the.10.aspx
47. Osama, A., Ashour, Y., El-Razek, R. A., & Mostafa, I. (2019). Public knowledge of warning signs and risk factors of cerebro-vascular stroke in Ismailia Governorate, Egypt. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery, 55(1), 1–6.
48. Othman, S. Y., Mohamed, A. M., El-Soussi, A. H., El-Monaem, S. A. A., & Ahmed, F. R. (2020). Effect of integrative nursing practices on cognitive recovery among severe traumatic brain injury patients. Journal of Nursing Education and Practice, 10(10), 75–89.
49. Park, C. S., Choi, E.-K., Han, K.-D., Lee, … Oh, S. (2018). Association between adult height, myocardial infarction, heart failure, stroke and death: A Korean nationwide population-based study. International Journal of Epidemiology, 47(1), 289–298.
50. Park, Y.-S., An, C.-S., & Lim, C.-G. (2021). Effects of A rehabilitation program using a wearable device on the upper limb function, performance of activities of daily living, and rehabilitation participation in patients with acute stroke. International Journal of Environmental Research and Public Health, 18(11), 5524.
51. Peters, S. A. E., Carcel, C., Millett, E. R. C., & Woodward, M. (2020). Sex differences in the association between major risk factors and the risk of stroke in the UK Biobank cohort study. Neurology, 95(20), e2715--e2726. https://doi.org/10.1212/WNL.0000000000010982
52. Polivka, J., Polivka, J., Pesta, M., Rohan, V., Celedova, L., Mahajani, S., … Golubnitschaja, O. (2019). Risks associated with the stroke predisposition at young age: Facts and hypotheses in light of individualized predictive and preventive approach. EPMA Journal, 10(1), 81–99. https://doi.org/10.1007/s13167-019-00162-5
53. Pont, W., Groeneveld, I., Arwert, H., Meesters, J., Mishre, R. R., Vliet Vlieland, T., ... (2020). Caregiver burden after stroke: Changes over time? Disability and Rehabilitation, 42(3), 360–367.
54. Price, A. J., Wright, F. L., Green, J., Balkwill, A., Kan, S. W., Yang, T. O., … Sudlow, C. L.M. (2018). Differences in risk factors for 3 types of stroke: UK prospective study and meta-analyses. Neurology, 90(4), e298–e306.
55. Rennert, R. C., Wali, A. R., Steinberg, J. A., Santiago-Dieppa, D. R., Olson, S. E., Pannell, J. S., & Khalessi, A. A. (2019). Epidemiology,

natural history, and clinical presentation of large vessel ischemic stroke. Neurosurgery, 85(Suppl 1), S4.
56. Rochmah, T. N., Rahmawati, I. T., Dahlui, M., Budiarto, W., & Bilqis, N. (2021). Economic burden of stroke disease: A systematic review. International Journal of Environmental Research and Public Health, 18(14), 7552.
57. Salvadori, E., Papi, G., Insalata, G., Rinnoci, V., Donnini, I., Martini, M., … Poggesi, A. (2020). Comparison between ischemic and hemorrhagic strokes in functional outcome at discharge from an intensive rehabilitation hospital. Diagnostics (Basel, Switzerland), 11(1). https://doi.org/10.3390/diagnostics11010038
58. Soto-Cámara, R., González-Bernal, J. J., González-Santos, J., Aguilar-Parra, J. M., Trigueros, R., & López-Liria, R. (2020). Knowledge on signs and risk factors in stroke patients. Journal of Clinical Medicine, 9(8), 2557.
59. Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness: A practical scale. The Lancet, 304(7872), 81–84.
60. Teasdale, G., Maas, A., Lecky, F., Manley, G., Stocchetti, N., & Murray, G. (2014). The Glasgow coma scale at 40 years: Standing the test of time. The Lancet Neurology, 13(8), 844–854.
61. Upadhyay, S., & Verma, N. (2021). Effect of sensory stimulation in comatose patients: an evidence based review of literature. 9(10), a15–a24.
62. Verdelho, A., Wardlaw, J., Pavlovic, A., Pantoni, L., Godefroy, O., Duering, M., Charidimou, A., Chabriat, H., & Biessels, G. J. (2021). Cognitive impairment in patients with cerebrovascular disease: a white paper from the links between stroke ESO Dementia Committee. European Stroke Journal, 6(1), 5–17.
63. World Stroke Organization. (2021). Understanding smoking and stroke. https://www.worldstroke.org/assets/downloads/stroke_risk_and_prevention_leaflet_smoking-en.pdf
64. Zhang, S., Zhang, W., & Zhou, G. (2019). Extended risk factors for stroke prevention. Journal of the National Medical Association, 111(4), 447–456.
65. Zuo, J., Tao, Y., Liu, M., Feng, L., Yang, Y., & Liao, L. (2021). The effect of family-centered sensory and affective stimulation on comatose patients with traumatic brain injury: a systematic review and meta-analysis. International Journal of Nursing Studies, 115, 103846.