RESEARCH ARTICLE

IMPACTS OF STROKES ON PATIENTS' SELECTIVE ATTENTION AND SHORT-TERM MEMORY (COTE D'IVOIRE)

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Manuscript Info

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Abstract

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Stroke is one of the leading causes of death and chronic disability worldwide. An estimated 15 million people suffer a stroke each year. Africa, including Côte d'Ivoire, is not spared. It is no longer rare to see younger and younger people (around 40 years old) suffering from strokes. The objective of this study is to highlight the impacts that strokes can have on certain cognitive functions. Specifically, it sought to assess the consequences of this impairment on selective attention and short-term memory (immediate memory and working memory). To do this, the method consisted of assessing the attentional and memory performance of post-stroke patients (n=95) through neuropsychological tests. These tests included the Stroop test for selective attention and the digit span test from the Wechsler Adult Intelligence Scale, 3rd edition (WAIS III) for immediate memory and working memory. The study found that stroke significantly affects the cognitive abilities of many (more than 50%) of those who suffer from it, particularly selective attention, immediate memory, and especially working memory. Unfortunately, stroke victims are often misunderstood and rejected by those around them because of changes in their attitude and personality, which some are inevitably unaware of as they no longer have full mental faculties.

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Introduction:-

Stroke is one of the leading causes of death and chronic disability worldwide. Every year, 15 million people suffer a stroke: 5 million of them die and 5 million suffer permanent disability, which places a burden on their families and communities [1]. Strokes are sometimes linked to unhealthy lifestyles (smoking, alcoholism, obesity, etc.), but other etiological factors also exist, including heredity and certain specific diseases (high blood pressure, hypercholesterolemia, atrial fibrillation, blood clotting disorders) [2]. Stroke is also a major cause of cognitive impairment, with 50 to 65% of stroke survivors suffering from it [3].

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In sub-Saharan Africa, strokes account for a significant proportion of the burden of chronic diseases [4]. In Côte d'Ivoire, it is estimated that 9.3% of deaths in public hospitals among people aged 45 to 69 are due to stroke. This constitutes a real public health problem [5], with a clear predominance among men [6]. The dramatic increase in the number of stroke victims is drawing more and more attention to this disease. The annual incidence of stroke increases with age: 5% occur before the age of 40, and 75% after the age of 60 [7]. The severity of a stroke varies, ranging from a transient ischemic attack (TIA), which resolves within a few minutes without leaving any lasting effects, to a very serious stroke (hemorrhagic stroke), which can lead to death within a few hours or days, to a stroke that leaves permanent effects of varying severity (ischemic stroke). The most common and debilitating after-effects are hemiplegia and aphasia, which are very often accompanied by cognitive and behavioral disorders. These represent both a source of social disability and psychological suffering for patients and their families [8].

The present study aims to take a closer look at the impact that strokes can have on certain cognitive functions. More specifically, the aim was to use neuropsychological tests to assess the selective attention and short-term memory of post-stroke patients.

Materials and Methods:-
Materials:-
The materials used in this behavioral study consist of: - Stroop test comprising three sheets, for the study of attentional selectivity (Appendix 1).
 - Wechsler Adult Intelligence Scale-Third Edition (WAIS III) digit memory test (Appendix 2).
I.2. Methods

Subjects:-
The study was conducted over a period of 6 months and involved 95 people aged 40 and over, of both sexes, including 20 controls (healthy subjects/ HS) of the same age group and 75 post-stroke patients (SS).

These healthy subjects (HS), who exercised regularly and all lived in the city, consisted of 10 men and 10 women. However, 80% of the controls were regular alcohol consumers (consumption ≥ 4 alcoholic drinks/week) [9]. These controls included 4 civil servants, 3 private sector employees, and 3 shopkeepers, to better represent the population of Daloa. These patients came from certain health and hospital facilities in the city of Daloa (Upper Sassandra region, Côte d'Ivoire): the Regional Hospital Center, the Catholic dispensary, and the Daloa Islamic Hospital. The patients' informed consent was obtained. Patients in the acute phase of the disease (less than 3 months after the onset) and individuals with color blindness were excluded from this study.

Behavioral study:-
The aim was to assess the selective attention of stroke patients using the Stroop test and their short-term memory (immediate memory and working memory) using the digit memory test from the Wechsler Adult Intelligence Scale-Third Edition (WAIS III) (see appendix).

Assessment of selective attention using the Stroop test
The Stroop test consists of three boards (see Appendix 1):
o   Board 1 contains rectangles of different colors (green, red, yellow, and blue);
o   Board 2 contains words describing colors, written in black ink;
o   and Board 3 contains the names of colors written in colored ink.

Each of the boards containing 10 lines of 5 words or colored rectangles are presented to the subject in succession.
The test begins with board 1. On this board are rectangles of four different colors: green, red, yellow, and blue. The subject is instructed to name the color of each rectangle as quickly as possible, audibly, from left to right, moving to the next line at the end of each line. Once at the end of the page, they start again until the allotted time (45 seconds) has elapsed. Sheet 2 contains the names of four different colors written in black ink: green, red, yellow, and blue. The subject is instructed to read these words aloud as quickly as possible, moving from left to right, line by line, as in step 1. Plate 3, which places the subject in a situation of interference, contains color names written in ink of different colors or not. The instruction is not to read the word, but rather to name as quickly as possible the color in which each word is written, line by line, from left to right. For each trial, the number of words read or colors named is counted during the allotted time of 45 seconds. Each time an error is detected (reading or naming error), it is immediately pointed out so that the subject can correct it. At the end of each sheet, the number of items named or read is determined and then analyzed [10].

Assessment of short-term memory using the WAIS III test
The digit memory test from the Wechsler Adult Intelligence Scale, Part 1-3rd edition (WAIS III) is a subtest consisting of two series of exercises. The first (forward order) has 16 items consisting of numbers to be repeated in the same order as the experimenter. The second (backward order) consists of 14 series of numbers to be repeated in reverse order to the experimenter (see appendix).- Immediate memory assessment The subject is seated comfortably in a chair. They are instructed to repeat a series of numbers in direct order (in the same order as the examiner). The number of digits presented for recall increases with each successful attempt. The series ends after two failed attempts at the same item. This test assesses the subjects' immediate memory [11]. - Working memory assessment The second part of this test assesses working memory. It is carried out under the same conditions. The numbers are recalled in reverse order to that given by the experimenter. Here, however, both trials of each item are administered, even if the first trial was successful. The series ends after two failed attempts at the same item. The scoring rule is the same in both tests: - 0 points for a failure; - 1 point for a correct answer.The tests take place in the mornings (9 a.m.) to minimize the effects of fatigue (both physical and mental).

Data processing:-
The data collected in this thesis were processed using STATISTICA® 10.0 software. The aim is to analyze the attentional and memory performance of stroke patients and then compare it with that of controls (healthy subjects). It is therefore necessary to verify the significance of the probable differences observed between the averages of the measurements obtained in each group (patients and healthy subjects). In other words, the aim is to determine whether the difference in performance values between the patient group and the control group is significant or not. To do this, an analysis of variance (ANOVA) was used to make these comparisons. A probability (p) of 0.05 is considered the significance threshold. Thus, if "p" is less than or equal to 0.05, then the difference between the variables compared is significant. On the other hand, if "p" is greater than 0.05, then the difference between the two variables compared is not significant.

Results and Discussion:-
Results:-
Stroop test results:-
A. Evaluation of the performance of the different groups of subjects in the first administration of the Stroop test (colored rectangles) The average score obtained in this first administration of the Stroop test for the HS group was 99.4±4, while the SS group scored an average of 59.2±5 designated items (Figure 1). The difference between the performances of the two groups is significant, since $F_{(1, 18)} = 23.703$, for $p=0.0012$.
B. Evaluation of the performance of the different groups of subjects in the second round of the Stroop test (words in black) When reading color names in black ink (test 2), the average performance of the HS group was significantly different from that of the SS group ($F_{(1, 18)} =30.930$, $p=0.00003$). The average scores obtained were 113.3 for the HS group and 66.5 for the SS group (Figure 1).
C. Evaluation of the performance of the different groups of subjects in the third round of the Stroop test (colored words)
In the third round of the Stroop test, the average number of colored words read correctly was 50.2 for the HS group, while the patients were only able to identify an average of 16.42 items. The comparison of performance at this level is even more significant (very, very significant) than during the presentation of the first two boards ($F_{(1, 18)} = 86.733$, $p=15.2\ 10^{-8}$) (Figure 1).
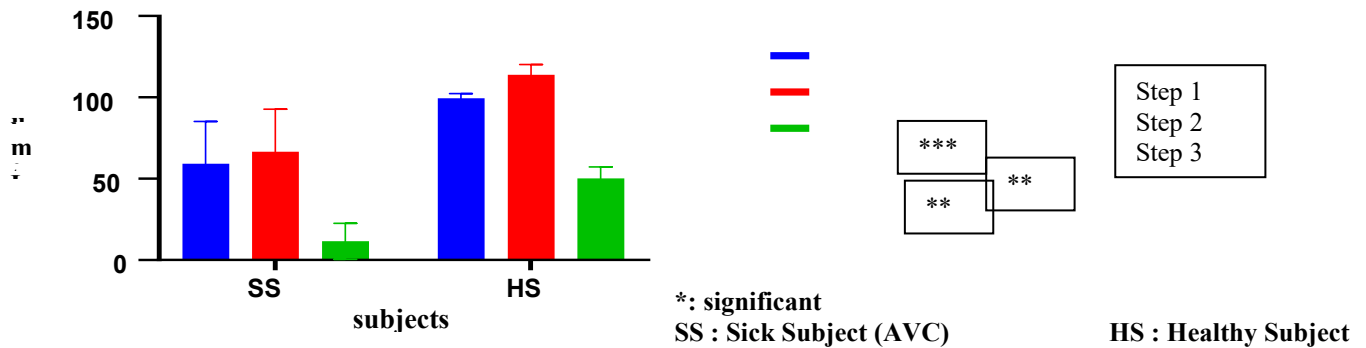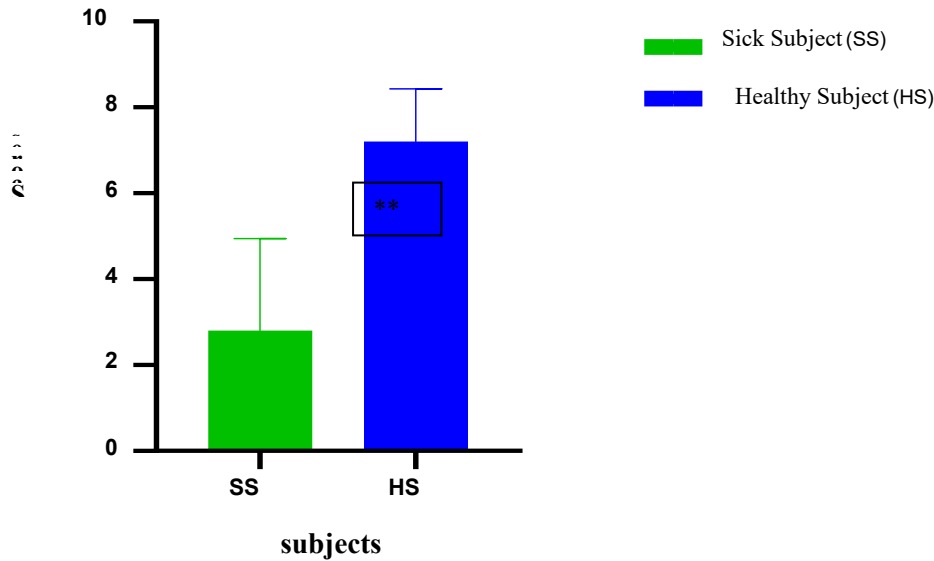

*: significant
SS : Sick Subject (AVC)   HS : Healthy Subject

Figure 1: Performance of different groups of subjects on the Stroop test

Results of the digit memory test (WAIS III)
a- Assessment of immediate memory (direct digit span task)
The first part of the WAIS III subtest assesses immediate memory. The average score obtained by the controls (HS) was 7.2 ± 2, while the SS group achieved an average score of 4 ± 2 (Figure 2).
The comparison of these two performances is significantly different, as F (1, 18) = 31.565 and p=0.0002.

*** : highly significant

Figure 2: Subject performance in the immediate memory assessment (WAIS III test)

b- Working memory assessment (digit span backward task)
The second part of the WAIS III subtest assesses working memory. In this test, HS subjects obtained an average score of 5.6 compared to only 3 for stroke patients (Figure 3). The comparison of performance at this level is highly significant (F (1, 18) =66.150 and p=12 10-8).
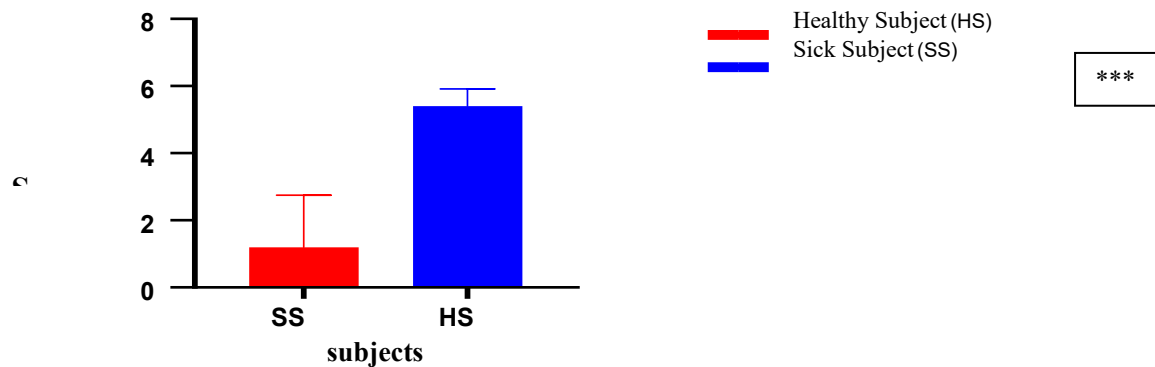

Figure 3: Subject performance during working memory assessment (WAIS III test)

Discussion:-

Strokes depend on the location of brain damage within each of the two cerebral hemispheres [12]. These lesions are thought to be the cause of a number of disorders (cognitive disorders). These disorders are heterogeneous, vary in intensity, and may or may not be associated with motor disorders [13]. Internationally, stroke is defined as resulting from the interruption of blood flow in the brain, usually when a blood vessel bursts or is blocked by a clot [14]. This interruption leads to a decrease in oxygenation and nutrient supply to the affected area of the brain.In this study, we set out to evaluate the effects of stroke on the cognitive abilities of stroke victims. To this end, neuropsychological tests (Stroop tests and WAIS III tests) were used. In the Stroop test, the first two boards are conditioning boards, preparing the subject for the third board, known as the incongruous board. The latter consists of color names written in different ink colors [15], [9]. This board requires more complex cognitive processing with inhibition of certain tasks. Selective attention models consider that selective information processing has two aspects: on the one hand, the selection of target information and, on the other hand, the active inhibition of distracting information [16].
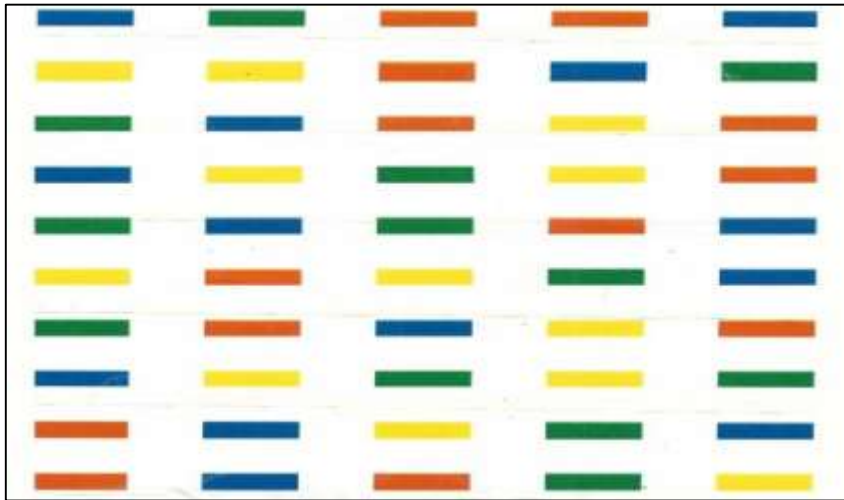
However, when distracting information is processed automatically (reading words), it interferes with the controlled processing of target information (color). In order to respond correctly to the task instructions, the subject must actively inhibit this processing. Our work shows that patients with cognitive disorders experience difficulties in this inhibition process. Their performance on this test declines significantly compared to controls. SS subjects experience remarkable difficulties in maintaining their attention over time. Our work is consistent with numerous data in the literature [17] stating that strokes very often cause attention disorders that manifest themselves in difficulties concentrating, distractibility (sensitivity to surrounding noises), and difficulties with dual tasks, regardless of the age of the subjects. According to some authors, this disease can occur at any age, even in children [18].

The second part of this study aimed to assess the memory abilities of post-stroke patients, particularly short-term memory. The immediate memory and working memory of these patients were assessed using the digit span test from the Wechsler Adult Intelligence Scale, Third Edition (WAIS III).Immediate memory, also known as primary memory, allows information (visual and auditory) to be captured and immediately reproduced without processing. It determines memory span, which is the maximum amount of information a person can retain after a single presentation. This number is 7 ± 2 items. With some effort, it supports working memory [9]. Working memory is an online, real-time information processing system (lasting from seconds to minutes) that plays a key role in most daily activities. Its dysfunction can lead to cognitive disorders of varying degrees, as well as social and professional maladjustment [19]. This system also has complex relationships with long-term memory systems. Its integrity is essential for the proper functioning of most other cognitive abilities [20]. Working memory is a specific form of short-term memory in which information to be retained is manipulated.

It is necessary for the continuity of an activity. As a result, we use it constantly. It allows us to perform complex cognitive processing on temporarily stored elements (following a conversation, mental arithmetic, dialing a phone number that has just been given to us, simultaneous translation by an interpreter, etc.) [21]. Working memory is sensitive to distraction and interference (in which case the information is irretrievably lost).The results of this study indicate a very significant impairment of immediate memory, but especially of working memory, in SS subjects. Mood disorders and behavioral disorders, sometimes resembling dementia, were also observed. Our data are consistent with those of Al-Qazzaz et al. (2024) [22], who found cognitive impairment and memory dysfunction in patients after stroke. Marika (2017) [23] reports cases of patients showing signs of dementia after a stroke. However, our results do not fully agree with the work of Maeshima et al. (2021) [24], who report impaired episodic memory with relative preservation of immediate memory in post-stroke patients.

ANNEXE 1 : STROOP test

STROOP : PLATE 1

STROOP : PLATE 2

STROOP : PLATE 3

ANNEXE 2 : Test de WAIS III
WAIS III : (Empan Direct et Empan Envers)

Ordre Direct : (Memoire immediate)

ITEM	ESSAI	CHIFFRES DE REFERENCE	REPONSE	NOTE
1	Essai 1	1-7.		
	Essai 2	6-3.		
2	Essai 1	5-8-2.		
	Essai 2	6-9-4.		
3	Essai 1	6-4-3-9.		
	Essai 2	7-2-8-6.		
4	Essai 1	4-2-7-3-1		
	Essai 2	7-5-8-3-6		
5	Essai 1	6-1-9-4-7-3		
	Essai 2	3-9-2-4-8-7		
6	Essai 1	5-9-1-7-4-2-8		
	Essai 2	4-1-7-9-3-8-6		
7	Essai 1	5-8-1-9-2-6-4-7		
	Essai 2	3-8-2-9-5-1-7-4		
8	Essai 1	2-7-5-8-6-2-5-8-4		
	Essai 2	7-1-3-9-4-2-5-6-8		

Note totale Ordre Direct (Max = 16)

WAIS III : Empan Envers

ORDRE INVERSE : (MEMOIRE DE TRAVAIL)

ITEM	ESSAI	CHIFFRES DE REFERENCE	REPONSE	NOTE
1	Essai 1	2-4 (4-2)		
	Essai 2	5-7 (7-5)		
2	Essai 1	6-2-9 (9-2-6)		
	Essai 2	4-1-5 (5-1-4)		
3	Essai 1	3-2-7-9 (9-7-2-3)		
	Essai 2	4-9-6-8 (8-6-9-4)		
4	Essai 1	1-5-2-8-6 (6-8-2-5-1)		
	Essai 2	6-1-8-4-3 (3-4-8-1-6)		
5	Essai 1	5-3-9-4-1-8 (8-1-4-9-3-5)		
	Essai 2	7-2-4-8-5-6 (6-5-8-4-2-7)		
6	Essai 1	8-1-2-9-3-6-5 (5-6-3-9-2-1-8)		
	Essai 2	4-7-3-9-1-2-8 (8-2-1-9-3-7-4)		
7	Essai 1	9-4-3-7-6-2-5-8 (8-5-2-6-7-3-4-9)		
	Essai 2	7-2-8-1-9-6-5-3 (3-5-6-9-1-8-2-7)		

Note totale Ordre Inverse (Max = 14)

Conclusion:-

This study shows that stroke has a significant impact on the selective attention, immediate memory, and working memory of those who suffer from it.Unfortunately, stroke victims are often misunderstood and rejected by those around them because of changes in their personality and attitude. Some are inevitably unaware of this, as they no longer have full mental faculties. It should also be noted that a significant proportion of the population of Haut-Sassandra is ignorant or unaware of this condition. As stroke care is difficult and costly, prevention remains the most effective measure.

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