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Strokes Following Military and Political Crises in Côte d'Ivoire: Lifestyle and Stroke Occurrence

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Abstract

Background: Strokes are a global public health problem. They are the third leading cause of death after cardiovascular disease and cancer. They are the leading cause of disability in adults. They are characterized by known risk factors such as high blood pressure, diabetes, smoking, physical inactivity, poor diet, obesity, etc. **Objective:** The aim of our study is to assess the role of patients' lifestyle in the occurrence of strokes following armed conflict. **Method:** This is a prospective study that took place from April 2021 to October 2023. It involved 430 patients and 230 controls, all of whom lived in Côte d'Ivoire during the military-political crisis. **Results:** Poor diet, lack of respect for identity, impaired quality of life, rejection by the community and lack of access to schooling for children are risk factors for post-armed conflict stroke. **Conclusion:** Our study on the role of patients' lifestyles in the occurrence of strokes following the military-political crisis in Côte d'Ivoire revealed that poor diet, lack of respect for identity, impaired quality of life, rejection by the community and lack of access to schooling for children are also risk factors.

Keywords

Strokes, Post-Conflict Strokes, Risk Factors, Lifestyle, Patients, Controls

1. Introduction

Stroke is a sudden onset (onset in less than 2 minutes) focal neurological deficit

related to brain parenchymal damage by infarction or hemorrhage.

Stroke is the third leading cause of death after cardiovascular diseases and cancer in industrialized countries. In fact, cardiovascular diseases are the leading cause of death in the world, accounting for nearly 17 million deaths per year, 80% of which occur in low- and middle-income countries. The proportion of deaths due to stroke is predominant, as it is the second leading cause of death in the category of cardiovascular diseases, after coronary heart disease. Projections for 2030 do not seem to indicate any change in this ranking for the place of stroke. It is estimated that one person is affected by a stroke every 5 seconds in the world. This is why the WHO does not hesitate to speak of a pandemic and expects a gradual increase in the incidence of stroke in the world, from 16 million cases in 2005 to nearly 23 million in 2030.

The main risk factors at the global level are high blood pressure, diabetes, tobacco consumption, physical inactivity, poor diet, obesity, high blood lipids, excessive alcohol consumption, ageing, low level of education, and genetic and psychological factors [1].

Some of these factors are called modifiable, while others are called non-modifiable.

Over the past 20 years, thanks to the fight against modifiable risk factors and rapid treatment by neurovascular units, the mortality rate linked to stroke has decreased in high-income countries. In contrast, in middle- and low-income countries, this rate has skyrocketed [1].

In Côte d'Ivoire, stroke is the leading cause of hospitalization, accounting for 85% admissions [2]. A study on the epidemiology of stroke in the neurovascular unit of the Neurology Department of the University Hospital of Cocody showed that socio-economically active subjects are the most affected [3] [4]. In our developing countries, stroke is occurring more and more at relatively young ages [3] [4].

In Côte d'Ivoire, the attempted military coup on 19 September 2002 split the country into two parts: the north, occupied by armed rebels, and the south, controlled by the government, leading to population displacement, physical trauma, rape, destruction and theft of property. After several years of negotiations between the government and the rebels, presidential elections were held in October 2010, with the results being contested, leading to the spread of war throughout the first quarter of 2011. The rebels went on to occupy all the country's towns and cities, and the incumbent president was overthrown on 11 April 2011.

Since these crises, the number of people suffering from stroke in Côte d'Ivoire has been increasing, with our hospital beds being occupied by 2/3 of these patients.

Is this phenomenon a coincidence or the consequence of the political and military crisis that occurred in Côte d'Ivoire? Did the war have an impact on the occurrence of stroke? Did the psychological trauma caused by the conflict have an impact on the occurrence of stroke?

We decided to carry out this study in order to try to answer these questions.

We therefore studied the factors related to the patients' lifestyle during and after the military-political crisis, such as diet, housing, community membership, lack of access to school for children, unhealthy environment, disrespect for identity, loss of employment, loss of income and loss of property.

The aim of our work is to assess the role of patients' lifestyles in the occurrence of strokes following armed conflict.

2. Methodology

It is constituted of patients and controls from people who have lived continuously in Côte d'Ivoire before, during and after the military-political crisis. They have all suffered the adverse effects of the war, such as physical trauma, confinement, food shortages, and so on. Some have lost their jobs, their possessions, their income…

- Type of study

This is a prospective study that took place from April 2021 to October 2023.

- Study setting

The survey was conducted in various private and public hospitals, but the majority of patients were recruited at the neurology department of the University Hospital of Cocody.

- The study population

It consists of 430 patients who suffered from a stroke and who consulted or were hospitalized during the study period and 240 controls, *i.e.* subjects who consulted or were hospitalized but did not have a stroke or the companions of the patients.

- Selection criteria
- Inclusion criteria

*Patients in whom the diagnosis of stroke was confirmed by cranial CT scan (brain scan).

*Controls: these are individuals who came to the clinic with a pathology other than stroke or apparently healthy individuals who agreed to participate in the study.

- Non-inclusion criteria

Patients without a medical record or with an incomplete medical record.

Patients who refused to participate in the study.

- Procedure for data collection

The data collection was carried out in two stages. The first stage consisted of recruiting all the subjects who had suffered a stroke confirmed by cranial-encephalic CT scan. The second stage consisted of recruiting the control subjects.

The participants' consent to the study was obtained in advance. The subjects were submitted to a questionnaire containing socio-demographic data (name and surname, date and place of birth, profession before 2011, profession during the survey, place of residence before 2011, home before 2011 and home at the time of the survey); medical history (hypertension, diabetes, heart disease, dyslipidemia, sickle cell anemia, stroke, obesity, oral contraceptive use, which are known risk

factors for stroke); psychiatric history (depression, psychosis, neurosis, etc.); lifestyle, *i.e.* the search for alcohol, tobacco, drug consumption, drug addiction, foods rich in fat and salt or poor in protein and calories, type of housing (modern, precarious), quality of life (nutrition, housing, environment, etc.), change in lifestyle, loss of employment or income due to the crisis, loss of assets due to the crisis.

- Statistical method

All the data were coded and the analysis was done on a microcomputer.

The statistical method of the data used the Epi Info software. The data processing was done by the chi-square test or the Fisher exact probability test with a significance threshold of 5% ($p < 0.05$).

The risk level estimation was done by the calculation of the Relative Risk (RR) with its confidence interval. The value of the RR is said to be significant if the interval of the RR excludes the value 1.

The qualitative variables were expressed in proportion. The khi two and Fisher tests were used for the comparisons.

3. Results

The results obtained are shown in Tables 1-12. They are expressed in numbers for the workforce and in percentages for the proportions. They show the distribution of strokes according to diet, type of housing, quality of life, questioning of belonging to one's community, lack of access to school for children, unhealthy environment, loss of employment, loss of income and loss of property.

Table 1. Lifestyle according to year of diagnosis.

Setting and living conditions	Year of diagnosis				Total	P	Relative risk	Confidence interval
	Before 2011		After 2011					
	Number	%	Number	%				
Community membership	0	00	51	100	51	0.60 (ns)	1	[0.964 - 0.993]
Children unable to attend school	0	00	3	100	3	1 (ns)	1	[0.968 - 0.994]
Unhealthy environment	31	96.88	1	3.13	32	0.45 (ns)	1.01	[0.951 - 1.080]
Disrespect for identity	53	100	0	0	53	0.60 (ns)	1	[0.964 - 0.993]
Loss of employment	07	100	0	0	07	1 (ns)	1	[0.964 - 0.993]
Loss of income	31	100	0	0	31	1 (ns)	1	[0.966 - 0.993]
Loss of property	74	97.37	2	2.63	76	0.63 (ns)	1	[0.97 - 1.05]

This table on patients' lifestyles shows the prevalence rates of normal nutrition, modern housing, community membership, children's lack of access to school, unhealthy environment, lack of respect for identity, loss of employment, loss of income and property before 2011 and after 2011. A comparison of the different factors was made using statistical tests, including the chi-square and Fisher's exact tests, which provide significance thresholds, relative risk and confidence intervals.

Table 2. Distribution of strokes according to diet.

Diet	Number	Percentage
Low sodium	26	6.05
Normal	236	54.88
High fat	144	33.49
High salt	24	5.58
Total	430	100.00

A normal diet was observed in 236 people (54.88%), while 144 (33.49%) had a high-fat diet.

Table 3. Diet of control group.

Diet	Number	Percentage
Normal	131	54.58
High fat	42	17.5
High salt	9	3.75
High in fat and salt	26	10.83
Low sodium	32	13.33
Total	240	100

Patients reported following various diets: a normal diet, a low-sodium diet, a high-sodium diet and a high-fat diet. A normal diet was observed in 236 patients, representing a prevalence rate of 54.88%, similar to that of the control group (54.58%). A high-fat diet was reported by 144 subjects, representing a prevalence rate of 33.49%, which is higher than that of the control group (17.5%). A low-salt diet was noted in 26 individuals, representing a prevalence rate of 6.05%, lower than that of the control group (13.33%). 24 patients, representing a prevalence rate of 5.58%, had a high-salt diet, similar to the rate in the control group (3.75%).

Statistical test: Chi-square test.

Diet	Normal	Little/No salt	High salt	High fat	High in fat and salt	Total
Control	34.99	60.00	26.47	32.31	31.71	35.87
Stroke	65.01	40.00	73.53	67.69	68.29	64.13
Total	100	100	100	100	100	100

Pearson $chi^2(4) = 17.9500$, $Pr = 0.001$.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 0.1% for a diet high in fat, fat and salt, but especially a diet high in salt. Poor diet is therefore a risk factor for stroke in our study.

Table 4. Distribution of strokes by type of housing.

Housing	Number	Percentage
Modern	405	94.19
Precarious	25	5.81
Total	430	100.00

The majority of subjects (94.19%) live in modern housing.

Table 5. Type of housing of control group.

Housing	Number	Percentage
Modern	233	97
Precarious	7	3
Total	240	100

The patients' living conditions were assessed. Two types of housing were identified: modern housing and substandard housing. Modern housing includes a running water supply and electricity. Substandard housing consists of mud-brick structures with no running water or electricity. 405 stroke patients, representing a prevalence rate of 94.19%, live in modern housing similar to that observed among the control group (97%). Only 25 patients, representing a prevalence rate of 5.81%, live in substandard housing similar to that of the control group (3%).

Before the attempted military coup in 2002, which turned into a rebellion, people lived according to their means, either in modern homes or in makeshift accommodation. With the bombing during the war in 2011, living conditions deteriorated further as homes were destroyed, and people fleeing the conflict were forced to live in makeshift accommodation.

There is therefore no link between housing and the occurrence of post-conflict strokes.

Statistical test: Chi-square test.

	Modern	Precarious	Total
Control	36.42	24.24	35.82
Stroke	63.58	75.76	64.18
Total	100	100	100

Pearson $chi^2(1) = 2.0241$, $Pr = 0.155$.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 15.5% for substandard housing. Substandard housing is therefore not a risk factor for stroke in our study. Thus, neither modern housing nor substandard housing are risk factors for stroke in our study.

Table 6. Distribution of strokes according to quality of life.

Quality of life	Number	Percentage
Impairment	24	5.58
Confinement	234	54.42
Lack of food	3	0.70
No	169	39.30
Total	430	100.00

The majority of subjects (54.42%) who suffered a stroke were confined.

Table 7. Confinement of control group.

Confinement	Number	Percentage
Yes	183	76.25
No	57	23.75
Total	240	100

Table 8. Lack of food of control group.

Lack of food	Number	Percentage
Yes	32	13.33
No	208	86.67
Total	240	100

Table 9. Impairment of quality of life of control group.

Impairment of quality of life	Number	Percentage
Yes	30	12.5
No	210	87.5
Total	240	100

In peacetime, people enjoy a quality of life characterized by freedom: freedom of movement, freedom of expression, the ability to feed themselves, and the opportunity to enjoy leisure activities… This quality of life is compromised in wartime when people are confined; they can no longer move about, feed themselves properly, express themselves, or enjoy leisure activities…Patients' quality of life during the war was assessed in terms of lockdown, food shortages, or both. 234 (54.42%) patients reported having experienced a lockdown that differed from that of the control group (76.25%), 3 (0.70%) of them reported food shortages at a rate significantly lower than that of the control group (13.33%), whilst 24 (5.58%) had experienced both confinement and food shortages, a rate also lower than that of the control group.

With the attempted military coup of 2002, which turned into a rebellion, people's freedom was severely curtailed. Some were confined to their homes due to

the intensity of the fighting or the fear of being denounced. People will face food shortages due to disruptions in market supplies, rising food prices, or the inability to leave their homes to go to the market.

Statistical test: Chi-square test.

	Control	Stroke	Total
No impairment of quality of life	87.50	39.53	56.72
Impairment of quality of life	12.50	60.47	43.28
Total	100	100	100

Pearson $chi^2(1) = 144.3524$, Pr = 0.000.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 0.000 for impaired quality of life. Impaired quality of life is a risk factor for stroke in our study.

Table 10. Quality of life according to year of diagnosis.

Quality of life	Year of diagnosis				Total	p
	Before 2011		After 2011			
	Number	%	Number	%		
Disruption	1	0.38	260	98.85	263	0.01 (s)
Impairment	0	00	24	100	24	
Confinement	1	0.43	233	99.57	234	
Lack of food	0	0	03	100	03	
No disruption	7	4.14	162	95.14	169	
Total	8	1.86	422	98.14	430	

This table compares patients' quality of life before 2011 and after 2011.

The Fisher test applied gives a significance threshold of 1% for the disruption to quality of life after 2011. The disruption to quality of life includes confinement, lack of food and deterioration in quality of life. We have defined deterioration in quality of life as the combination of confinement and lack of food.

Table 11. Distribution of strokes according to community membership.

Community membership	Number	Percentage
No	379	88.14
Yes/2011	51	11.86
Total	430	100.00

The majority of individuals (379, or 88.14%) stated that their community membership was not questioned before or after the crisis.

Table 12. Community membership of control group.

Community membership	Number	Percentage
No	10	4.17
Yes	230	95.83
Total	240	100

A sense of belonging to one's community is essential for the individual. Human beings are social creatures who are born, grow up and live in a community in which they flourish. In times of war, this harmony can be disrupted, whether because of political views or other factors, or even because of one's ethnic background. They may then be rejected by the community, which is often a source of anxiety, worry, fear of death or of being attacked. The majority of individuals (379, or 88.14%) state that their sense of belonging to the community was not called into question before or after the crisis, unlike the control group (95.83%). However, 51 (11.86%) people report that their sense of belonging to the community was called into question after the crisis, a higher rate than that of the control group (4.17%).

Before the attempted military coup in 2002, which turned into a rebellion, people lived in perfect harmony. From that point onwards, a climate of mistrust took hold amongst the population, bringing with it exclusion and xenophobia towards people from different regions and even towards foreigners. As a result, some people were ostracized by their communities (see **Tables 13-24**).

Statistical test: Chi-square test.

Community membership	Community membership	No community membership	Total
Control	37.77	16.39	35.82
Stroke	62.23	83.61	64.18
Total	100	100	100

Pearson $chi^2(1) = 11.0177$, $Pr = 0.001$.

The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.001$ for rejection by the community. Rejection by the community is therefore a risk factor for stroke in our study.

Table 13. Distribution of strokes according to children's lack of access to school.

Children unable to access school	Number	Percentage
No	427	99.30
Yes	3	0.70
Total	430	100.00

Almost all subjects (99.3%) reported that children had access to school during the post-election period.

Table 14. Children's access to school of control group.

Children's access to school	Number	Percentage
Yes	37	15.42
No	203	84.58
Total	240	100

Children's access to school is an indicator of peace. A lack of access to school for children is indicative of a state of conflict or war. Every parent's wish is for their children to succeed through education. A lack of access to school for children can be a major concern for parents and affect their health. Almost all of the 427 respondents about 99.3% reported that children did not have access to school during the post-election period, a rate higher than that of the control group, which stood at 84.58%. Only three people, or 0.70%, said that children had access to school after the post-election crisis, a rate lower than that of the control group (15.42%).

Statistical test: Chi-square test.

	Control	Stroke	Total
Children unable to access school	00.0	99.07	63.58
Children's access to school	100	0.93	36.42
Total	100	100	100

Pearson $chi^2(1) = 652.8860$, Pr = 0.000.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 0.001 for children's lack of access to school. Children's lack of access to school is therefore a risk factor for stroke in our study.

Table 15. Unhealthy environment.

Unhealthy environment	Number	Percentage
No	398	92.56
Yes	32	7.44
Total	430	100.00

Almost all subjects (92.56%) lived in a healthy environment.

Table 16. Unhealthy environment of control group.

Unhealthy environment	Number	Percentage
Yes	47	19.60
No	193	80.40
Total	240	100

The environment contributes to an individual's quality of life. An unhealthy environment whether due to noise, unpleasant odours, air quality or other factors contributes to a decline in quality of life and is a source of illness. The environment in which patients lived before and after the war was assessed. An unhealthy environment, caused by toxic pollution or noise pollution from the deafening sounds of weapons of war, can affect people's health. The patients' environment before and after the war was assessed. An unhealthy environment caused by toxic pollution and noise pollution from the deafening sounds of weapons of war can affect people's health. Almost all subjects (398, or 92.56%) lived in a healthy environment, a rate similar to that of the control group (80.4%). Only 32 (7.44%) people reported that their environment was unhealthy, whereas 19.6% of the control group lived in an unhealthy environment.

Before the attempted military coup in 2002, which turned into a rebellion, people lived in a healthy environment. From that point onwards, conditions gradually deteriorated, reaching a peak in 2011 with intense fighting and its accompanying destruction, killings, corpses littering the streets and the inability of refuse collection companies to operate.

Table 17. Failure to respect identity.

Respect for identity	Number	Percentage
No	377	87.67
Yes	53	12.33
Total	430	100.00

Only 53 people (12.33%) reported that their identity was respected.

Table 18. Failure to respect identity of control group.

Respect for identity	Number	Percentage
No	50	20.8
Yes	190	79.2
Total	240	100

Identity is the enduring and fundamental nature of an individual or a group, which defines their individuality and uniqueness. Respect for identity is therefore important to human beings. To fail to respect an individual's identity is to undermine their very being. This can lead to frustration and the development of negative feelings such as hatred, anger and a desire for revenge… During conflicts, identity can be violated or threatened. Respect for one's identity is important to human beings. During conflicts, identity can be violated or threatened. Thus, 377 stroke patients, representing a prevalence rate of 87.67%, felt that their identity had been respected, whilst 53 others, representing a prevalence rate of 12.33%, reported that their identity had not been respected. 50 control subjects (20.8%)

stated that their identity had not been respected, whilst 190 others (79.2%) reported the opposite.

Before the attempted military coup in 2002, which turned into a rebellion, the people lived in perfect harmony. From that point onwards, mistrust took hold amongst the people, bringing with it exclusion and xenophobia towards people from different regions and even towards foreigners. This situation worsened in 2011. Consequently, the identity of certain individuals was not respected.

Statistical test: Chi-square test.

	Control	Stroke	Total
No respect for identity	0.00	87.21	55.97
Respect for identity	100	12.79	44.03
Total	100	100	100

Pearson $chi^2(1) = 652.8860$, Pr = 0.000.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 0.000 for lack of respect for identity. Lack of respect for identity is therefore a risk factor for stroke in our study.

Table 19. Job loss.

Job loss	Number	Percentage
No	423	98.37
Yes	7	1.63
Total	430	100.00

The majority of patients (423), or 98.37%, did not lose their jobs. Only 7 (1.63%) stroke victims lost their jobs after the stroke.

Table 20. Job loss of control group.

Job loss	Number	Percentage
Yes	13	5.42
No	227	94.58
Total	240	100

Employment is paid work. It enables individuals to fulfil their potential, establish themselves in society and thrive. Employment is important for individuals. It enables them to provide for themselves, their families and, in some cases, their communities. War can sometimes lead to job losses. The majority of patients (423), or 98.37%, did not lose their jobs. Only 7 (1.63%) stroke victims lost their jobs following the stroke. 227 control subjects (94.58%) did not lose their jobs, whilst 13 (5.42%) of them did.

Before the attempted military coup in 2002, which escalated into a rebellion, Côte d'Ivoire enjoyed steady economic growth and jobs were secure. From that point onwards, the economic situation gradually deteriorated, reaching a low point in 2011 with the closure and relocation of businesses to neighbouring countries. The population was then left unemployed.

Statistical test: Chi-square test.

	No job loss	Job loss	Total
Control	34.92	65	35.82
Stroke	65.08	35	64.18
Total	100	100	100

Pearson $chi^2(1) = 7.6349$, $Pr = 0.006$.

The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.006$ for no job loss. Job loss is therefore not a risk factor for stroke in our study. There is therefore no link between job loss and the occurrence of post-conflict strokes.

Table 21. Loss of income.

Loss of income	Number	Percentage
No	399	92.79
Yes	31	7.21
Total	430	100.00

The majority of patients (399), or 92.79%, did not lose their income. Only 31 (7.21%) stroke victims lost their income after the stroke.

Table 22. Loss of income control group.

Loss of income	Number	Percentage
Yes	43	17.92
No	197	82.08
Total	240	100

Income is anything received in kind or in cash by a person as remuneration for an activity or work. Income is therefore important to an individual. Income, like employment, is important to an individual. It enables them to provide for themselves, their family and, in some cases, their community. War can sometimes lead to a loss of income. The majority of patients (399), or 92.79%, did not lose their income. Only 31 (7.21%) stroke victims lost their income following the stroke. 197 control subjects (82.08%) did not lose their income, whilst 43 (17.92%) of them did.

Before the attempted military coup in 2002, which turned into a rebellion, Côte d'Ivoire enjoyed steady economic growth, with jobs and incomes secure. From that point onwards, the economic situation gradually deteriorated, reaching a peak in 2011 with the closure and relocation of businesses to neighbouring countries, as well as the destruction of local assets. People lost their livelihoods or saw their incomes reduced.

Statistical test: Chi-square test.

	No loss of income	Loss of income	Total
Control	33.05	58.11	35.82
Stroke	66.95	41.89	64.18
Total	100	100	100

Pearson $chi^2(1)$ =17.9739, Pr = 0.000.

The chi-square test applied between stroke patients and controls shows a significance threshold of p = 0.000 for no loss of income. Loss of income is therefore not a risk factor for stroke in our study. There is therefore no link between loss of income and the occurrence of post-conflict strokes. There is therefore no link between loss of income and the occurrence of post-conflict strokes.

Table 23. Loss of property.

Loss of property	Number	Percentage
No	354	82.33
Yes	76	17.67
Total	430	100.00

67 (17.67%) patients lost their property during the crisis. The majority of subjects (354, or 82.33%) retained their property, while 67 (17.67%) lost their property during the crisis.

Table 24. Loss of property of control group.

Loss of property	Number	Percentage
Yes	43	17.92
No	197	82.08
Total	240	100

Property refers to what a person owns, that which has financial value and can be held as an asset. Such property has been acquired or built up over many years of hard work and sacrifice. It is sometimes the sole source of income for owners who are retired or very elderly and can no longer work. The loss of such property through destruction or theft can occur during wartime. These possessions were

acquired or built after many years of hard work and sacrifice. They are sometimes the only source of income for owners who are retired or very elderly and can no longer work. The loss of these assets through destruction or theft can occur during the war. Only 76 (17.67%) patients lost their assets during the crisis. 197 respondents (82.08%) did not lose their assets, whilst 43 (17.92%) of them did.

Before the attempted military coup in 2002, which escalated into a rebellion, Côte d'Ivoire was at peace. The people and their property were safe. From that point onwards, the security situation deteriorated gradually, reaching a peak in 2011 with the destruction and theft of people's property.

Statistical test: Chi-square test.

Property	No loss of property	Loss of property	Total
Control	35.64	36.67	35.82
Stroke	64.36	63.33	64.18
Total	100	100	100

Pearson $chi^2(1) = 0.0455$, $Pr = 0.831$.

The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.831$ for loss of possessions. Loss of possessions is therefore not a risk factor for stroke in our study. There is therefore no link between the loss of property and the occurrence of post-conflict strokes.

4. Discussion

It is now clearly established that the risk of stroke is influenced by dietary factors [5] [6]. Poor diet is the most important behavioral risk factor, especially in determining coronary risk. According to the WHO, poor diet is responsible for 10% of coronary heart disease and strokes [7]. Hypertension related to salt consumption is responsible for approximately 14% of strokes and 9% of myocardial infarctions [8]. In our study, 24 patients, representing a prevalence rate of 5.58%, had a high-salt diet. Our result is lower than that reported by He *et al.* [9] (28.4%) but close to that of Whelton [8] (14%). Conversely, 144 patients (33.49%) had a high-fat diet, while 266 others (54.88%) had a normal diet. Our observation is similar to that of Najat [10]. Stroke occurs in both subjects with a normal diet (54.88%) and in patients with a high-fat diet (33.49%), consistent with Najat's study [10]. In our study, 24 patients, representing a prevalence rate of 5.58%, had a high-salt diet. Our result is lower than that reported by He *et al.* [9] (28.4%) but close to that of Whelton [8] (14%). Dietary salt overdose can lead to complications such as hypertension, which can cause stroke. In the study group, a high-salt diet was found in 28.4% of individuals who experienced a stroke, compared to 71.6% in those consuming a diet not enriched with salt, a difference that was not statistically significant according to He [9].

In our study, 144 patients (33.49%) had a high-fat diet. High-fat diet consump-

tion was noted in 43.5% of stroke patients compared to 17.6% of those consuming a low-fat diet. Half of the participants did not monitor their food intake. This difference is statistically significant, strongly implicating diet as a risk factor for stroke. These results are consistent with those obtained for BMI [10]. Our result (33.49%) is similar to that reported by Najat, which is 43.5%. The diet of the majority of the population living in Côte d'Ivoire is high in fat, whether in soups (peanuts, palm kernels) or fried cassava semolina accompanied by fried fatty and salted fish commonly called "Garba", or fried plantains with fish called "Aloco". This high-fat diet of our patients may therefore be the cause of their strokes. Indeed, statistical tests show that a high-fat diet is a risk factor for post-conflict stroke. Our observation is consistent with that of Najat. We observed that 266 other patients (54.88%) with a normal diet suffered a stroke. This prevalence rate is close to that of Najat [10], who found that 43.5% of stroke patients had a high-fat diet. Our observation is similar to Najat's. Indeed, in Côte d'Ivoire, we do not measure the amount of fat in our food during cooking. What the 266 patients reported as a normal diet is probably not. Most Ivorians consume a lot of fatty foods. If we were to measure the exact amount of fat in the foods consumed by these patients, we would find that these subjects did not have a normal diet as they claimed, but rather a high-fat diet. Stroke occurs in both individuals with a normal diet (54.88%) and those with a high-fat diet (33.49%), consistent with Najat's study [10]. Our study shows that poor diet is a risk factor for stroke. This modifiable risk factor can therefore be eliminated or reduced by reducing excess salt and fat in our food through public education.

The patients' place of residence was assessed. Two types of housing were identified: modern housing and precarious housing. 405 stroke victims, representing a prevalence rate of 94.19%, live in modern housing. Only 25 patients, representing a prevalence rate of 5.81%, live in precarious housing. The majority of subjects (94.19%) live in modern housing. Modern housing does not prevent the occurrence of strokes. Precarious housing is therefore not synonymous with a risk factor for stroke. The tests applied yielded a relative risk of 0.98 with a confidence interval of 0.966 - 0.993. Fisher's exact test provided a significance level of 100% ($p = 1$). Housing type is therefore not a risk factor for post-conflict stroke. In 2015, a study by Halonen *et al.* [11] of 37,699 Finns found a positive association between childhood life events and the risk of cardiovascular (CV) disease only among those living in disadvantaged residential areas. Our observation differs from that of Halonen *et al.* Therefore, precarious housing is not a risk factor for stroke in our study. There is no link between housing and the occurrence of post-conflict stroke.

Quality of life disruption combines impaired quality of life, confinement, and food insecurity. Patients experienced impaired quality of life when they were confined and lacked food., During the war, in areas of intense fighting, residents were confined, holed up in their homes with no access to food. A disruption in patients' quality of life was observed in 1 (0.38%) patient before the war (2011) and in 260

(98.85%) patients after 2011. The significance level was 1%. Therefore, this finding is significant. It constitutes a risk factor for post-conflict stroke.233 (99.57%) subjects reported being confined during the war (after 2011). Only one (0.43%) reported being confined before the war (before 2011). The significance level was 1%. This constitutes a risk factor for post-conflict stroke. Brie reports in a 2019 study of prisons in California that the incidence of hypertension among people placed in seclusion was almost three times higher than among those placed in maximum security in the general population (47.5% vs. 16.5%) [12]. We know that high blood pressure is a major risk factor for stroke. The majority of our patients were confined during the war and likely developed high blood pressure, which can lead to stroke in the short or long term. Sharon describes how people confined during wartime can experience heart palpitations, insomnia, tremors, fatigue, vision deterioration, hypersensitivity, and a worsening of pre-existing conditions [13]. Our subjects experienced the situation described by Sharon, which caused heart palpitations and insomnia. Insomnia is a risk factor for cardiovascular disease and therefore stroke. Most of our subjects had a history of hypertension, diabetes, etc. Confinement likely exacerbated these conditions and led to post-war strokes, given that these are known to be major cardiovascular risk factors.

Low social support is a psychosocial risk factor for cardiovascular disease. However, there are interactions between social support and certain other psychosocial risk factors. For example, an individual who is hostile in their relationships with others, or depressed, and who excludes themselves from social participation, will be more prone to intense stress reactions without benefiting from the positive effects of social support [14]. The majority of people report that their membership in the community has been called into question because of their political opinions, ethnicity or nationality. They have been threatened, sometimes with physical assault. This situation has forced them to hide, isolate themselves or flee, thus excluding themselves from their community as a result of the crisis. Our observation is similar to that described by Lett *et al*., who assert that low social support is a psychosocial risk factor for cardiovascular disease and that individuals who are hostile in their relationships with others, or who are depressed and exclude themselves from social participation, are more likely to have intense stress reactions [14]. Social relationships can act as 'stress buffers' that mitigate the negative impacts associated with difficult times in life (illness, bereavement, divorce, etc.). An adequate social network can provide people affected by these trials with structural and emotional support that allows them to better absorb the shock and thus reduce the harmful physiological consequences of chronic stress, particularly the risk of cardiovascular disease. Studies also show that individuals with a developed social network tend to be more physically active and adopt healthier lifestyles, which helps reduce the risk of cardiovascular disease and improve life expectancy. Our patients therefore did not benefit from these conditions, which would have enabled them to cope better with the war situation (and avoid cardiovascular risks). Socially isolated individuals are also at greater risk of having less heart rate

variability (the interval between two contractions) and left ventricular hypertrophy, two risk factors for cardiovascular mortality. Over time, all these effects of chronic stress end up damaging the heart and blood vessels and may explain the marked increase in cardiovascular events observed in socially isolated individuals. Our subjects were therefore subject to cardiovascular risk as described by the authors, which probably contributed to the occurrence of post-conflict strokes.

Children's access to school is an indicator of peace. Children's lack of access to school is evidence of conflict and war. Every parent wants their children to succeed through education. Children's lack of access to school can be a major concern for parents and affect their health. Almost all of the 427 respondents (99.3%) reported that children had access to school during the post-election period. Only three people, or 0.70%, said that children did not have access to school after the post-election crisis, but no cases were reported before 2011, representing a relative risk of 1.01 with a confidence interval of (0.968 - 0.994). The chi-square test applied gives a significance threshold of 100% ($p = 1$). Lack of access to school for children is therefore not significant as a risk factor for post-conflict stroke.

The WHO estimates that approximately 80% of premature deaths linked to outdoor air pollution are the result of ischemic heart disease and strokes, 14% from chronic obstructive pulmonary disease or acute lower respiratory infections, and the remaining 6% from lung cancer [7]. The main sources of urban air pollution with a high impact on health that can be modified relate to industry, transport, urban planning, housing, electricity generation, and urban and agricultural waste management [7]. In our study, there was no industrial air pollution as reported in the literature. In the United States, air pollution, particularly environmental exposure, has rapidly become a widespread health risk in urban areas. It has been identified as a new risk factor for stroke. Chronic exposure has been associated with an increased risk of stroke [15]. In our work, we mainly dealt with wastewater from septic tanks and air from household waste. Only one patient lived in an industrial area. Our observation differs from that described in the United States, where air pollution is particularly severe due to the enormous amount of industrial waste released into the atmosphere and the environment and the exhaust fumes from millions of vehicles. In the United States, populations are chronically exposed for years or even their entire lives, whereas the only case in our study was exposed to pollution only during the crisis period. The subjects in our study lived in an unhealthy environment, polluted by the decomposition of the bodies of combatants and civilians littering the streets and by particles emitted into the atmosphere by the detonations of heavy weapons such as shells. Residents in neighbourhoods and cities were forced to burn bodies with used tyres to prevent them from decomposing. Household and other waste was not collected by sanitation companies and sometimes formed biomass. Due to a lack of butane gas or lamp oil, people cooked with wood and charcoal, and fires were lit using either plastic materials or worn-out tyres. The conditions in our study are similar to those described in WHO reports. Our subjects were therefore exposed to a cardiovascular

risk of stroke. According to WHO reports, 4.3 million people die prematurely each year from diseases attributable to indoor air pollution resulting from the inefficient use of solid fuels. Among these causes of death, in descending order of importance, are stroke (34%), ischemic heart disease (26%), chronic obstructive pulmonary disease (22%), pneumonia (12%) and lung cancer (6%) [7].

Respect for identity is important for human beings. During conflicts, identity can be violated or threatened. Thus, 377 stroke survivors, or 87.67% of the sample, felt that their identity had been respected, while 53 others, or 12.33%, reported that their identity had not been respected. Disrespect for identity is not necessarily a factor contributing to the occurrence of stroke, since the vast majority of subjects (87.67%) who suffered a stroke had their identity respected. After 2011, 53 people (100%) reported that their identity was not respected. No cases were reported before 2011, representing a relative risk of 1 with a confidence interval of (0.964 - 0.993). The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.000$ for lack of respect for identity. Lack of respect for identity is therefore a risk factor for stroke in our study. Non-compliance with identity contributed to the occurrence of stroke in these 53 individuals who were victims of non-compliance with their identity. They therefore excluded themselves from their community and from social participation without social support, which are psychosocial risk factors for cardiovascular disease according to Lett [14].

In our study, job loss does not appear to be a risk factor for stroke. It is employment that provides us with the income to achieve a certain socio-economic status. While the majority of patients have not lost their jobs, their employment does not provide them with a sufficient income to achieve a good socio-economic status. In fact, most of them are in low-income jobs. The high cost of living and high standard of living reduce their purchasing power, placing them in a low socio-economic position. Thus, according to the observations of authors such as Marmot [16] and Kerr *et al*. [17], they are exposed to risk factors for stroke. Marmot observed that a low socio-economic status, defined by a low level of education and a low-income job, is associated with a shorter life expectancy. He also points out that there is a strong social gradient between the development of heart disease and socio-economic status [16]. According to Kerr *et al*., people with a low socioeconomic status are 1.7 times more likely to have a stroke, and traditional cardiovascular risk factors only explain part of this increased risk [17]. This may explain the high prevalence of stroke among subjects who have not lost their jobs (98. 87%). The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.006$ for no job loss. Job loss is therefore not a risk factor for stroke in our study. Although some authors have observed a link between job loss and the occurrence of cardiovascular events in their studies [18]-[21], others have not found an association between job loss and cardiovascular risk. Two longitudinal studies conducted in the United States by Kasl and Cobb [22] and Schnall *et al*. [23] found less evidence of an association between job loss

and subsequent cardiovascular risk. Studying workers displaced by a factory closure, Kasl and Cobb [22] reported that although blood pressure rose slightly during the anticipation phase preceding the factory closure, this increase did not persist after the closure. Schnall *et al*. [23], in a study of 139 employees laid off from a brokerage firm, found limited support for increased blood pressure levels in the anticipation phase, as reported by Kasl and Cobb [22], but found no evidence of a persistent elevation in blood pressure. The authors of a recent comprehensive review of the literature [24] concluded that job loss should not be considered a risk factor for poor cardiovascular outcomes. Job loss is not a cardiovascular risk factor, particularly for post-conflict stroke, in our work, which is consistent with what is described in the literature.

Our work shows that loss of income is not a risk factor for post-conflict stroke. However, the low economic status of the population and the increasingly high cost of living, which makes access to healthcare difficult, may be responsible for the occurrence of stroke. Our findings are therefore similar to those reported by authors such as Marmot, who observed that a low socioeconomic status, defined by a low level of education and a low-income job, is associated with a shorter life expectancy. He also points out that there is a strong social gradient between the development of heart disease and socioeconomic status [16]. Furthermore, people with a low socioeconomic status are 1.7 times more likely to have a stroke, and traditional cardiovascular risk factors only explain part of this increased risk, according to Kerr [17]. Thus, according to Marmot and Kerr's description, our patients (92.79%) who had not lost income but had a low socioeconomic status were 1.7 times more likely to have a post-conflict stroke. The majority of patients (64%) in Maïga's study [25] were from low socio-economic backgrounds, a finding also reported by Bilongo [26] (60%), Mahob [27] and Sadek [28] (65%). In socio-economic terms, 36 (41.9%) patients had an unstable income according to Traoré [29]. The majority of our patients (399), or 92.79%, did not lose their income. Only 31 (7.21%) stroke victims lost their income after the post-election crisis. Our result is significantly lower than those of Maïga (64%), Bilongo (60%), Mahob and Sadek (65%) and Traoré (41.9%). Our observation differs from those of Maïga, Bilongo, Mohab and Sadek and Traoré. The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.000$ for no loss of income. Loss of income is therefore not a risk factor for stroke in our study. Low income is not a risk factor for post-conflict stroke. Our observation differs from that of the following authors: Maïga [25], Bilongo [26], Mohab [27] and Sadek [27], who found a low socio-economic status among stroke patients in their study. Stroke occurs independently of income. It could be said that loss of income, and therefore low socioeconomic status, is a protective factor against stroke, contrary to the study by Edmondson [30], which reports that low socioeconomic status is associated with higher cardiovascular risk and excess mortality, regardless of traditional cardiovascular risk factors and access to care [30]. Our observation differs from that of Emmanuel Wiernik [31], who noted that at an equivalent level of perceived stress, the impact of stress on cardiometabolic risk must be higher for

individuals with lower socio-economic status (SES). This could be the case if they are exposed more often or for longer periods of time, or if they have fewer resources to cope with it. Thus, even if participants are potentially exposed to the same stressor regardless of their SES, those with high SES would not suffer the consequences, thanks to greater psychological or material resources that would mitigate its effect [31]. All the individuals in our study experienced the same stress, but we note that those with a high socio-economic status were more affected by stroke. Thus, life events such as a promotion, job loss or divorce can change an individual's income, even in the short term, as reported by Krieger *et al.* [32].

For some, property is their only source of income. The majority of patients (82.33%) say they have not lost any property. During and after the crisis, property was confiscated (houses, cars, etc.). It was only returned to its owners after several months or years, in a defective or even destroyed state, impossible to renovate. All of this led to a loss of income, exposing individuals to the risk of stroke, according to descriptions by authors such as Marmot [16] and Kerr [17]. Indeed, according to Marmot, there is a strong social gradient between the development of heart disease and socio-economic status [16]. Kerr, for his part, reports that people with a low socio-economic status are 1.7 times more likely to have a stroke [17]. Thus, although they did not lose their property, patients experienced a decrease in their source of income due to a low socio-economic status, which is a risk factor for post-conflict stroke. The chi-square test applied between stroke patients and controls shows a significance threshold of $p = 0.831$ for loss of property. Loss of property is therefore not a risk factor for stroke in our study. Life events such as a promotion, job loss or divorce can change an individual's income, even in the short term, as reported by Krieger *et al.* [32]. Like loss of income, loss of property is not a risk factor for stroke in our study. Stroke occurred more frequently in subjects who did not lose their property. There is no link between property and the occurrence of stroke. Property does not prevent stroke, as one might think, but statistical tests show the opposite.

5. Conclusion

Our study shows that housing, unhealthy environments, loss of income, loss of employment and loss of property are not risk factors for stroke after armed conflict. However, poor diet, impaired quality of life, lack of respect for personal identity, community rejection, and limited access to schooling for children all constitute stroke risk factors in post-conflict populations. Conventional stroke hazards including hypertension, diabetes, tobacco consumption, physical inactivity and obesity must also be considered, as interventions targeting stroke prevention amid armed conflicts need to address all these contributors.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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