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## ORIGINAL PAPER

Mater Sociomed. 2015 Oct; 27(5): 314-317

# CLINICAL-EPIDEMIOLOGICAL STUDY ON STROKE PRESENCE IN THE POPULATION OF HERZEGOVINA-NERETVA CANTON INFLUENCED BY INVESTIGATED RISK FACTORS

Senad Medjedovic<sup>1</sup>, Dervis Deljo<sup>2</sup>, Aziz Sukalo<sup>2</sup>, Izet Masic<sup>3</sup><sup>1</sup>Cantonal Hospital Mostar, Mostar, Bosnia and Herzegovina<sup>2</sup>"Farmavita", Sarajevo, Bosnia and Herzegovina<sup>3</sup>Medical Faculty, University of Sarajevo, Sarajevo, Bosnia and Herzegovina

Corresponding author: Senad Medjedovic, Cantonal Hospital Mostar, Bosnia and Herzegovina

## ABSTRACT

**Introduction:** Stroke is a rapid loss of brain function due to disturbance blood flow to the brain. The existence of multiple risk factors, the length of their duration, and severity of each factor individually, is positively correlated with the occurrence of stroke. Stroke is the third cause of disability and premature death for men and women. **Aim:** The aim of this research is that through clinical and epidemiological studies the origin and development of stroke to inspect the same level of representation in the population of the Herzegovina-Neretva Canton. **Material and methods:** This survey covers the entire population of residents in the Herzegovina-Neretva Canton, and the number of patients who had a need for primary and secondary treating the symptoms of stroke. The very setting of this model of anthropological research modern human groups and theoretical estimates of the impact of genetic and / or environmental risk factors in the formation of phenotypic expression of complex traits of stroke, at the population level, resulted in the realization of the very methodology of this research. The study was conducted at the Department of Neurology, Regional Medical Center (RMC) "Dr. Safet Mujic" and the Department of Neurology, Clinical Center Mostar. These two health institutions, in addition to primary care are at the disposal for entire population of the Herzegovina-Neretva Canton and beyond. Data were collected by examining the details of the history of the board of hospitalized patients in the period from 1 January 2010–to 31 December 2014. The processed are 10 risk factors–potential causes of stroke. We also as research material, used records of hospital morbidity–the disease-illness statistics form (form number: 03-21-61; 03/02/60; 03/02/61; 09/03/60). **Results:** In our study, stroke is the second most frequent in the period of investigation, and noted the rapid growth that is in 2010 and 10.21% to 14.52% in 2014. There was a slight statistically significant differences in relation to the number of infected men and women, and the same is in favor of the patients are female. The number of patients with ischemic stroke, 954 of them or 48.38% was male and 1,018 or 51.62% were female. Of the 10 possible risk factors, factor 6 has a statistically significant canonical factor value, of which hypertension–CVI and the level of  $P = 0009^*$ ,  $p =$  secondary hypertension,  $0034^*$ , hypertensive heart disease,  $p =$ ,  $0021^*$ , Diabetes mellitus of  $P = 0029^*$ ,  $p =$  Anemia,  $0052^*$  and C-reactive protein (CRP) of  $p = 0049^*$ , respectively, these canonical factors carry the entire amount of information about the relations impact of certain risk factors in the onset and development of the brain shock. **Conclusion:** We conclude that there is a statistically significant correlation between the studied risk factors in the genesis of the origin and development of different types of stroke. **Key words:** stroke, risk factors, Herzegovina-Neretva Canton.

## 1. INTRODUCTION

Stroke (cerebrovascular accident, CVI, brain apoplexy) is a rapid loss of brain function due to disturbance of blood flow to the brain. It is a disease of the brain parenchyma, resulting from disorders of cerebral circulation, regardless of whether the disorder is the result of processes in the brain or is disturbed cerebral circulation result of diseases of other organs or organ

systems or it is caused by the action of disparate physical and chemical agents (1, 2).

The incidence in Europe ranges from 2-4% in some countries up to 8%, while the mortality of the same is around 25%. Despite diagnostic and therapeutic advances, today CV disease is the third cause of death in the world (after the cardiac–heart disease and cancer), and at the second place as a cause of dis-

ability (after trauma–injuries) (3, 4).

Risk factors for stroke can be classified into three groups: those that cannot be influenced (aging, gender, racial heritage, ethnicity); which can be influenced (hypertension, cigarette smoking, diabetes, obesity, stress) and the under-confirmed (abuse of alcohol, blood coagulation disorder, impaired fibrinolysis, platelet hyperaggregability, hormones) (4, 5).

The existence of multiple risk factors, the length of their duration and severity of each factor individually, is positively correlated with the occurrence of stroke. Stroke is the third cause of disability and premature death for men and women. Mental, physical and social consequences of stroke can be large. These sequences decreased physical activity of patients, and increase the risk of developing a new stroke or cardiovascular disease. Prevention of stroke remains a major medical and social problem (6-11). Further investigation is needed to risk factors for stroke, as well as measures of primary and secondary prevention.

**2. GOAL**

The goal of this research is that through clinical and epidemiological studies of the origin and development of stroke examine the level of stroke representation in the population of the Herzegovina-Neretva Canton.

**3. MATERIAL AND METHODS**

**3.1. Sample**

This survey covers the entire population of residents in the Herzegovina-Neretva Canton, or the number of patients who had a need for primary and secondary treatment of stroke symptoms (CVI or stroke), as well as those patients who were treated due to risk factors directly or indirectly associated with the development and emergence of cerebrovascular accident (stroke).

The research was conducted at the Department of Neurology, Regional Medical Center (RMC) “Dr. Safet Mujic” and the Department of Neurology, Clinical Centre Mostar. These two health institutions, in addition to primary care are responsible for the entire population of the Herzegovina-Neretva Canton and beyond.

Data were collected by examining the details of the history of the hospitalized patients in the period from 1 January 2010–to 31 December 2014.

In total 10 risk factors are processed–potential causes of stroke. We also as research material, used records of hospital morbidity–the disease-illness statistics form (form number: 03-21-61; 03/02/60; 03/02/61; 09/03/60).

**3.2. Methods**

This study is a clinical-epidemiological on the origin and development of stroke and the importance of prevention in the Herzegovina-Neretva Canton (Federation of Bosnia and Herzegovina, B&H).

The very setting of this model of anthropological research in modern human groups and theoretical estimates of the impact of genetic and/or environmental risk factors in the formation of phenotypic expression of complex traits of stroke, at the population level, resulted in the selection of methodology for this research.

**3.3. Statistical analysis**

Statistical analysis of the data was done with the software package for statistical and mathematical processing SPSS 17 and SPSS 20.

The following analysis was performed: A multivariate (MANOVA) and (ANOVA) variance analysis, Roy’s t-test, Pearson’s contingency coefficient (X) and multiple correlation coefficient (R) and canonical correlation analysis.

**4. RESULTS**

Presented is demographic and health status of the studied population in relation to the number of citizens in municipalities and biological type of population, with a brief reference to the birth rate, mortality and population growth of the Herzegovina-Neretva Canton in 2010 and 2014.

Municipality	Total number of inhabitants	0-14 years (%)	15-64 years (%)	65 years and over (%)
Čitluk	15761	20.3	65.1	14.5
Mostar	111364	16.6	65.5	17.8
Čapljina	23050	16.6	65.6	17.8
Jablanica	11784	16.3	70.0	13.7
Konjic	28266	17.3	67.2	15.4
Neum	4542	11.8	69.5	18.6
Prozor/Rama	16 984	17.7	69.4	12.9
Ravno	1433	1.6	68.2	30.1
Stolac	13084	11.1	69.3	19.5
Total	225268	16.5	66.5	17.0

Table 1. Demographic indicators and biological type of population of Herzegovina–Neretva Canton in 2010

Municipality	Total number of inhabitants	0-14 years (%)	15-64 years (%)	65 years and over (%)
Čapljina	22874	16.5	66.0	17.5
Čitluk	15833	20.4	64.7	14.9
Jablanica	11612	14.3	72.0	13.7
Konjic	27566	16.4	67.0	15.6
Mostar	112103	16.5	66.1	17.4
Neum	4403	10.1	70.8	19.0
Prozor/Rama	15738	16.7	70.2	13.0
Ravno	1432	0.8	69.2	29.9
Stolac	13001	10.2	70.5	19.3
Total	224562	15.9	67.2	16.9

Table 2. Demographic indicators and biological type of population in Herzegovina–Neretva Canton in 2014

We followed the regression and situational character of the population and therefore by comparing age groups in 2010, in the framework of biological type of population we can say that the obtained indicators show: population growth in the area of Herzegovina/Neretva Canton (HNC) in 2013 was -1.2 % which is a very low birth rate. So we can conclude that in 2013 the mortality rate is higher than natality in the following municipalities: Neum (-7.7%), Čapljina (-4.1%), Konjic (-3.1%), Jablanica (-1, 6%), Ravno (-1.4%) and Mostar (-0.2%), which certainly has the effect of negative values of natural growth. In terms of statistical indicators for Prozor-Rama, we can say that this municipality in the HNC is the only one with positive population growth rate, which is 0.4.

Stroke is the second most frequent in the studied period with

Cause of death	2010	%	2011	%	2012	%	2013	%	2014	%
Diseases, states, injuries	Structure index %	specific mortality rate /1000	Structure index %	specific mortality rate /1000	Structure index %	specific mortality rate /1000	Structure index %	specific mortality rate /1000	Structure index %	specific mortality rate /1000
Diseases of the circulatory system (I00-I99)	59.0	5.9	58.8	5.6	59.01	5.4	59.8	6.02	61.4	6.09
Malignant neoplasms (C00-C99)	16.7	1.82	14.3	1.7	11.9	1.5	14.8	1.63	15.1	1.79
Symptoms, signs and abnormal clinical findings (R00-R99)	-	-	10.4	1.2	5.11	1.0	7.1	1.32	6.14	1.82
Respiratory diseases (J00-J99)	4.02	0.6	5.2	0.7	6.3	0.2	2.7	0.4	2.47	0.05
Endocrine and Metabolism Diseases (E00-E90)	1.46	0.22	1.6	0.4	2.8	0.5	2.8	0.9	3.9	0.8
Diseases of the digestive tract (K00-K93)	1.52	0.2	5.9	0.8	3.0	0.4	3.1	0.22	2.4	0.26
Other causes of death	17.3	1.65	5.8	0.7	11.88	1.47	9.7	1.3	8.95	1.33
Total	100%	10.39	100%	11.1	100%	10.47	100%	11.79	100%	12.14

Table 3- The causes of mortality, the index of structure and rates of specific mortality by groups of diseases in the population of the Herzegovina-Neretva Canton (2010–2014)

Diagnosis	Stroke		
	M	F	TOTAL
Gender			
No. of patients	N / %	N / %	N / %
Ischemic CVI	954 48.38	1018 51.62	1972 83.99
Hemorrhagic CVI	156 48.90	163 51.10	319 13.59
Ischemic-hemorrhagic CVI	30 52.63	27 47.37	57 2.43
Total	1140 48.56	1208 51.44	2348 100

Table 4. Representation of hospitalized patients by gender and type of stroke in patients with stroke in the whole researched period (2010 - 2014)

Linear combinations	Canonical R	Canonical R-sqr.	χ <sup>2</sup>	Df (n-1)	P
Dg. secondary hypertension	.958	.919	88.452	239	<b>.0034*</b>
Dg. Essential-prim. hypertension.	.731	.535	33.182	36	.6033
Dg. Hypertensive heart disease	.892	.817	76.351	199	.0021*
Dg. Hypertension-ischemic CVI	.449	.312	54.951	64	.0009*
Dg. Hypertension-hemorrhage CVI	.908	.873	79.952	167	.5040
Dg. Diabetes mellitus	.449	.202	37.951	39	<b>.0029*</b>
Dg. Hyperlipidemia	.449	.376	17.951	85	.4874
Dg. C-reactive protein (CRP)	.908	.873	79.952	167	.0049*
Dg. Hematocrit (HCT)	.449	.202	37.951	39	.3570
Dg. Anemia	.449	.376	17.951	85	.0052*

Table 5. The canonical correlation between the studied group of risk factors in relation to the formation and development of the type of stroke (cerebrovascular accident)

noted rapid growth which for 2010 amounted to 10.21% and up to 14.52% in 2014.

In terms of structure by gender, of the 2449 hospitalized patients included in this study, a total of 1,163 patients are male, or 47.49% of the studied sample of respondents and 1,286 women, or 52.51% of the studied sample of respondents. There was a slight statistically significant difference in relation to the

number of affected men and women, and the same is in favor of female patients.

From the total number of patients with ischemic stroke 954 of them or 48.38% were male and 1,018 or 51.62% were female, which indicates that females were more exposed to this type of stroke.

From Table 5, which shows the canonical correlation between the risk factors and the emergence and development of stroke, shows that out of 10 risk factors, 6 factors have statistically significant value of canonical factor, of which hypertension—and CVI level p=0.0009, secondary hypertension p=0.0034, Hypertensive heart p=0.0021, Diabetes Mellitus p=0.0029, Anemia p=0.0052, and C-reactive protein (CRP) with p=0.0049, respectively, these canonical factors carry the entire amount of information about the relations impact of certain risk factors in the onset and development of stroke.

### 5. DISCUSSION

The main objective of this study was to perform clinical-epidemiological study on the origin and development of stroke and determine the importance of prevention in the population in the Herzegovina-Neretva Canton.

Stroke represents rapid loss of brain function due to disturbance blood flow to the brain. This problem dates back to the ancient times of human origin and at its origin was engaged a number of researchers who are trying to based on the results of research prevent, or reduce the occurrence of this disease. Investigated are the causes, consequences, therapeutic treatments as well as in the last period of preventive measures for the protection of the origin and development of stroke. Certainly a special place in the last several decades research have risk factors that are presumed to largely condition and contribute to the emergence and development of cerebrovascular accident (8, 9).

It is well known that the population age is very important demographic and health indicator. The age is determined by the biological type of population, which also represents a dynamic index of population age structure, or a parameter that generally characterizes the age structure of the population observed in our case in the Canton. In our study by comparing age groups within the biological type of population we get the following features: As in previous years the biological type of the population had a regressive character, which existed in inactive population, and reveals a slight decrease in the rate of these two population groups.

In terms of gender structure, of the 2449 hospitalized patients included in this study, a total of 1,163 patients are male, or 47.49% of the studied sample of respondents and 1,286 women, or 52.51% of the studied sample of respondents. There was a slight statistically significant difference in relation to the number of affected men and women, and the same is in favor of the female patients. The number of patients with ischemic stroke, 954 of them or 48.38% were male and 1,018 or 51.62% were female, which indicates that females were exposed somewhat more this type of stroke.

In our study we found that shows that out of 10 risk factors, 6 factors have statistically significant value of canonical factor, of which hypertension—and CVI level  $p=0.0009$ , secondary hypertension  $p=0.0034$ , Hypertensive heart  $p=0.0021$ , Diabetes Mellitus  $p=0.0029$ , Anemia  $p=0.0052$ , and C-reactive protein (CRP) with  $p=0.0049$ , respectively, these canonical factors carry the entire amount of information about the relations impact of certain risk factors in the onset and development of stroke.

Our findings are correlated with the results of other studies. In the Framingham study (1991), Wolf and colleagues pointed out that smoking is a significant risk factor in addition to hypertension and the risk of stroke increases with the number of cigarettes smoked (10). Jovicevic M. et al. (2003), in his study entitled "Risk factors for ischemic stroke in young people", according to a large morbidity and mortality of cerebral ischemia, as well as high rates of disability in survivors, requiring early detection and treatment of risk factors. Special attention was focused on the risk factors in patients under 45 years of age. The study included 30 patients with ischemic stroke aged 23–45 years (11). Compared to a half there were 22 (73.3%) males and 8 (26.7%). Among the most important risk factors established the existence of hereditary pattern in 12 (40%) patients, diabetes mellitus in three (10%), heart disease in 23 (76.6%), and of cerebrovascular in three (10%) patients. Smoking was found in 16 (53.3%) patients, and misuse of drugs and drug use has not been established in any of the patients. With regard to other risk factors pathologically altered serum lipid levels were found in 13 (43.3%) patients and obesity was a risk factor in 12 (40%) patients. None of the patients did not use oral contraceptives, or the history of our patients revealed information about migraine. Seven (23.3%) patients gave information about the increased consumption of alcoholic beverages. The international group of researchers at the University of Texas (2011), determined that daily intake of multivitamins does not reduce the risk of heart attack or stroke, which are the results of the 14,500 men for more than 10 years. Scientists have found that there is a small reduction in the risk of cancer in people taking vitamin supplements (12).

## 6. CONCLUSION

Descriptive statistical analysis of indicators and parameters of frequency in distribution presence of the morbidity (disease) in relation to the most frequent diagnosis of diseases among inhabitants of the Herzegovina-Neretva Canton (data from primary health institutions RMC "Dr Safet Mujic" and University Hospital Center "Bijeli brijeg" in Mostar, we concluded that in the study period 2010-201, compared to the most frequent diagnosis of diseases, stroke (cerebrovascular accident), occupies a very high place by the number of patients (163) relative to the leading diagnoses of hospital treatment.

Considering the causes of mortality by sex, based on indicators of primary health care, we have come to the conclusion that for females on the list of leading causes of death is stroke (163) with 17.1% of total mortality with increased index structure of total mortality compared the research period (from 16% in 2010 to 17.1 in 2014). We conclude that there is a statistically significant difference in the number of infected patients depending on gender and representation types of stroke (stroke) in the study period. "By establishing structure of relations between the couple's canonical factor, it can be concluded that there is a connection and interdependence of risk factors, and that it is direct and positive, which means that all the isolated risk factors connected to each other and are present in stroke. We conclude that there is a statistically significant relationship investigated the risk factors in the genesis of the origin and development of different types of stroke—(Cerebrovascular accident).

On the basis of previously been said, we can conclude that the results are a confirmation of the hypothesis of this study, which said results of clinical and epidemiological studies have shown a statistically significant representation of stroke—(Cerebrovascular accident), the population of the Herzegovina-Neretva Canton, under the influence of the investigated risk factors.

CONFLICT OF INTEREST: NONE DECLARED

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