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ORIGINAL ARTICLE

SEX DIFFERENCES IN CLINICAL PRESENTATION, SEVERITY AND OUTCOME IN PATIENTS WITH ACUTE ISCHEMIC STROKE; A PROSPECTIVE COHORT STUDY

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ABSTRACT

Background: Many differences between men and women are seen in the epidemiology, risk factors, clinical presentation, severity and outcome of stroke. **Aim:** To assess sex differences in clinical presentation, severity and outcome of stroke. **Subjects:** This prospective cohort study included 70 stroke patients (34 males and 35 females with age ranged from 30 to 90 years) during a period from April 2017 to September 2017. Written informed consent was obtained from all patients recruited or written assent from a relative. **Methods:** All patients were assessed according to detailed medical history and complete general and neurological examination. Glasgow Coma Scale was used to assess level of consciousness. Initial evaluation of stroke severity was assessed by using National Institute of Health Stroke Scale (NIHSS). Modified Rankin Scale (mRS) was used for assessing the extent of disability. Laboratory investigations included full routine laboratory investigations at admission and radiological investigations included brain computed tomography and magnetic resonance imaging. Twelve-Leads electrocardiogram was done to all patients. **Results:** There was a highly statistically significant difference regarding to smoking habit (men were more smokers) while there were statistically significant difference regarding to the presence of atrial fibrillation (AF) and obesity as females had more AF and more obese. Women as well had more a statistically significant severe strokes and worse outcome using NIHSS and stroke outcome by using mRS. Females had more severe strokes and worse outcome. **Conclusion:** Sex is one of the fundamental factors for stroke severity and outcome.

Key Words: stroke, sex, NIHSS, mRS, outcome, severity

INTRODUCTION

Many differences between men and women are seen in the epidemiology, risk factors, clinical presentation, severity and outcome of stroke**.** Analysis of the epidemiological data indicates that stroke is a sexually dimorphic disease[(1)].

Men experience a higher risk of stroke over most of the life span, with several notable exceptions. There is a stroke surge in women between the ages of 19 and 30 years, associated with the peripartum[(2)] and a second increase in risk in women between 45 and 54 years of age, in the peri-menopause[(3)].

There are sex differences regarding to traditional stroke risk factors. Women are more likely to experience after menopause more incidence of hypertension, diabetes mellitus (DM), atrial fibrillation (AF), and obesity, and more likely to have a family history of stroke[(4)] as well ,while men are more likely to have a history of heart disease, myocardial infarction, peripheral arterial disease, current smoking, and alcohol consumption[(5)].

Women are reported to experience more aphasic disorders, visual field disturbances and dysphagia than men while there have been no reported differences in either motor

or sensory deficits[6]. Furthermore, stroke in women is more frequently associated with anterior circulation ischemia, while men are more likely to have cerebellar and brainstem symptoms and higher incidences of posterior circulation syndromes than women[7].

Women have increased stroke severity compared to men, as measured using the National Institute of Health Stroke Scale (NIHSS) at admission and more disabled in functional activities during the acute phase of stroke and at 3 months post-stroke[8].Women are more likely to have depression after stroke which can impair recovery and quality of life[9].

The aim of the study is to understand potential sex-related differences in stroke incidence, risk factors, clinical presentation, severity and outcome of stroke and to be aware of the different burden of cerebrovascular stroke disease in women and men.

PATIENTS AND METHODS

This prospective cohort study was conducted on 70 patients in the intensive care and stroke units, Neurology Department, Zagazig University Hospitals during a period from April 2017 to September 2017.

The study was approved by the research ethical committee of Faculty of Medicine, Zagazig University (ZU-IRB #3387/2-2017). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

The patients were divided according to sex into two groups:

Group "A" which includes (34) male patients.

Group "B" which includes (36) female patients.

Inclusion criteria: Acute ischemic stroke patients from both genders with age above 18 years old. **Exclusion criteria:** The following conditions were excluded: Head injury, acute hemorrhagic stroke, brain tumors, CNS infections, stroke patients with metabolic emergencies, stroke patients with uncompensated system failure, dementia or patients who required assistance in their daily life before stroke.The ethical consideration: According to ethical rules of institutional review board (IRB) Informed consent from patients or their relatives about the study was obtained and no harmful maneuvers performed or used for any patients.

Methods:

All patients were subjected to the following: Detailed medical history with special attention to past medical history obtained from the patients or their relatives to establish the presence of any risk factor: hypertension, DM, dyslipidemia, smoking, cardiac diseases, hyperuricemia, alcohol drinking and obesity which was assessed by Body Mass Index (BMI).Full general examination. Thorough neurological examination. The following scales were used to assess the level of consciousness, stroke severity, follow up and short-term outcome of stroke: The Glasgow Coma Scale (GCS)[10], National Institutes of Health Stroke Scale (NIHSS)[11], modified Rankin Scale (mRS)[12], Trial of Org 10172 in Acute Stroke Treatment (TOAST)[13] and the Oxfordshire Community Stroke Project[14].

Full routine laboratory investigations including complete blood count, liver and kidney function tests, plasma glucose assessment, lipid and coagulation profiles were done in Zagazig University Hospitals laboratories. Cardiac investigations including 12 Leads electrocardiogram and echocardiography to detect cardiac causes of stroke. Carotid doppler ultrasonography was done in Cardiology department, Zagazig University Hospitals during hospitalization. Radiological investigations including computed tomography (CT) scan of the brain (using Philips system with 4.8 scanning time and 512 x 512 matrix size) and/or Magnetic Resonance Imaging (MRI) of the brain with diffusion weighted image were done in Radiology department, Zagazig University Hospitals.

Statistical analysis:

All data were analyzed using SPSS 22.0 for windows (IBM 2013). Continuous variables were expressed as the mean ± SD and median (range), and the categorical variables were expressed as a number (percentage).

The Chi-square test was used for comparing categorical variables. Fisher's

exact test is used when you want to conduct a chi-square test but one or more of the cells have an expected frequency of five or less.

For all above mentioned statistical test done, the threshold of significance is fixed at 5% level (P value).

RESULTS

This study included 70 patients, 34 males and 36 females.

The following risk factors were more common in males than females: smoking (highly significant), hypertension [(non-significant (NS)] and dyslipidemia (NS). The following risk factors were more common in females: TIA (NS), previous stroke (NS), DM, (NS), atrial fibrillation (AF) [(significant (S)], uric acid (NS) and obesity (S) (table 1).

In our study, we found that females had more posterior circulation infarction (POCI) than males (33% vs. 11.8%). Males had lacunar infarction (LACI) more than females (17.6% vs. 11.1%). Males had total anterior circulation infarction (TACI) and partial anterior circulation infarction (PACI) more than females (35.3% vs. 27.8% respectively) **(figure 1)**.

According to TOAST classification, females had large artery atherosclerosis more than males (35.7% vs. 31.25%). Also, females had cardio-embolic strokes more than males (32.15% vs. 18.75). Males had small artery atherosclerosis more than females (25% vs. 14.3%) **(figure 2)**.

In our study, the mean body mass index (BMI) in males was (23.13 ± 3.21) while in females it was (24.38 ± 3.41). The mean systolic blood pressure in males was (145.44 ± 21.47) while in females it was (141.80 ± 23.08). The mean diastolic blood pressure in males was (89.70 ± 12.36) while in females (89.55 ± 13.03). The mean NIHSS in males at stroke onset was (14.88 ± 5.09) with a range (5-23) while in females it was (17.19 ± 7.66) with a range (2-38) **(table 1)**.

The mean random blood glucose for males was (153.73 ± 74.32) while in females was (184.86 ± 103.62). The mean cholesterol level in males was 188.05 ± 33.71 while in females was 181.05 ± 50.76. The mean uric acid level in males was (6.07 ± 1.67) while in females (5.72 ± 2.28) **(table 2)**.

The mean NIHSS for males after 7 days of stroke onset was (12.82 ± 6.22) with a range (2-24) while in females was (15.94 ± 8.27) with a range (1-40). The mean mRS in males was (3.55 ± 1.05) while in females was (3.38 ± 1.17) **(table 3)**.

Table (4) shows that the mean mRS in females was higher at 3 months follow up with a mean (3 ± 1.41) while in males was (2.79 ± 1.22).

Table (5) shows that there was statistically significant difference in NIHSS between males and females at stroke onset and after 7 days. Also, there was statistically significant difference between males and females in mRS at 7 days from stroke onset and at 3 months follow up.

Table (1): Comparison between males and females as regard risk factors for stroke

Risk factors for stroke	Males		Females		p-value (sig.)
	No.	%	No.	%	
Smoking					
No	13	38.2%	33	91.7%	**<0.001****
Yes	21	61.8%	3	8.3%	
Alcohol					
No	34	100%	36	100%	**1.000**
Yes	0	0%	0	0%	
Hypertension					
No	9	26.5%	13	36.1%	**0.385**
Yes	25	73.5%	23	63.9%	
Diabetes mellitus					
No	21	61.8%	20	55.6%	**0.598**

Risk factors for stroke	Males		Females		p-value (sig.)
	No.	%	No.	%	
Yes	13	38.2%	16	44.4%	
TIA					
No	28	82.4%	29	80.6%	**0.847**
Yes	6	17.6%	7	19.4%	
Previous stroke					
No	31	91.2%	32	88.9%	**1.000**
Yes	3	8.8%	4	11.1%	
AF					
No	28	82.4%	19	52.8%	**0.008***
Yes	6	17.6%	17	47.2%	**(S)**
Dyslipidemia					
No	19	55.9%	24	66.7%	**0.354**
Yes	15	44.1%	12	33.3%	
Hyperuricemia					
No	23	67.6%	19	52.8%	**0.231**
Yes	11	32.4%	17	47.2%	
Obesity					
No	24	70.6%	17	47.2%	**0.047***
Yes	10	29.4%	19	52.8%	**(S)**

* Significant ** Highly Significant
TIA, transient ischemic attack; AF, atrial fibrillation

Table (2): Comparison between males & females as regard **clinical data & laboratory findings at stroke onset**

	Males		Females	
	No.	%	**No.**	**%**
BMI (kg/m^2)				
Mean ± SD	23.13 ± 3.21		**24.38 ± 3.41**	
Average	23	67.6%	19	**52.8%**
Overweight	10	29.4%	16	**44.4%**
Obese	1	2.9%	1	**2.8%**
SBP (mmHg)				
Mean ± SD	145.44 ± 21.47		**141.80 ± 23.08**	
DBP(mmHg)				
Mean ± SD	89.70 ± 12.36		**89.55 ± 13.03**	
NIHSS				
Mean ± SD	14.88 ± 5.09		**17.19 ± 7.66**	
Laboratory findings	**Males**		**Females**	
Random Blood Sugar(mg/dl)				
Mean ± SD	153.73 ± 74.32		**184.86 ± 103.62**	
Cholesterol (mg/dl) Mean ± SD	188.05 ± 33.71		**181.05 ± 50.76**	
Uric acid (mg/dl)				
Mean ± SD	6.07 ± 1.67		**5.72 ± 2.28**	

BMI, Body mass index; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; NIHSS, National Institute for Health Stroke Scale.

Table (3): Comparison between males and females as regard **clinical data at 7 days after stroke onset.**

Clinical data at 7 days after stroke onset	Males		Females	
	No.	%	No.	%
NIHSS				
Mean ± SD	12.82 ± 6.22		**15.94 ± 8.27**	
mRS				
Mean ± SD	3.55 ± 1.05		**3.38 ± 1.17**	
1	3	8.8%	**4**	**11.1%**
2	1	2.9%	**1**	**2.8%**
3	8	23.5%	**15**	**41.7%**
4	18	52.9%	**9**	**25%**
5	4	11.8%	**7**	**19.4%**

NIHSS, National Institute for Health Stroke Scale**;** mRS, Modified Rankin Score**.**

Table (4): Comparison between males and females as regard **clinical data at 3 months after stroke onset.**

Clinical data at 3 months after stroke onset.	Males		Females	
	No.	%	No.	%
mRS				
Mean ± SD	2.79 ± 1.22		**3 ± 1.41**	
0	2	5.9%	**2**	**5.6%**
1	2	5.9%	**2**	**5.6%**
2	7	20.6%	**8**	**22.2%**
3	16	47.1%	**13**	**36.1%**
4	5	14.7%	**6**	**16.7%**
5	1	2.9%	**3**	**8.3%**
6	1	2.9%	**2**	**5.6%**

mRS, Modified Rankin Score.

Table (5): Comparison between males and females as regard difference and percent **change** of **National Institutes of Health Stroke Scale (NIHSS) and Modified Rankin Scale (mRS).**

	Males	Females	p-value (sig.)
NIHSS difference			
Mean ± SD	-2.05 ± 2.42	**-1.25 ± 1.84**	**0.029***
NIHSS % change			
Mean ± SD	-19.09 ± 22.68	**-10.89 ± 12.87**	**0.070**
mRs difference			
Mean ± SD	-0.76 ± 0.65	**-0.38 ± 0.80**	**0.025***
mRS % change			
Mean ± SD	-25.09 ± 26.22	**-14.62 ± 29.23**	**0.059**

* Significant
NIHSS, National Institutes of Health Stroke Scale Difference = after 7 days – At onset
NIHSS Percent change = (Difference/at onset) x100.
mRs, Modified Rankin Scale Difference = After 3 months – At 7 days
mRs Percent change = (Difference/At 7 days) x100.

Figure (1): Comparison between males and females as regard stroke syndromes according to OxfordShire Community classification in studied stroke patients.

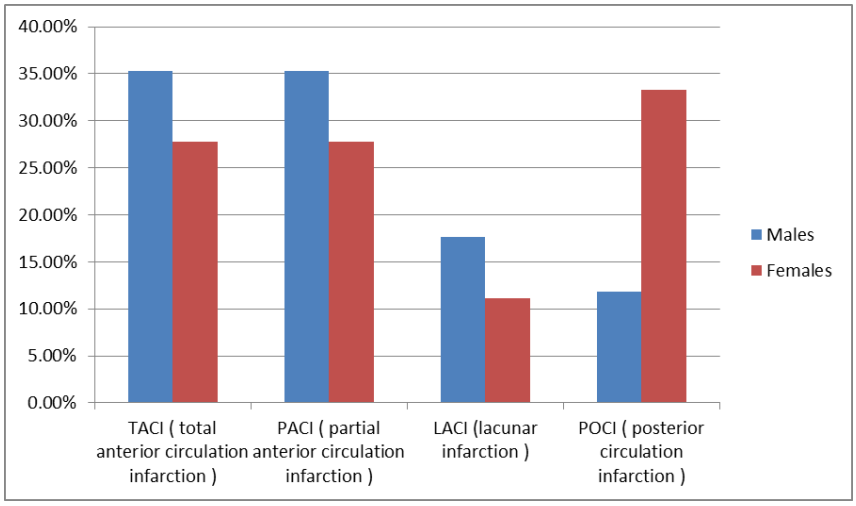
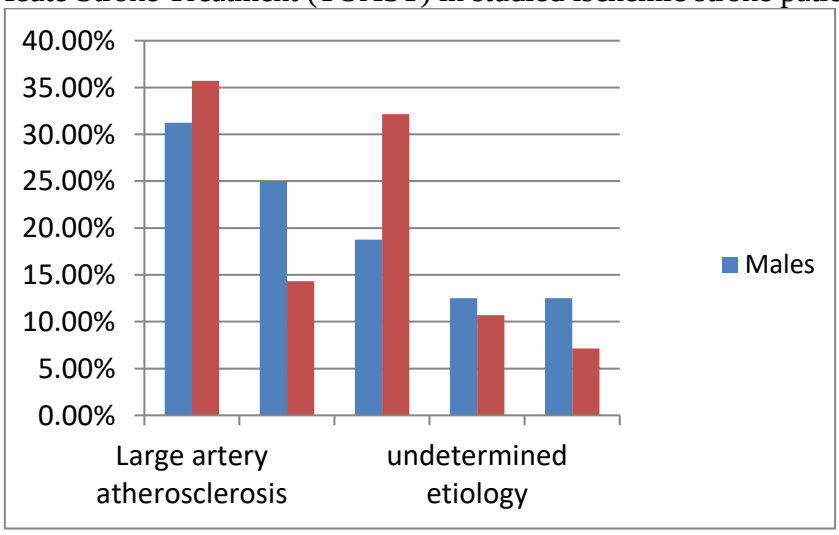


Figure (2): Comparison between males and females as regard infarction subtypes according to Trial of Org 10172 in Acute Stroke Treatment (TOAST) in studied ischemic stroke patients



DISCUSSION

Stroke is the third most prevalent cause of death after heart disease and cancer, and is the leading cause of long term disability[(15)].

Women increasingly outnumber men in the elderly population, the period of highest risk for stroke. However, there is also a growing recognition that major sex differences in ischemic sensitivity. Also exposure to sex hormones has a big impact on coagulation and fibrinolysis, key factors in the initiation of thrombosis[(16)].

As regarding **stroke risk factors** in this work **(table 1)**, we found that men were slightly more **hypertensive** than women (73.5% vs. 63.9%) but the difference was not statistically significant (P=0.385). **Mozaffarian et al.**[(17)] said that although both men and women develop hypertension, men have a higher incidence of hypertension compared with women of the same age until the sixth decade of life. A study recently done by **Ahangar et al.**[(18)] showed that among 230 stroke patients hypertension was significantly more prevalent in men.

On the contrast to our study, **Yuehua et al.**[(19)] reported that among 2864 stroke patients, hypertension was more frequently encountered as a pre-stroke comorbidity in older women than men (85.66% vs. 78.45).

In our study, men were more **smokers** than women (61.8% vs. 8.3) the difference

was highly significant (p<0.001). **Peters et al.**[20] stated that the risk of stroke in men and women who smoked was (67% and 83% respectively) which was greater compared with nonsmoking individuals.

In our study, men were more **dyslipidemic** than women the difference was not significant (p=0.354). Similar results were reported by **Touzé and Rothwell**[5] who investigated 2566 stroke patients (1185 men and 1381 women) and found that 31.3% of men were dyslipidemic vs. 26.9% of women (p=0.01).

Another study done by **Maeda et al.**[21] on 33953 stroke patients including 13323 women demonstrated the opposite as women had elevated total cholesterol and LDL more than men (P<0.0001).

In our study, **DM** was more common in females than males 44.4% vs. 38.2% (P=0.598) but the difference was not statistically significant. Similar results by **Santalucia et al.**[22] who prospectively studied 1272 stroke patients (567 women and 705 men) with no significant difference in presence of DM between both sexes.

Gall et al.[4] studied 1316 stroke patients (585 men and 731 women) and found that 20% of men were diabetic and only 14 % of women were diabetic with statistically significant difference (P<0.01). **Maeda et al.**[21] showed that DM significantly more prevalent in men than women (P<0.0001).

On the other hand, a study in Taiwan by **Ong et al.**[23] conducted on 4278 stroke patients found that DM was statistically significant higher in women than their male counterparts (46.6% vs. 42.1% P<0.01).

Peters et al.[24] found that the excess risk of stroke associated with DM is significantly higher in women than men.

In this work, we found that **AF** was significantly higher in women than men (47.2% vs. 17.6%, P=0.008) that goes with various results obtained from **Ong et al.**[23] who concluded that AF was significantly higher in women more than men (P<0.01).

Also, **Santalucia et al.**[22] found that among 1272 stroke patients, AF was present in 29.1% of women and 21.2% of men (P<0.01).

Poli et al.[25] conducted a study on 780 patients with AF and found that there was a higher risk of stroke in anticoagulated AF women than in men.

As regard serum **uric acid** (UA), we found that men had elevated serum UA more than women (Mean±SD: 6.07±1.67 vs. 5.72±2.28 respectively) but the difference was not statistically significant. **Zhong et al.**[26] found that 1 mg/dL increase in UA levels was significantly associated with a 10% increased risk of stroke in men and an 11% increased risk in women. A nonlinear relationship was observed in men, whereas a linear relationship was found in women.

In contrast, **Kopel et al.**[27] showed that higher uric acid levels were more relevant with hypertension, DM, and metabolic syndrome in women than men.

Li et al.[28] explained how elevated uric acid can cause endothelial damage in both men and women by enhancing of lipid peroxidation and platelet adhesiveness, stimulating vascular smooth cell proliferation, causing vascular inflammation and accelerating atherosclerosis.

In our study, we found that women were more **obese** than men (52.8% vs. 29.4%) the difference was statistically significant. In an interesting study by **Campello et al.**[29]**,** they included 388 patients with ischemic stroke and said that the impact of abdominal obesity differed according to sex and android fat distribution. In women central obesity is less frequent but it appears to confer an increased risk of stroke. However, abdominal obesity in men, regardless of weight, would not be a risk indicator for stroke.

In our study, women had previous history of **transient Ischemic attacks** (TIAs) and **previous strokes** more often than men but the difference was not statistically significant. Similar results were reported by **Santalucia et al.**[22] who also didn't find significant difference between both sexes in presence of previous TIAs.

According to **OxfordShire Community classification of stroke syndromes**, we found that females had POCI

more than males (33% vs. 11.8%). Males had LACI more than females (17.6% vs. 11.1%). Men had TACI (35.3% vs. 27.8%) and PACI (35.3% vs. 27.8%) more than women.

That was against **Niewada et al.**[30] who prospectively studied 17370 ischemic stroke patients (8003 females and 9367 males) for 6 months and found that stroke in women was more frequently associated with anterior circulation ischemia.

However, **Barrett et al.**[31] performed a study on 276 patients (55% men vs. 45% women) and said that stroke subtype did not differ significantly between sexes (P=0.79).

The difference between these results can be explained by different sample sizes of the studied populations.

According to the **TOAST criteria**, in our study**,** females had cardioembolic strokes more than males (32.15% vs. 18.75). Males had small artery atherosclerosis more than females (25% vs. 14.3%). That is consistent with previous study done by **Stuart-Shor et al.**[32] on 1107 consecutive patients with acute ischemic stroke (54.9% females) and reported that women are more likely to have cardioembolic stroke and that men are more likely to have large artery atherosclerosis or small vessel disease. Whereas **Smith et al.**[33] found no sex difference in TOAST criteria.

In our study, females had more severe strokes as they had higher **NIHSS** scores at stroke onset [The mean±SD NIHSS in males at stroke onset was (14.88±5.09) while in females it was (17.19±7.66)] and showed less improvement in NIHSS scores after 7 days [The mean±SD NIHSS for males after 7 days of stroke onset was (12.82±6.22) while in females was (15.94±8.27)] so females needed more hospital stay than men. That goes with other studies done by **Gall et al.**[4] **and Smith et al.**[33] who reported that women had greater severity more than men. On the contrary, **Barrett et al.**[31] did not find sex differences regarding stroke severity**.**

Paciaroni et al.[34] explained the reason for increased stroke severity in women because women have a higher risk of thromboembolic complications from AF compared to men and cardio-embolic stroke is more severe than other stroke subtypes, the higher prevalence of AF among elderly women is more than likely to explain the increased stroke severity in women.

In our study, women had more change in **modified Rankin Scale (mRS)** scores at 3 months follow up than men (-14.62 ± 29.23 vs. -25.09 ± 26.22 respectively) indicating worse outcome and more dependency.

Kapral et al.[35] found that women who survive stroke have less favorable outcomes than their male counterparts and women are more likely to have physical impairments and limitations in activities of daily living.

CONCLUSION

Stroke has many factors affecting its clinical picture, severity and outcome. In this study we found that sex is one of the fundamental factors regarding this difference. Women had more severe strokes and worse outcome than men.

We recommend that clinicians should consider sex disparities regarding stroke while dealing with female patients as women tend to have more atypical symptoms at stroke onset.

We also recommend rehabilitation programs of female stroke patients to focus more on improving their physical functioning and to diagnose and treat depression nictitating development of the best rehabilitation recovery programs that gives more specific attention to the unique needs of women.

Competing interests

The authors declare that they have no competing interests.

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REFERENCES

1- **Turtzo LC and McCullough LD.** Sex Differences in Stroke. Cerebrovasc Dis 2010; 26: 462–474.

2- **Putaala J, Curtze S, Hiltunen S, Tolppanen H, Kaste M and Tatlisumakal T.** Causes of death and predictors of 5-year mortality in young adults after first-ever ischemic stroke: the Helsinki Young Stroke Registry. Stroke 2009; 40 (8): 2698-2703.

3- **Towfighi A, Saver JL, Engelhardt R and Ovbiagele B.** A midlife stroke surge among women in the United States. Neurology 2007; 69 (20): 1898-1904.

4- Gall SL, Donnan G, Dewey HM, Macdonell R, Sturm J, Gilligan A et al. Sex differences in presentation, severity, and management of stroke in a population-based study. Neurology 2010; 74(12): 975-981.

5- Touzé E and Rothwell PM. Sex Differences in Heritability of Ischemic Stroke (A Systematic Review and Meta-Analysis). Stroke 2008; 39:16-23.

6- Roquer J, Ana Rodríguez Campello and Meritxell Gomis. Sex Differences in First-Ever Acute Stroke: Stroke 2003; 34: 1581-1585.

7- Reid JM, Dai D, Gubitz GJ, Kapral MK, Christian C and Phillips SJ. Gender Differences in Stroke Examined in a 10-Year Cohort of Patients Admitted to a Canadian Teaching Hospital: Stroke 2008; 39:1090-1095.

8- Petrea RE, Beiser AS, Seshadri S, Kelly-Hayes M, Kase CS, and Wolf PA. Gender differences in stroke incidence and poststroke disability in the Framingham heart study. Stroke 2009; 40 (4): 1032-1037.

9- Gray LJ, Sprigg N, Bath PMW, Boysen G, De Deyn PP, Leys D et al. Sex Differences in Quality of Life in Stroke Survivors Data From the Tinzaparin in Acute Ischaemic Stroke Trial (TAIST). Stroke 2007; 38: 2960-2964.

10- Teasdale G and Jennett B. Assessment of coma and impaired consciousness. A practical scale. Lancet 1974; 304(7872): 81-84.

11- Fonarow GC, Saver JL, Smith EE, Broderick JP, Kleindorfer DO, Sacco RL et al. Relationship of national institutes of health stroke scale to 30-day mortality in medicare beneficiaries with acute ischemic stroke. J Am Heart Assoc 2012; 1(1):42-50.

12- Saposnik G, Di Legge S, Webster F and Hachinski V. Predictors of major neurologic improvement after thrombolysis in acute stroke. Neurology 2005; 65(8):1169-1174.

13- Pinto A, Tuttolomondo A, Di Raimondo D, Fernandez P and Licata G. Risk factors profile and clinical outcome of ischemic stroke patients admitted in a Department of Internal Medicine and classified by TOAST classification. Int Angiol 2006; 25(3):261-267.

14- Bamford J, Sandercock P, Dennis M, Burn J and Warlow C. Classification and natural history of clinically identifiable subtypes of brain infarction. Lancet 1991; 337:1521–1526.

15- Lloyd-Jones D, Adams RJ, Brown TM, Mercedes CA, Shifan DA, Giovanni DE et al. Executive summary: Heart disease and FU stroke statistics 2010 update: A report from the American Heart Association. Circulation 2010; 121: 948-954.

16- Meaghan Roy-O'Reilly and Louise D. Sex Differences in Stroke: The Contribution of Coagulation. Exp Neurol 2014; 259: 16-27.

17- Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M et al. Heart Disease and Stroke Statistics-2016 Update: A Report From the American Heart Association Circulation 2016; 133(4): e38-360.

18- Ahangar AA, Saadat P, Heidari B, Taheri ST and Alijanpour S. Sex difference in types and distribution of risk factors in ischemic and hemorrhagic stroke. SAGE Journals 2018; 13(1):83-86.

19- Yuehua Pu, Liu L, Wang Y, Zou X, Pan Y, Soo Y et al. Geographic and sex difference in the distribution of intracranial atherosclerosis in China. Stroke 2013; 44(8):2109-2114.

20- Peters SA, Huxley RR and Woodward M. Smoking as a risk factor for stroke in women compared with men: a systematic review and meta-analysis of 81 cohorts, including 3,980,359 individuals and 42,401 strokes. Stroke 2013; 44(10): 2821-2828.

21- Maeda K, Toyoda K, Minematsu K and Kobayashi S. Effects of sex difference on clinical features of acute ischemic stroke in Japan. J Stroke Cerebrovasc Dis 2013; 22(7):1070-1075.

22- Santalucia P. Pezzella FR, Sessa M, Monaco S, Torgano G, Anticoli S, et al. Sex differences in clinical presentation, severity and outcome of stroke: Results from a hospital-based registry. European Journal of Internal Medicine 2013; 24(2): 167-171.

23- Ong C, Wong Y, Sung S, Wu C, Hsu Y, Su Y et al. Sex-related differences in the risk factors for in-hospital mortality and outcomes of ischemic stroke patients in rural areas of Taiwan. PLoS One 2017; 12(9): e0185361.

24- Peters SA, Huxley RR and Woodward M. Diabetes as risk factor for incident coronary heart disease in women compared with men. Diabetologia 2014; 57 (8): 1542–1551.

25- Poli D, Antonucci E, Grifoni E, Abbate R, Gensini GF and Prisco D. Gender differences in stroke risk of atrial fibrillation patients on oral anticoagulant treatment. Thromb Haemost 2009; 101: 938–942.

26- Zhong C, Zhong X, Xu T, Xu T and Zhang Y. Sex-Specific Relationship Between Serum Uric Acid and Risk of Stroke: A Dose-Response Meta-Analysis of Prospective Studies. J Am Heart Assoc 2017; 6(4): e005042.

27- Kopel E, Kivity S, Steinlauf S, Segev S, Sidi Y and Olchovsky D. The association between serum uric acid and diabetes mellitus is stronger in women. J Womens Health (Larchmt) 2013; 22(9): 782-789.

28- Li M, Hou W, Zhang X, Hu L and Tang Z. Hyperuricemia and risk of stroke: a systematic review and meta-analysis of prospective studies. Atherosclerosis 2016; 232(2): 265-270.

29- Campello RA, Jiménez-Conde J, Ois Á, Cuadrado-Godia E, Giralt-Steinhauer E, Vivanco RM et al. Sex-related differences in abdominal obesity impact on ischemic stroke risk. Eur J Neurol 2017; 24(2): 397-403.

30- Niewada M, Kobayashi A, Sandercock PAG, Kamiński B and Członkowska A. Influence of Gender on Baseline Features and Clinical Outcomes among 17,370 Patients with Confirmed Ischaemic Stroke in the International Stroke Trial. Neuroepidemiology 2005; 24: 123–128.

31- Barrett KM, Brott TG, Brown RD Jr, Frankel MR, Worrall BB, Silliman SL et al. Sex Differences in Stroke Severity, Symptoms, and Deficits After First-ever Ischemic Stroke. Journal of Stroke and Cerebrovascular Diseases 2007; 16(1): 34-39.

32- Stuart-Shor EM, Wellenius GA, DelloIacono DM, Mittleman MA. Gender differences in presenting and prodromal stroke symptoms. Stroke 2009; 40(4): 1121-1126.

33- Smith EE, Olson DM, Fonarow GC, Reeves MJ, Zhao X, Saver JL et al. Age-related differences in characteristics, performance measures, treatment trends, and outcomes in patients with ischemic stroke. Circulation 2010; 121(7): 879-891.

34- Paciaroni M, Billeci AMR, Maurizio CS and Agnelli G. Hormone Replacement Therapy and Stroke. Current Vascular Pharmacology 2008; 6(2): 112-123.

35- Kapral MK, Fang J, Hill MD, Silver F, Richards J, Jaigobin C et al. Sex Differences in Stroke Care and Outcomes: Stroke 2005; 36: 809-814.

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