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Risk Factors in Acute Stroke Patients With and Without Sleep Apnea

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ABSTRACT

Background: More than 50% of stroke patients have sleep-disordered breathing (SDB), mostly in the form of obstructive sleep apnea (OSA). SDB represents both a risk factor and a consequence of stroke. The presence of SDB has been linked with the poorer long-term outcome and increased long-term stroke mortality. About 20 to 40% of stroke patients have sleep-wake disorders (SWD), mostly in form of insomnia, excessive daytime sleepiness/fatigue, or hypersomnia (increased sleep needs). **Objective:** The aim of this study was to analyze the frequency of risk factors in patients with acute stroke and sleep apnea. **Methods:** The study included patients without cognitive impairment or with mild cognitive impairment. The diagnosis of apnea syndrome was made on the basis of the Snoring and Apnea Syndrome Questionnaire, the Epworth Sleep Scale, the Berlin Questionnaire, the Stanford Sleepiness Scale, and the General Sleep Questionnaire. The severity of stroke was assessed by the National Institutes of Health Stroke Scale and the Rankin Disability Scale. Patients with a Glasgow score <8 on the day of neuropsychiatric examination were excluded from the study, as well as patients with epileptic seizures at the onset of stroke, with aphasia, with Mini- mental test <23, with verified previous dementia / cognitive impairment. **Results:** There is no statistically significant difference in the age of men and women, both with apnea and without apnea. In patients with apnea, heart disease was in the first place 91.8%, followed by hypertension 86.4%, Body mass index 79.1%, hyperlipidemia 50%, smoking 38.2 % and diabetes mellitus 20.9%. Hypertension was the most common risk factor in patients without apnea 83.6%, followed by heart disease 81.0%, Body mass index 60.9%, hyperlipidemia 48.21%, smoking 28.2 % and diabetes mellitus 20%. **Conclusion:** Heart diseases, hypertension and body mass index are significantly more frequent in patients with than in patients without sleep apnea.

Keywords: Stroke, Sleep apnea, Risk Factors.

1. BACKGROUND

More than 50% of stroke patients have sleep-disordered breathing (SDB), mostly in the form of obstructive sleep apnea (OSA). SDB represents both a risk factor and a consequence of stroke. The presence of SDB has been linked with the poorer long-term outcome and increased long-term stroke mortality. About 20 to 40% of stroke patients have sleep-wake disorders (SWD), mostly in form of insomnia, excessive daytime sleepiness/fatigue, or hypersomnia (increased sleep needs). Brain damage per se, often at the thalamic or brainstem level, can be also a cause of persisting SWD (1).

Sleep apnea and/or habitual snoring began to be recognised as independent risk factors for arterial hypertension (HTN), cardiac arrhythmias, coronary artery disease, myocardial infarction, and ischemic stroke (2) only during late 20th century. Males had a higher percentage of SDB (AHI>10) than females (65% vs 48%, respectively). Patients with recurrent strokes had a higher percentage of SDB than patients with first stroke (74% vs 57% respectively) (3). Apneas during sleep (sleep apnea-SA) are present in about 1% of the total population.

Aging increases the prevalence of SA and it is three times more often in older than 40 years of age. In the adults, obstructive sleep apnea (OSA) is much more often in comparison to central sleep apnea (CSA) (84% vs. 0.4%). Mixed sleep apnea (MSA) is a combination of two forms and occurs in 15% of all population. SA is found in 50-70% of patients with stroke (4).

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2. OBJECTIVE

The aim of this study was to analyze the frequency of risk factors in patients with acute stroke and sleep apnea.

3. MATERIAL AND METHODS

This prospective study was conducted at the Clinic of Neurology of the University Clinical Center in Tuzla. The examined group of 100 patients in the acute phase of stroke sleep apnea (SA) was evaluated. Acute stroke has been diagnosed either by computed tomography and Magnetic resonance imaging of the brain. Average age was 65.13 ± 9.27 years. Among them it was 65 (59%) men. Number of patients with no apnea in control group was the same as well as gender ratio, with average age of 64 ± 8.69 years. There was no significant difference in patient's age with or without sleep apnea neither in men nor women.

The study group included patients who meet the following criteria: confirmation of diagnosis of ischemic stroke (IS) or hemorrhagic stroke (HS) by computed tomography (CT) and /or magnetic resonance imaging (MR) of the brain, pulmonary tests and neuropsychiatric assessment of sleep apnea performed within seven days after stroke, Mini - Mental test (MMT) >23 , Glasgow coma scale (GCS) >8 , written consent for participation in the research by the patient or a member of the patients immediate family. Patients with a Glasgow score <8 on the day of neuropsychiatric examination were excluded from the study, as well as patients with epileptic seizures at the onset of stroke, with aphasia, with MMT <23 , with verified previous dementia /cognitive impairment (based on hetero anamnestic data from patient relatives, data from previous medical findings and based on the Mini Mental test of patients with verified alcohol abuse (defined by at least 5 drinks per day). Neurological, neuropsychiatric, internist and pulmological tests were performed in all patients at five different time periods: the first test - in the acute phase of stroke (first week of stroke), second test - one month after the stroke, third test- three months after stroke, fourth test - six months after stroke and fifth test - twelve months after stroke. In these periods, all patients were evaluated: The National Institute of Health Stroke Scale (5), Mini - Mental Test (6), The Sleep and snoring Questionnaire Test (7), The Berlin Questionnaire Test (8), The Epworth Sleepiness Scale (9), The Stanford Sleepiness Scale (10) and the General sleep questionnaire (11). The findings of CT of the brain and MR of the brain were interpreted by a radiologist who was not familiar with the goals and hypotheses of the research and whose results established the following: type of stroke, localization of the lesion, and lesion size. The research included the registration of the following socio-demographic characteristics: gender and age.

Methods/ Instruments

Glasgow coma scale

Observation and examination included three areas that were ranked according to the given instructions and thus three scores were obtained, one for each area;

eye opening, best verbal response and motor response. These three scores were added into results which represents the Glasgow Coma Scale that ranges from 3 (most severe degree of coma) to 15 (normal consciousness). In relation to the brain lesion, the score is classified into three stages: severe lesion - if the score is 3 to 8, moderate lesion - if the score is 9-12 and mild lesion - if the score is 13 to 15.

Stroke Scale of the National Institutes of Health

Neurological deficit was measured by the NIHSS scale, a graded neurological scale that examined the state of consciousness, visual field defects, bulbo-motor and facial nerve function, motor and sensory impairment, ataxia, speech function, and neglect phenomenon. This scale is one of the most commonly used scales in research, but also in clinical work. The score ranged from 0 to 42, with the highest score indicating the most severe neurological deficit.

Mini-Mental State

In clinical practice, Mini-Mental State is the most widely used instrument for evaluating disorders of intellectual efficiency and the presence of intellectual deterioration. It has proven to be a valid, highly reliable test, sensitive to changes over time. It consists of examining different cognitive areas. The total score ranged from 0 (maximum cognitive deficit) to a maximum of 30 (no cognitive deficit). Different degrees of cognitive dysfunction (between these endpoints) correspond to the following scores: a score <10 - severe dementia, a score between 10 and 20 - moderate dementia, a score between 21 and 25 - mild dementia, score 26 which is a borderline score according to dementia and score >27 - no dementia.

The Sleep and Snoring Questionnaire Test

The Snoring and Sleep Apnea Questionnaire consists of 12 questions answered with yes or no. The scale was filled in by the examiner. Affirmative answers to questions 1, 3, 4, 8 and 9 are a high indicator for sleep apnea.

Berlin Questionnaire Test

The Berlin questionnaire included 10 questions on risk factors for sleep apnea, including body weight, snoring, breathing pauses, drowsiness on walking or during the day and hypertension. The scale was filled by the examiner by circling the offered answers. The ranking of the answers is gradual: 0 = never or almost never, 1 = 1 to 2 times a month, 2 = 1 to 2 times a week, 3 = 3 times a week and 4 = almost every day.

Epworth Sleepiness Scale

The Epworth scale is designed to identify sleep problems. It consists of 4 parts that analyze drowsiness, sleep apnea/snoring, narcolepsy and other disorders. Scoring and analysis were performed according to the attached key. The ranking of the answers is gradual: 1 = rarely or never, 2 = sometimes, 3 = often, 4 = mostly. The scale was filled in by the examiner.

Stanford Sleepiness Scale

The Stanford Sleepiness Scale is designed to self fatigue and measure drowsiness. It consists of 7 levels that describe the degree of drowsiness. It is used along with other scales when diagnosing sleep disorders and narco-

lepsy. If the patients score is above 3, he has serious sleep problems. The scale was filled by the examiner.

General sleep questionnaire

The General Sleep Questionnaire is adapted from the General Sleep Questionnaire and Vigilance Assessment from Stanford University which is also used at the Center for Sleep Disorders, New Jersey. This questionnaire contains the following data: socio demographic (name, age, gender, and occupation), sleep pattern data, daytime sleepiness, chronic somatic diseases, and health data.

The questionnaire has a total of 46 questions. The scale is filled in by the examiner with yes or no. The general questionnaire analyzed the following risk factors. Hypertension (systolic blood pressure > 140 mm Hg, or diastolic > 90 mm Hg or both), diagnosed at least two years before the stroke, or documented treatment of hypertension, heart disease (angina pectoris, myocardial infarction, arterial fibrillation, and consecutive heart failure) diagnosed by an internal medicine specialist or a cardiologist. Diabetes mellitus is defined by the use of drugs for diabetes before stroke or a documented blood glucose concentration > 7 mol /L, hyperlipidemia (if cholesterol >5, ALDL> 3 and triglycerides > 2, smoking at least 10 cigarettes per day for months, and body mass index (BMI), which represents the ratio of body weight of the patient (kg / m2) and whose value was included in four categories. BMI categories were: malnutrition <18.5, normal weight = 18.5 - 24.9, elevated = 25 - 29.9 and obesity ≥ 30.

Statistical analysis

Numerical test results were statistically processed, analyzed and compared, to obtain answers to questions formulated within the research objectives. From the basic descriptive statistical parameters, standard statistical methods were used for qualitative and quantitative evaluation of the obtained results: absolute numbers, relative numbers, arithmetic mean (X), standard deviation (SD), and range of values. When testing the statistical significance of main differences, the standard Student T-test was used. Descriptive statistics were processed using the X2 (Hi - square test) and the proportional test. When testing statistical hypotheses, a significance level of p <0.05 was taken. All calculations were performed using the Arcus Quickstadt Biomedical statistical data processing program as well as the long rank test with p < 0.05 considered significant. The research was approved by the Committee of the University Clinical Center Tuzla.

4. RESULTS

The study included 110 patients with verified sleep apnea-type breathing disorder (here in after apnea), mean

Sex	With apnea		Without apnea		t	p
	Age X	Age SD	Age X	Age SD		
Men	65.68	9.12	64.94	9.22	-0.46	0.65
Women	64.33	9.54	65.13	9.12	0.32	0.75
Total	65.13	9.27	64.94	8.69	-0.16	0.88

Table 1. Distribution of patients with and without apnea in relation to age and gender. X = arithmetic mean; SD = standard deviation

Age (years)	With apnea				Without apnea				Total			
	Men		Women		Men		Women		With		Without	
	N	%	N	%	N	%	N	%	N	%	N	%
41-50	1	1.5	3	6.6	2	3.1	3	6.6	4	3.6	5	4.5
51-60	16	24.6	12	26.7	15	23.1	12	26.7	28	25.5	27	24.5
61-70	26	40.0	18	40.0	27	41.5	18	40.0	44	40.0	45	41.0
>70	22	33.9	12	26.7	21	32.3	12	26.7	34	30.9	33	30.0
Total	65	100.0	45	100.0	65	100.0	45	100.0	110	100.0	110	100.0

Table 2. Distribution of patients with and without apnea in relation to age and gender. With apnea (t=0.75, p=0.46) Without apnea (t=0.27, p=0.79)

Risk factors	With apnea				Without apnea				Total			
	Men		Women		Men		Women		With		Without	
	N	%	N	%	N	%	N	%	N	%	N	%
Hypertension	55	84.6	40	88.9	60	92.3	32	71.1	95	86.4**	92	83.6
Heart diseases	57	87.6	44	97.8	61	93.8	28	62.2	101	91.8**	89	80.9
Diabetes	11	16.9	12	26.7	14	21.5	8	17.8	23	20.9	22	20.0
Hyperlipidemia	35	53.8	20	44.4	37	56.9	16	35.6	55	50.0	53	48.2
Smoking	30	46.2	12	26.7	29	44.6	2	4.4	42	38.2	31	28.2
BMI	54	83.1	33	73.3	46	70.7	21	46.7	87	79.1*	67	60.9

Table 3. Distribution of patients with and without apnea in relation to risk factors and gender. X2 (Hi-square test) ** Hypertension (X2=10.21, p=0.001) ** Heart diseases (X2=10.19, p=0.001) * Body mass index (BMI) (X2=7.81, p=0.005)

Risk factors	With apnea	Without apnea	X	P
Hypertension	95	92	10.21	0.001*
Heart diseases	101	89	10.19	0.001*
Diabetes	23	22	0.48	0.49
Hyperlipidemia	55	53	1.49	0.22
Smoking	42	31	3.54	0.06
BMI	87	67	7.81	0.005*

Table 4. The statistical significance of patients with and without sleep apnea compared to the risk factors. * Hypertension (X2=10.21, p=0.001) *(Heart disease X2=10.19, p=0.001) * Body mass index (BMI) (X2=7.81, p=0.005)

age 65.13 ± 9.27 years, most of whom were men (65 or 59%). The control group consisted of the same number of patients without apnea (n = 110), mean age 64.94 ± 8.69 years, with the same sex distribution (m = 65; f = 45). There is no statistically significant difference in the age of patients with and without apnea, neither in men (t = -0.46, p = 0.65) nor in women (t = 0.32, p = 0.75), nor in total men and women (t = -0.16, p = 0.88) (Table 1).

Most patients of both sexes with apnea were in the age group of 61–70 years 44 (40%), followed by the age group over 70 years 34 (31%). The mean age of men was 65.68 ± 9.12 (range 41 to 85) years, and women 64.33 ± 9.54 (range 41 to 85). Most patients without apnea were

in the age group 61–70 years 45 (41%), followed by the age group over 70 years 33 (30%). The mean age of men without apnea was 64.94 ± 9.22 (range 41 to 85) years, and women 65.13 ± 9.12 (range 41 to 85) years. There is no statistically significant difference in the age of men and women, both with apnea ($t = 0.75$, $p = 0.46$) and without apnea ($t = 0.27$, $p = 0.79$). The largest number of men with apnea belonged to the age group of 61-70 years (26 / 40.0%), followed by the age group over 70 years 22 (33.9%). The largest number of women belonged to the age group 61-70 years 18 (40%), followed by the age group over 70 years and from 51-60 years 12 (26.7%). The largest number of men without apnea belonged to the age group of 61-70 years 27 (41.5%), followed by the age group over 70 years 21 (32.3%). The largest number of women belonged to the age group of 61-70 years 18 (40%), followed by the age group over 70 years and from 51-60 years 12 (26.7%) (Table 2).

In the process of examining common risk factors in patients with stroke and sleep apnea, the following factors were analyzed: hypertension, heart disease (angina pectoris, myocardial infarction, atrial fibrillation and heart failure), diabetes mellitus, hyperlipidemia, smoking and body mass index (BMI). In patients with apnea, heart disease was in the first place in terms of dullness (101 / 91.8%), followed by hypertension (95 / 86.4%). In men with apnea, heart disease was the most common risk factor (57 / 87.6%), followed by hypertension (55 / 84.6%). In women with apnea, heart disease was also the most common risk factor (44 / 97.8%), followed by hypertension (40 / 88.9%). Hypertension was the most common risk factor in patients without apnea (92 / 83.6%), followed by heart disease (89 / 81.0%). In men without apnea, heart disease was the most common risk factor (61 / 93.8%), followed by hypertension (60 / 92.3%). In women without apnea, hypertension was the most common risk factor 32 (71.1%) followed by heart disease (28 / 62.2%) (Table 3).

Heart diseases (101/91.8%) ($X^2=10.19$, $p=0.001$), hypertension (95/86.4%) ($X^2=10.21$, $p=0.001$), and body mass index (BMI) >29 kg/m² (87/79.1%) ($X^2=7.81$, $p=0.005$) were significantly more frequent in patients with than without sleep apnea, while for the other risk factors there was no statistically significant difference (Table 4).

5. DISCUSSION

Sleep-disordered breathing (SDB) is more probably the cause rather than the consequence of stroke because of the following: apneas are essentially obstructive rather than central, the frequency of SDB is not different between transient ischemic attack and cerebral infarction, and previous excessive daytime sleepiness is significantly more frequent among stroke patients with SDB than those without. The presence of SDB in stroke patients could lead to a poor outcome. Experimental and clinical studies have shown that both short and long-term factors may play a role in increasing the susceptibility to stroke in patients with obstructive sleep apnea syndrome (12).

The mean age of patients in both groups in this study corresponds to the mean age of similar studies (13). Most studies have reported that the incidence of apnea and stroke increases with age. In a study by Ohayon et al. peak incidence was found in the age group with a range of 50 to 60 years and decreased incidence in the older age groups. According to age groups, most patients of both sexes with apnea were in the age group from 61 to 70 years 44 (40%), followed by the age group over 70 years 34 (31%) (14). Endeshaw et al. state that patients aged 57 and older are 3.5 times more likely to have apnea (15), while Young et al. state that patients in the age group of 70 to 80 years have almost twice the percentage of sleep-disordered breathing compared to patients up to 40 years of age (4). The majority of patients in our study were men 59%, which corresponds to the results of other studies because men are more susceptible to the occurrence of apnea due to the reduced threshold of carbon dioxide sensitivity compared to women (16). The difference between the sexes may be related to a greater distribution of body fat in the neck area in men than in women which is an important risk factor for narrowing and closing of the upper airways. Weight gain was verified in 50% of men (17). Ronen et al. in their study state that women have more stable upper airways than men (18). Young et al. state that men are twice as likely as women to have apnea, but this difference is not seen after menopause (19).

The most important role in reducing the incidence and mortality of stroke is the identification and treatment of potential risk factors. In the United States (USA), at least 5% of the general population has OSA. It is a risk factor for the development of systemic hypertension and poses an increased risk for coronary heart disease, and can also lead to congestive heart failure and acute IMU (20). The results of this study showed that in the first place, in terms of prevalence of the analyzed risk factors in patients with apnea, was heart disease (101/91.8%) while hypertension was the most common risk factor in patients without apnea (92/83.6%). The frequency of this risk factor in patients with and without apnea showed a significant difference.

Mehra et al. in Heart Health Study showed four times higher incidence of atrial fibrillation in patients with AHI >30 events/hour. Treatment of sleep apnea in these patients results in a significant reduction in risk (21). Several observational cohort studies have shown that treatment with continuous positive airway pressure (CPAP) reduces mortality. Data from a historical cohort study performed in Spain in which 871 patients diagnosed with OSAS between 1994 and 2000 were followed through 2001. The cohort was divided into 3 groups based upon their compliance with CPAP: >6 hr per night, 1-6 hr per night and <1 hr per night. At 5 years of follow-up, the group using their CPAP <1 hr/night had a significantly decreased survival (86%) compared to the group using their CPAP >6 hr (96%) and 1-6 hr (91%) per night (22). Wierzbick et al. found heart disease in 81% of patients with stroke, which is slightly lower than in this and the studies below. Analysis of this risk fac-

tor shows that the largest number of patients with heart disease, 12.5%, has a very serious degree of sleep-disordered breathing. Although there was a difference in the frequency of patients with and without the presence of heart disease, the analysis did not show a significant association between the presence of heart disease and the degree of sleep-disordered breathing (23). Several studies have shown the emergence of independent associations between OSA syndrome and cardiovascular disease, including arterial hypertension, ischemic heart disease, and stroke (24). Roebuck et al. state that patients with untreated OSA have a higher risk of recurrent atrial fibrillation, as opposed to treated CPAP, as do patients without apnea. The same authors state that high blood pressure, which is associated with sleep apnea, is a major cause of later heart failure (25).

The second risk factor in our study was hypertension in 95 (86.4%) with and 92 (83.6%) without apnea and the difference was significant. Treatment of hypertension leads to a 30% to 40% reduction in the risk of stroke (26). In this study, hypertension is in a slightly higher percentage compared to the study of Wierzbicka et al. where 43 patients, aged 68.5 ± 11.0 years, with a diagnosis of acute stroke were analyzed. Hypertension was verified in 67% of patients, but no significant difference was found between patients with and without apnea (23). Selic et al. in their study suggest that sleep apnea is an independent risk factor for arterial hypertension and is present in 50% to 70% of patients with ischemic stroke (27). In a study conducted at our Clinic, this risk factor was found in 81% of patients, which is close to our research (28). The prevalence of patients with hypertension in relation to four degrees of sleep disorders was also analyzed. A very serious degree of sleep disorder has been reported in 35% of patients with hypertension. Peppard et al. state that apnea is an independent risk factor for hypertension and that during 4 years of follow-up this risk is (odds ratio of 2.03 for AHI of 5-15 and 2.89 for AHI > 15) independent of other risk factors (29).

In third place in terms of the presence of risk factors in patients with anemia was elevated BMI in 87 (79.1%) patients, and without apnea 67 (60.9%). This difference is statistically significant ($X^2 = 7.81, p = 0.005$). Elwood et al. stated that patients who were registered in the sleep breathing disorders have a higher BMI, corresponding to the results of our study (30). Newman et al. showed that men with a weight of more than 10 kg of normal have 5.21 times higher risk of AHI > 15, and women 2.5 times more likely (31). Sharma et al. state that the onset and peak of obesity and OSA are identical (32). In a study done in 690 patients over four years with an average age of 46 years and a BMI of 29-30 kg/m² it was found that a 10% increase in body weight increased AHI by 32%. The relative risk in obese patients for apnea and stroke in BMI > 29 kg / m² is ≥ 10.74 times higher than in BMI < 29 kg/m² (29). Punjabi et al. in his research reported that metabolic syndrome is nine times more common in patients with sleep apnea, independent of obesity and is characterized by increased levels of fasting blood glu-

cose, high blood pressure, abnormal lipid metabolism and obesity (33).

Hyperlipidemia was found in the fourth place in the presence of risk factors in patients with apnea in 55 (50%) and 53 (48.2%) without apnea. The frequency of this risk factor in patients with and without apnea was not significant. Wierzbick et al. reported that hyperlipidemia in 74% of patients with SA and stroke which is higher than in our study (23). Pasic in his research states hyperlipidemia in 52% of patients, and 20% of patients had sleep disorders, which is similar to our research (28). In other studies, no significant association was found between hyperlipidemia and the degree of sleep-disordered breathing in patients with stroke (34).

According to Gao, patients with apnea are more likely to develop a metabolic syndrome that includes abdominal obesity in combination with elevated blood pressure, elevated plasma glucose and elevated triglycerides, and decreased high-density lipoprotein and cholesterol (35). Nichols states that elevated low-density serum lipoprotein (LDL) and decreased high-density serum lipoprotein (HDL) are proven risk factors for symptomatic atherosclerosis and stroke, as well as a risk factor for apnea (36).

Smoking, which increases the risk of stroke and apnea, ranks fifth in the presence of risk factors in patients with apnea, and smoking cessation is key to reducing both of these risks (37). In this study, smoking was found in 42 (38.2%) with apnea and 31 (28.2%) patients without apnea. The frequency of this risk factor in patients with and without apnea did not show a significant difference. Almost identical data are found in the research done by Pasic where smoking was verified in (36.5%) patients with stroke and sleep disorders. Although the high incidence of smokers was 36.5%, no significant association was found between smoking and the degree of sleep-disordered breathing in patients with stroke in this study as well (28). Shepard et al. state that many patients with OSA were smokers or still smoke, which further increases the risk for ischemic heart disease, lung disease, and stroke (38). According to Wetter et al. smokers have a higher risk than non-smokers to the occurrence of moderate or more severe apnea (odds ratio, 4.44). The Smokers (> or = 40 cigarettes a day) have the highest risk for apnea and stroke (39).

Diabetes mellitus (23/21%) was verified in the sixth place in terms of the presence of risk factors in patients with apnea, which is similar in the case of patients without apnea (22/20%). The frequency of this risk factor in patients with and without apnea was not significant. A similar prevalence of diabetes in our study was found in a study by Johnson et al. was 22% (40). Research by Zhu et al. shows that patients with apnea have significantly higher fasting and postprandial glucose values, hemoglobin HbA1C levels, total cholesterol, low-density lipoproteins, and triglycerides compared to patients without apnea. A Wisconsin cohort study shows that patients with apnea are more likely to develop diabetes mellitus than those without apnea (16). The highest insulin resistance was found in patients with AHI > 15 (50).

Studies also show a correlation between the degree of oxygen desaturation during the night and increased fasting and postprandial glucose values, as well as increased insulin resistance in apnea (41). According to research by Selic et al. diabetes mellitus and smoking are strong predictors of apnea after ischemic stroke (27). According to Fox et al. the long-term risk of diabetes mellitus type 2 significantly increases with increasing weight. In contrast, 5 kg of weight loss is resulting in a reduction of risk of 50%. The link between cardiovascular disease and diabetes mellitus was 78.6% in those with normal body weight, compared to 86.9% among obese people (42). Controlling the risk factors of stroke can play an important role in reducing the incidence of stroke worldwide, as well as offering better control of hyperlipidemia and T2DM. Smoking reduction, avoidance of sedentary lifestyle, adopting a healthy lifestyle, eating healthy, maintaining a balanced diet, and exercising daily can reduce the risk of stroke (43).

6. CONCLUSION

In our study, no statistically significant difference was found in the age of men and women, both with apnea and without apnea in acute stroke. Heart diseases, hypertension and body mass index are significantly more frequent in patients with than in patients without sleep apnea. Hyperlipidemia, smoking and diabetes mellitus are also more frequent but differences are not statistically significant.

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