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DOES SLEEP APNEA AFFECT THE OUTCOME OF STROKE PATIENTS?

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SUMMARY

Background: *Sleep apnea is described as an isolated risk factor for stroke or recurrent stroke which could be cause of death. In our study, the aim was to determine whether sleep apnea affects the outcome of stroke patients.*

Subjects and methods: *This is a prospective study in which a group of 110 patients in the acute phase of a stroke was evaluated sleep apnea. Acute stroke has been diagnosed either by computed tomography and magnetic resonance imaging of the brain. There was no significant difference in patient's age with or without sleep apnea neither in men nor women. Neurological, neuropsychiatric, pulmonary test were performed in all patients at five different time periods. In these time periods, all patients were evaluated: Glasgow scale, The American National Institutes of Health Scale Assessment, Mini Mental Test, The Sleep and snoring Questionnaire Test, The Berlin Questionnaire Test, The Epworth Sleepiness Scale, The Stanford Sleepiness Scale and The general sleep questionnaire.*

Results: *One year after the onset of stroke, 91 (82.7%) of 110 patients with apnea survived. The survival rate of patients with sleep apnea is significantly lower than without sleep apnea (p=0.01). In men with apnea, the survival rate was significantly lower in patients without apnea (p=0.004). The largest number of survivors of apnea had diabetes mellitus, followed by survival of patients with heart disease, body mass index >29 kg/m^2 and hypertension, with hyperlipoproteinemia and smoking. The highest number of survivors without apnea was body mass index >29 kg/m^2, followed by survival of patients with hyperlipoproteinemia, heart disease, hypertension, smoking, and diabetes mellitus.*

Conclusion: *Patients with sleep apnea have a significant correlation in survival rates compared with sexually and age-matched subjects, associated with concomitant risk factors such as hypertension, body mass index, and smoking.*

Key words: *outcome – stroke - sleep apnea*

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INTRODUCTION

Apnea during sleep (sleep apnea - SA) is present in about 1% of the total population. Ageing increases a prevalence of SA and it is three times more often in older than 40's. In the adults, obstructive sleep apnea (OSA) is much more often in comparison to the central sleep apnea (CSA) (84% vs. 0.4%). This is due to the concentric collapse of the oropharynx and hypopharynx, and the inability of the air to flow through these anatomical structures. CSA is a consequence of lesions in the medullary respiratory centers. Mixed sleep apnea (MSA) is a combination of two forms and occurs in 15% of all population (Young et al. 2002). In women, incidence increase after menopause. In women who use hormonal therapy frequency of apnea is similar to period before menopause. SA prevalence among men 30 to 60 years of age is 10-20% (Young et al. 1993). SA syndrome is described as an isolated risk factor for stroke or recurrent stroke which could be cause of death. They are independent to other cardiovascular and cerebrovascular risk factors. Hemodynamic, metabolic and hematological changes associated with breathing disorders during sleep lead to decreased cerebral perfusion and increased coagulability which might be in pathophysiological background of the stroke and death (Mohsenin et al. 2001). In the United States, at least 5% of the general population has OSA. It is a risk factor for the development of arterial hypertension and coronary heart disease, and can lead to congestive heart failure and acute ischemic stroke (Shahar et al. 2001, Portela et al. 2009). SA is found in 50-70% of patients with stroke (Hermann et al. 2009).

According to the World Health Organization (WHO) stroke is defined as the sudden development of focal or global symptoms and signs of cerebral dysfunction that last longer than 24 hours or lead to death, and are the result of a pathological process of vascular origin (Thorvaldsen et al. 1995).

The basic division of stroke, according to the type of pathological process, is into ischemic stroke (IS) which covers 70-85%, and hemorrhagic stroke (HS). As a consequence of stroke, different degrees of physical, cognitive and psychosocial functioning have been reported in patients (Demarin et al. 2003). The most commonly used tests to diagnose sleep apnea in addition to examination by a pulmonologist, internist are Polysomnography, Sleep and snoring Questionnaire Test (Denbar 2002), Berlin Questionnaire Test (Netzer et al. 1999), Epworth Sleepiness Scale (Johns 1991), Stanford Sleepiness Scale (Hodes et al. 1973) and general sleep questionnaire (Douglass et al. 1994). There are a small number of studies that have provided data on the one year survival of patients with sleep apnea after stroke. In our study, the aim was to determine whether sleep apnea affects the outcome of stroke patients.

SUBJECTS AND METHODS

Participants

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, pulmonological 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 pneumological tests were performed in all patients at five different time periods:

- First test - in acute phase of stroke (first week of stroke);
- Second test - one month after stroke;
- Third test - three months after stroke;
- Fourth test - six months after stroke;
- Fifth test - twelve months after stroke.

Measures/ Instruments

In the stated time periods, all patient were evaluated:

- Glasgow coma scale (Teasdale & Jannet 1974) (in the first test);
- American National institute of health Scale Assessment Scale (NIHSS) (Lyden et al. 2003) (in all tests);
- Mini Mental State (Folstein et al. 1975) (in the first and fifth tests);
- Sleep and snoring Questionnaire Test (Denbar 2002);
- Berlin Questionnaire Test (Netzer et al. 1999);
- Epworth Sleepiness Scale (Johns 1991);
- Stanford Sleepiness Scale (Hodes et al. 1973);
- General sleep questionnaire (Douglass et al. 1994).

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 which 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;
- mild lesion - if the score is 13 to 15.

Stroke Scale of the National Institutes of Health

Neurological deficit was measured by the NIHS scale, a graded neurological scale that examined the state of consciousness, visual field defects, bulbomotor and facial nerve function, motor and sensory impairment, ataxia, speech function, and the 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 that examine 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:

- score < 10 - severe dementia;
- score between 10 and 20 - moderate dementia;
- score between 21 and 25 - mild dementia;
- score 26 borderline score according to dementia;
- 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 to times a week and 4 = almost every day.

Stanford Sleepiness Scale

The Stanford Sleepiness Scale is designed to self assess 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 narcolepsy. If the patients score is above 3, he has serious sleep problems. The scale was filled by the examiner.

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 by 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: sociodemographic (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 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 cardiologist. Diabetes mellitus is defined by the use of drugs for diabetes before stroke or a documented blood glucose concentration > 7 mmol /L, hyperlipoproteinemia (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/m^2) 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.

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 based on whose results were established:

- type of stroke;
- localization of the lesion;
- lesion size;
- silent heart attacks.

Brain MRI was performed in patients with a clinical picture of a brainstem lesion, with a negative CT scan of the brain, or when the finding needed to be supplemented with an MRI scan. Strokes, by type are divided in to: a) hemorrhagic; b) ischemic strokes. If the CT or MR finding failed to show an acute, silent or old brain lesion, then its localization was determined on the basis of a neurological examination and grouped into insults in the region:

- brain stem/cerebellum and
- hemisphere (left, right).

Based on the localization changes verified by the findings of CT and MR of the brain, ischemic strokes are grouped into strokes in the region:

- brain stem/cerebellum;
- brain stem/cerebellum + hemisphere;
- hemisphere (left, right, bilateral).

Lesions in the hemispheres were grouped in to superficial (anterior and posterior circulation) and deep (lacunar infarction, striato-capsular, thalamus). According to the CT and MR findings of the brain, (hemorrhagic stroke) HMU was grouped according to the same principle as for (ischemic stroke) IMU with the addition of intraventricular hemorrhage. The research included the registration of the following socio–demographic characteristics: gender and age. The degree of neurological deficit was evaluated on the day of admission to the recent National institute of Health Stroke Scale (NIHSS) (Lyden et al. 2001).

Statistical Analyses

Numerical test results were statistically processed, analyzed and compared, in order 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 χ^2 (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 Quickstat Biomedical statistical data processing program. The research was approved by the Committee of the University-Clinical Center Tuzla.

RESULTS

One year after stroke onset survived 91 (82.7%) out of 110 patients with apnea. Average age of survived patients was 63.66±8.78 years. Survival rate of patients with sleep apnea is significantly less than without sleep apnea (χ^2=7.49; p=0.01). Among them 52 (80%) were men. In control group, without apnea survived 104 (94.5%) patients with average age of 65.00±8.62 years.

Among them 62 (95.4%) were men. In men with apnea there is significantly lower survival range in order to patients without apnea (χ^2=8.22, p=0.004). In women there is no difference. Survival of both gender in patients with apnea (22; 64.7%) was the lowest in group older than 70 years of age (Table 1).

The largest number of surviving patients with apnea had diabetes mellitus (out of 23 survived 20 or 86.6%), followed by the survival of patients with heart disease (out of 101 survived 87 or 86.1%), a body mass index (BMI) > 29 kg/m^2 (out of 87 survived 74 or 85.1%), and hypertension (out of 95 survived 80 or 84.2%), with hyperlipoproteinemia (out of 55 survived 46 or 83.6%) and smoking (out of 35 of 42 survived and 83%) (Table 2).

The largest number of surviving patients without apnea had with BMI >29 kg/m^2 (out of 67 surviving 65/97%), followed by survival with hyperlipoproteinemia (out of 53 survived 51/96.2%), heart disease (out of 89 survived 85 / 95.5%), hypertension (out of 92 survived 87/94.6%), smoking (out of 31 survived 29 / 93.5%) and diabetes mellitus (out of 22 survived 20/91%) (Table 3).

There was a significant difference in the survival of patients with and without sleep apnea as compared to smoking (*χ^2=5.05, p=0.03) , BMI (*χ^2=6.06, p=0.01) and hypertension (*χ^2=5.88, p=0.02), while for heart disease (χ^2=3.5, p=0.08) hyperlipidemia (χ^2=1.7, p=0.30) and diabetes mellitus (χ^2=0.16, p=0.69), this difference was not statistically significant.

Table 1. One-year survival rate of stroke patients with and without sleep apnea by sex

Survival by months	Men with apnea		Men without apnea		Women with apnea		Women without apnea		Total with apnea		Total without apnea	
	N (65)	%	N (65)	%	N (45)	%	N (45)	%	N (110)	%	N (110)	%
1	64	98.5	65	100.0	45	100.0	45	100.0	109	99.1	110	100.0
2	62	95.4	64	98.5	43	95.5	44	97.8	105	95.5	108	98.2
3	62	95.4	64	98.5	42	93.3	43	95.6	104	94.5	107	97.3
4	61	93.8	63	96.9	42	93.3	43	95.6	103	93.6	106	96.4
5	61	93.8	63	96.9	42	93.3	43	95.6	103	93.6	106	96.4
6	59	90.8	63	96.9	41	91.1	43	95.6	100	91.0	106	96.4
7	58	89.2	63	96.9	41	91.1	43	95.6	99	90.0	106	96.4
8	56	86.2	63	96.9	41	91.1	43	95.6	97	88.2	106	96.4
9	56	86.2	63	96.9	41	91.1	43	95.6	97	88.2	106	96.4
10	56	86.2	63	96.9	41	91.1	42	93.3	97	88.2	105	95.5
11	54	83.1	62	95.4	40	88.9	42	93.3	94	85.5	104	94.5
12	52	80.0	62	95.4	39	86.7	42	93.3	91	82.7	104	94.5

SM - Survival by months; χ^2 - Hi-square test; Men with and without apnea (*χ^2=8.22, p=0.004);
Women with and without (χ^2=0.49, p=0.48); Total with and without apnea (*χ^2=7.49, p=0.01)

Table 2. One-year survival rate of stroke patients with apnea according to risk factors

Survival by months	Hypertension N (95)	%	Heart disease N (101)	%	Diabetes mellitus N (23)	%	HLP N (55)	%	Smoking N (42)	%	BMI N (87)	%
1	94	98.9	100	99.0	23	100.0	54	98.2	42	100.0	86	98.9
2	91	95.8	97	96.0	21	91.3	53	96.4	39	92.6	84	96.6
3	90	94.7	96	95.0	21	91.3	53	96.4	39	92.6	83	95.4
4	89	93.7	96	95.0	21	91.3	52	94.5	39	92.6	82	94.3
5	89	93.7	96	95.0	21	91.3	52	94.5	39	92.6	82	94.3
6	86	90.5	93	92.1	21	91.3	51	92.7	37	90.2	81	93.1
7	86	90.5	93	92.1	21	91.3	49	89.1	36	85.7	80	92.0
8	86	90.5	91	90.0	21	91.3	49	89.1	35	83.3	77	88.2
9	86	90.5	91	90.0	21	91.3	49	89.1	35	83.3	77	88.2
10	86	90.5	91	90.0	21	91.3	49	89.1	35	83.3	77	88.2
11	83	87.4	90	89.1	21	91.3	47	85.5	35	83.3	75	86.2
12	80	84.2	87	86.1	20	86.6	46	83.6	35	83.3	74	85.1
Total	80	84.2	87	86.1	20	86.6	46	83.6	35	83.3	74	85.1

HA - Hypertension; HD - Heart disease; BM - Diabetes mellitus; HLP - Hyperlipidemia; BNI - Body mass indeks

Table 3. One-year survival rate of stroke patients without apnea according to risk factors

Survival	Hypertension		Heart disease		Diabetes mellitus		HLP		Smoking		BMI	
by months	N (92)	%	N (89)	%	N (22)	%	N (53)	%	N (31)	%	N (67)	%
1	92	100.0	89	100.0	22	100.0	53	100.0	31	100.0	67	100.0
2	91	98.9	88	98.9	21	95.5	53	100.0	31	100.0	66	98.5
3	91	98.9	87	97.8	21	95.5	52	98.1	30	96.8	66	98.5
4	90	97.8	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
5	90	97.8	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
6	90	97.8	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
7	90	97.8	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
8	90	97.8	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
9	89	96.7	86	96.6	21	95.5	52	98.1	30	96.8	66	98.5
10	88	95.6	86	96.6	21	95.5	51	96.2	30	96.8	65	97.0
11	87	94.6	85	95.5	20	91.0	51	96.2	29	93.5	65	97.0
12	87	94.6	85	95.5	20	91.0	51	96.2	29	93.5	65	97.0
Total	87	94.6	85	95.5	20	91.0	51	96.2	29	93.5	65	97.0

χ^2 - Hi-square test; Hypertension (*χ^2=5.88, p=0.02); Heart disease (χ^2=3.05, p=0.08); Diabetes mellitus (χ^2=0.16, p=0.69); Hyperlipidemia (χ^2=1.07, p=0.30); Smoking (*χ^2=5.05, p=0.03); Body mass index (BMI) (*χ^2=6.06, p=0.01)

DISCUSSION

Young et al. (1993) state that the survival of patients with sleep apnea do not depend on risk factors, which is not in correlation with our results. On the other hand in a prospective study Marin et al. (2005) carried out for a period of 10 years in patients with OSA, and AHI > 30, was found an increased risk of cardiovascular mortality, defined as fatal myocardial infarction and increased mortality from stroke (odds ratio 2.87). Patients with mild OSA, or those undergoing treatment with CPAP had no significantly increased a hazard ratio compared with those patients without OSA. In this study, the authors also found that untreated severe OSA are a significant risk factor for cardiovascular morbidity, which included non - fatal myocardial infarction and stroke (odds ratio 3.17). Our study also found higher survival in patients without apnea with heart disease, but it was not significant. In a study that includes 1,620 patients followed from 1976 to 1988, with apnea indicate that 57 died (3.5%) patients (53 men and 4 women), of which 53% died from cardiovascular causes. The death rate of men, revealed an increase in the mortality of patients under 70 years of age. The increase in mortality was significant in the fourth and fifth decade of (3.33, p<0.002, 3.23, p<0.0002). In patients older than 70 years, hazard ratio 0.33 (p<0.0007). These results suggest that sleep apnea affects mortality indirectly, probably by a factor of risk for hypertension and heart disease, which would correspond to our study (Lavie et al. 1995).

A growing body of evidence suggests that obesity and sleep apnea, in part through effects on blood pressure, and also direct effects on the heart, can have long-term effects on cardiac structure and function in adults and children, as well as on mortality. Even after blood pressure control, OSA may be an independent risk factor for developing left ventricular hypertrophy and arterial enlargement (Sukhija et. al. 2006, Oto at al. 2007). Sleep apnea is also associated with impaired systolic and diastolic function of the right ventricle regardless of hypertension (Tovily et al. 2007). These results correspond to our results in the study.

Bassetti et al. (1997) in the five-year study of 152 patients after ischemic stroke, suggest that older age, high BMI, diabetes mellitus, hypertension, coronary heart disease and poor results on Epwort scale sleepiness are more common in patients with AHI > 30, than in patients with AHI < 10[th] It is mentioned that the mortality associated with higher initial AHI, as well as age, hypertension, diabetes mellitus and coronary heart disease. Foucher (2007) in his study found that sleep apnea leads to an increase in cardiovascular morbidity and mortality. Pathophysiological mechanisms, including sympathetic activation, oxidative stress, systemic inflammation, hyperlipidemia, insulin resistance, lipid peroxidation can influence the development and progression of hypertension, ischemic cardiomyopathy, a heart rhythm disorder, heart failure, kidney failure and stroke.

Takama and Kurabayashi (2009) in their study conducted on 132 patients (43 with apnea and 92 without apnea) followed by 610±268 days, suggest that patients with sleep apnea have a much lower survival rate than patients without apnea (p<0.005) , especially those with OSA (p<0.0005). The ratio of fatal CV event, said 2.45 times higher (95% confidence interval 1.26 to 5.08) for OSA (p<0.01) and associated with an increased risk of death said. In conclusion, our study indicate that patients with sleep apnea have a worse prognosis long term, and that the presence of OSA is a strong predictor of fatal CV event.

Peker et al. (2000) in his research a prospective on 62 patients with stroke aged 67.6±10.4 years identified apnea in 19 patients with stroke. During the study, cardiovascular death was reported in 16 patients (37.5%) compared to 4 (9.3%), without apnea (p=0.018), which is higher than in our study. Hu et al. (2005) during study that lasted 19.1 years found mortality rate of 31% within test group of 2978 patients with stroke and apnea. The risk of mortality from stroke in patients with hypertension as a risk factor content was 4.5 times higher. Becker et al. (2003) reported that sleep is tightly associated with hypertension and survival. Successful treatment of apnea leads to a significant reduction in hypertension as the main risk factors for stroke and death, which corresponds to our results.

Wierzbick et al. (2006) evaluated 43 patients with stroke and sleep apnea. Other risk factors for stroke were also analyzed. Hypertension was found in 67%, hyperlipidemia in 74% and smoking in 25.5% of patients. The results showed that the stated risk factors for stroke in patients with apnea did not show a significant difference.

Smoking is an independent factor that can increase the risk of stroke by about 40% in men and 60% among women, and whose influence is growing in proportion with the number of cigarettes smoked, and retains its importance even when other risk factors are mitigated or removed (Bonita, 1992). According to Wetter et al. (25) 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.

According to Fox et al. (2008) 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.

Flegal et al. (1998) reported in their study that the increase in the number of OSA in the age group 25 to 29 years have coincided with the growth rate of obesity that takes place at the same time. The decline in the age group of 60 years and more likely reflects increased mortality especially from cardiovascular and cerebrovascular diseases. In line with previous research, we can confirm that as hypertension, obesity, type 2 diabetes mellitus, chronic ischemic heart disease and hypercholesterolemia associated with OSA. Data showed greater dominance of men than women for this disease state. In support of this are lower prevalence of obesity in women.

CONCLUSION

The survival rate of patients with sleep apnea is significantly lower than without apnea. The average age of death of patients with sleep apnea is significantly higher than the age of patients without sleep apnea. Men with sleep apnea have a significantly lower survival rate. Patients with sleep apnea have a significant correlation in survival rates compared with sexually and age-matched subjects, associated with concomitant risk factors such as hypertension, body mass index, and smoking.

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Contribution of individual authors:

Biljana Kojić contributed to the idea.

Zikrija Dostović, Omer Ć Ibrahimagić, Dževdet Smajlović & Amra Iljazović conributed to the critical revision of the paper.

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