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Anthropometric and physiologic assessment in sleep apnoea patients regarding body fat distribution

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Background: Obstructive sleep apnoea (OSA) is characterised by repeated episodes of pauses in breathing during sleep due to obstruction of the upper airway that result in transient hypoxaemia, sleep fragmentation and long-term cardiovascular disease. The most common risk factors for OSA include: obesity, age over 50 and neck circumference of more than 41 cm for females and more than 43 cm in males. Sleep apnoea is more common in men than in women. The aim of the conducted research was to evaluate relations between the anthropometric features connected with adipose tissue distribution and the severity of OSA.

Materials and methods: The study was carried out on 180 patients (144 males and 36 females) diagnosed with OSA syndrome. The standard sleep parameters obtained from night polysomnography as well as skin-fat fold thickness and neck circumference and waist-to-hip ratio were analysed. Statistical analysis was performed using STATISTICA 10.

Results: It was stated that anthropometric parameters connected with the accumulation of adipose tissue in upper body were significantly related to severity of OSA in males ($p \leq 0.05$). Body mass index (BMI) was significantly correlated with severity of OSA in females ($p \leq 0.05$).

Conclusions: In males, there is a connection between the severity of OSA, BMI and a higher accumulation of adipose tissue in upper part of the body measured by neck circumference and shoulder thickness of skin-fat folds, whereas in females only by BMI. (Folia Morphol 2016; 75, 3: 393–399)

Key words: obstructive sleep apnoea, apnoea-hypopnoea index, SO_{2nadir}, anthropometric assessment, obesity

INTRODUCTION

Obstructive sleep apnoea (OSA) is characterised by repeated episodes of pauses in breathing during sleep due to the obstruction of the upper airway that result in transient hypoxaemia, sleep fragmentation and long-term cardiovascular disease (American Academy of Sleep Medicine). The most common risk factors for OSA include: obesity, age over 50 and neck circumference of more than 41 cm for females and more than 43 cm in males. Sleep apnoea is more

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common in men than in women [20]. OSA is a chronic disease of a complex aetiopathogensis, associated with a certain set of morphological features. Beside an excessive mass of the tongue and the soft palate in relation to the size of oral cavity, an increased neck circumference as well as features of visceral obesity are observed [6]. Significant differences influenced by sex are also noticed. OSA in males is connected with visceral obesity, whereas in females, it concerns general adiposity [9].

Numerous studies show that there are significant correlations between the amount of adipose tissue accumulated, assessed using anthropometric methods and bioelectrical impedance analysis (BIA), and severity of OSA [10, 15]. The percentage of the adipose tissue, particularly visceral tissue, assessed with bioelectrical impedance analysis method has a significant clinical predictive value as far as the occurrence or lack of OSA is concerned. However, radiological methods, such as computed tomography (CT) and nuclear magnetic resonance (NMR), are the most useful [10]. Some researchers point out that there is excessive water retention in intercellular canals of the neck structures in OSA patients, connected with pulmonary hypertension [1, 15, 20].

Anthropometric methods of the assessment of adipose tissue distribution are based on measurements of skin-fat folds and body circumferences in standardised areas [12]. Measurements of the adipose tissue are conducted to predict the occurrence of obesity [19].

While evaluating a patient suspected of suffering from OSA syndrome, the following factors are taken into account: body mass index (BMI), the circumference of the neck, waist and hips as well as the thickness of the skin-fat folds. The results of numerous clinical observations show that not only the general amount of adipose tissue, but also its distribution is strictly connected with OSA syndrome. According to some authors, apnoea-hypopnoea index (AHI) shows a stronger correlation with BMI and abdominal circumference than neck circumference, which proves that abdominal obesity influences severity of OSA [18]. However, most researchers state that an increased neck circumference is, apart from BMI, the strongest parameter connected with OSA and with AHI value in particular, taking into account the fact that neck circumference correlates with the value of AHI parameter at 30% [2, 4, 5, 8, 11, 17]. It is thought to be connected with a significantly higher accumulation of adipose tissue antero-laterally of the airways, notwithstanding general adiposity expressed with the BMI value [14].

In the case of measurements of the thickness of skin-fat folds, it was observed that patients diagnosed with OSA, in comparison with the respective group of the same BMI but not suffering from OSA, have thicker skin-fat folds (Ip), and the SO_{2nadir} parameter significantly correlates with the thickness of the skin-fat fold measured below the triceps, brachii muscle and below the scapula as well as with the sum of skin-fat folds in both sexes and the neck fold in females. Moreover, males of similar BMI and waist circumference have significantly thicker scapula fold, waist to hip ratio (WHR) and neck circumference than females as well as more severe OSA measured using AHI parameter [3, 13, 16]. However, not all research showed significant correlation between the thickness of skin-fat folds and OSA occurrence [18].

The aim of the research was to evaluate a relation between anthropometric features connected with distribution of the adipose tissue and severity of OSA.

MATERIALS AND METHODS

The analysis was conducted on 180 patients (144 males and 36 females) diagnosed with OSA syndrome. OSA was diagnosed during 1-day diagnostic hospitalisation. All-night polysomnography (PSG) was performed. The study was conducted in Department of Otolaryngology, Central Clinical Hospital of Warsaw Medical University, Warsaw, Poland.

The study was approved by the bioethics committee of the Warsaw Medical University No 258/2013.

The following parameters were analysed: BMI (body weight/height^2 in kg/m^2); waist circumference, WHR; AHI (in occurrences/h) — number of apnoea episodes/h of sleep; minimum blood oxygenation during the whole night (SO_{2nadir} in %); arousal — change in electroencephalography record during the sleep; biceps — the measurement was conducted in the half-length of the upper arm above the biceps; triceps — the measurement was carried out in the half-length of the upper arm above the triceps; scapula — the measurement was done above the lower angle of the scapula; hip — the measurement was conducted above the ilium along the midaxillary line; E-sum of skin-fat folds; neck — at the height of the hyoid bone; waist — at the height of the navel; hips — at the height of the hip joints.

The aim of the research was to evaluate the connection between physiological parameters reflecting sleep quality and selected anthropometric parameters which characterise the type of adipose tissue distribution. It is known that patients suffering from OSA are usually obese, however, BMI value itself does not

Table 1. Values of anthropometric measurements (x ± standard deviation) taking into account sex of the studied patients as well as the results of the analysis of differences between mean values

Parameter	Females	Males	Total	P (t-Student)	P (Mann-Whitney)
Age [years]	50.35 ± 12.67	49.80 ± 12.25	52.40 ± 14.06	0.1363	0.0920
AHI [occurrences/h]	33.61 ± 26.59	34.88 ± 26.26	28.46 ± 27.50	0.1029	0.0351
SO_{2nadir} [%]	80.71 ± 12.12	80.92 ± 10.53	79.88 ± 17.30	0.6673	0.3538
Arousal	27.10 ± 21.43	25.92 ± 18.11	32.35 ± 32.12	0.2005	0.6207
Biceps [cm]	15.46 ± 7.16	14.51 ± 6.76	19.28 ± 7.54	0.0003	0.0002
Triceps [cm]	23.11 ± 9.47	21.51 ± 9.35	29.53 ± 6.93	0.0000	0.0000
Scapula [cm]	39.38 ± 13.65	39.38 ± 13.69	39.42 ± 13.70	0.9870	0.9800
Hip [cm]	38.24 ± 12.55	38.29 ± 13.17	38.06 ± 9.86	0.9052	0.8285
Sum of skin-fat folds [mm]	116.20 ± 36.71	113.68 ± 37.14	126.28 ± 33.53	0.0654	0.0355
Neck [cm]	41.23 ± 3.86	42.44 ± 3.07	36.49 ± 3.01	0.0000	0.0000
Waist [cm]	104.03 ± 14.08	105.94 ± 12.90	96.62 ± 16.05	0.0003	0.0001
Hips [cm]	109.77 ± 11.15	109.52 ± 10.09	110.73 ± 14.69	0.6398	0.7007
Height [m]	1.75 ± 0.09	1.78 ± 0.07	1.64 ± 0.07	0.0000	0.0000
Body mass [kg]	93.32 ± 18.74	97.07 ± 17.13	79.14 ±17.90	0.0000	0.0000
BMI [kg/m^2]	30.44 ± 5.44	30.68 ± 5.07	29.54 ± 6.61	0.2386	0.0276
WHR	0.95 ± 0.07	0.97 ± 0.06	0.87 ± 0.06	0.0000	0.0000

*Correlation coefficient was statistically significant at p ≤ 0.05. AHI — apnoea-hypopnoea index; BMI — body mass index; WHR — waist to hip ratio

reflect the character of obesity. Meanwhile, it is postulated that OSA patients, especially men, have characteristic abdominal obesity, attributing an important role to visceral adipose tissue in OSA pathogenesis.

Standardised attended 14-channel overnight laboratory PSG was performed using oronasal thermocouple (Grass, USA). Sleep stages were manually scored in 30-s epochs using standard AASM 2005 criteria. The AHI was computed and manually revised. PSG sleep time was obtained by summing the time spent in epochs scored as any stage of sleep during the period from "lights off" (approximately 22:00) to "lights on" (approximately 07:00).

Statistical analysis

Severity of OSA was classified on the basis of AHI, SO_{2nadir} and arousal index. STATISTICA 10 was used to conduct statistical analysis. After calculating the descriptive statistics, significance of the discovered differences between mean values in groups distinguished according to sex, BMI and AHI ($p \leq 0.05$) was tested. Significance of differences between pairs of variables was measured using Student's t-test and Mann-Whitney U test. Significance of group differences was measured applying the method of multiple analysis of variance ANOVA ($p \leq 0.05$), the post hoc analysis was based on: Fisher's exact test (least significant differences), Scheff's test and Newman-Keulus's test. Significance of correlation between variables was measured with Spearman's rank correlation test and Pearson's linear correlation. A detailed analysis of correlations between selected parameters was carried out applying the method of stepwise regression, discarding outliers from the analysis those observations that were completely different from mean values according to the results of Grubbs test and Dixon's Q test.

RESULTS

Table 1 presents the results of mean values (with standard variations) for the studies parameters taking into account sex of the patients.

It was stated that subgroups of males and females differed significantly as far as AHI, the thickness of skin-fat fold above the biceps and triceps, the circumferences of the neck, waist and the relation of waist circumference to hips, height and body weight were concerned. While the last two parameters were significantly connected with human sexual dimorphism, the other ones determined higher accumulation of adipose tissue in upper part of the body (from the neck to the waist) in males in comparison with females (Table 1).

It was also stated that, taking into account correlations higher than 0.05, statistically significant ones were correlations between the thickness of particular skin-fat folds with one another as well as with the circumference of the waist and hips. Although the

Table 2. Values of coefficients of correlation measured with Spearman's rank correlation of the material in total

	Age	AHI	SO_{2nadir}	Arousal	Biceps	Triceps	Scapula	Hip	Sum of skin-fat folds	Neck	Waist	Hips	BMI	WHR
Age	1.00	0.13	–0.22*	0.17*	–0.05	–0.09	–0.16*	–0.26*	–0.17*	0.00	–0.01	–0.07	0.03	0.08
AHI	0.13	1.00	–0.70*	0.46*	0.32*	0.22	0.37*	0.34*	0.38*	0.45*	0.48*	0.47*	0.38*	0.27*
SO_{2nadir}	–0.22*	–0.70*	1.00	–0.34*	–0.38*	–0.28	–0.36	–0.29*	–0.37*	–0.28*	–0.43*	–0.42*	–0.45*	–0.24*
Arousal	0.17*	0.46*	–0.34*	1.00	0.19*	0.18	0.14	0.12	0.17	0.25*	0.24*	0.17	0.17*	0.23*
Biceps	–0.05	0.32*	–0.38*	0.19*	1.00	0.72	0.67*	0.59*	0.84*	0.25*	0.56*	0.58*	0.57*	0.21*
Triceps	–0.09	0.22*	–0.28*	0.18	0.72*	1.00	0.54*	0.51*	0.77*	0.08	0.37*	0.43*	0.36*	0.05
Scapula	–0.16*	0.37*	–0.36*	0.14	0.67*	0.54	1.00	0.68*	0.88*	0.47*	0.67*	0.61*	0.59*	0.37*
Hip	–0.26*	0.34*	–0.29*	0.12	0.59*	0.51	0.68*	1.00	0.85*	0.38*	0.57*	0.61*	0.58*	0.23*
Sum of skin-fat folds	–0.17*	0.38*	–0.37*	0.17	0.84*	0.77	0.88*	0.85*	1.00	0.38*	0.65*	0.66*	0.62*	0.28*
Neck	0.00	0.45*	–0.28*	0.25*	0.25*	0.08	0.47*	0.38*	0.38*	1.00	0.77*	0.60*	0.65*	0.65*
Waist	–0.01	0.48*	–0.43*	0.24*	0.56*	0.37	0.67*	0.57*	0.65*	0.77*	1.00	0.82*	0.84*	0.70*
Hips	–0.07	0.47*	–0.42*	0.17*	0.58*	0.43	0.61*	0.61*	0.66*	0.60*	0.82*	1.00	0.80*	0.24*
BMI	0.03	0.38*	–0.45*	0.17*	0.57*	0.36	0.59*	0.58*	0.62*	0.65*	0.84*	0.80*	1.00	0.48*
WHR	0.08	0.27*	–0.24*	0.23*	0.21*	0.05	0.37*	0.23*	0.28*	0.65*	0.70*	0.24*	0.48*	1.00

*Correlation coefficient was statistically significant at $p \leq 0.05$. Age in years, apnoea-hypopnoea index (AHI) in occurrences/h, SO_{2nadir} in %, thickness of skin-fat folds in mm, height in cm, weight in kg, body mass index (BMI) in kg/m^2, body circumferences in cm; WHR — waist to hip ratio

Table 3. Values of coefficients of correlation measured with Spearman's rank correlation of the material in males

	Age	AHI	SO_{2nadir}	Arousal	Biceps	Triceps	Scapula	Hip	Sum of skin-fat folds	Neck	Waist	Hips	BMI	WHR
Age	1.00	0.06	–0.12	0.14	–0.12	–0.14	–0.16	–0.28*	–0.21*	0.05	0.02	–0.12	0.03	0.14
AHI	0.06	1.00	–0.67*	0.46*	0.38*	0.24*	0.40*	0.36*	0.40*	0.48*	0.48*	0.52*	0.37*	0.23*
SO_{2nadir}	–0.12	–0.67*	1.00	–0.29*	–0.34*	–0.23*	–0.38*	–0.29*	–0.35*	–0.35*	–0.44*	–0.41*	–0.43*	–0.30*
Arousal	0.14*	0.46*	–0.29*	1.00	0.20	0.21*	0.17	0.16	0.20	0.28*	0.29*	0.23*	0.21*	0.22*
Biceps	–0.12	0.38*	–0.34*	0.20	1.00	0.68*	0.71*	0.62*	0.84*	0.51*	0.67*	0.62*	0.62*	0.42*
Triceps	–0.14	0.24*	–0.23*	0.21*	0.68*	1.00	0.56*	0.53*	0.76*	0.33*	0.47*	0.44*	0.41*	0.25*
Scapula	–0.16	0.40*	–0.38*	0.17	0.71*	0.56*	1.00	0.66*	0.88*	0.56*	0.68*	0.61*	0.61*	0.44*
Hip	–0.28*	0.36*	–0.29*	0.16	0.62*	0.53*	0.66*	1.00	0.86*	0.49*	0.58*	0.60*	0.60*	0.29*
Sum of skin-fat folds	–0.21*	0.40*	–0.35*	0.20	0.84*	0.76*	0.88*	0.86*	1.00	0.57*	0.71*	0.67*	0.66*	0.41*
Neck	0.05	0.48*	–0.35*	0.28*	0.51*	0.33*	0.56*	0.49*	0.57*	1.00	0.82*	0.75*	0.77*	0.52*
Waist	0.02	0.48*	–0.44*	0.29*	0.67*	0.47*	0.68*	0.58*	0.71*	0.82*	1.00	0.82*	0.84*	0.74*
Hips	–0.12	0.52*	–0.41*	0.23*	0.62*	0.44*	0.61*	0.60*	0.67*	0.75*	0.82*	1.00	0.78*	0.27*
BMI	0.03	0.37*	–0.43*	0.21*	0.62*	0.41*	0.61*	0.60*	0.66*	0.77*	0.84*	0.78*	1.00	0.53*
WHR	0.14	0.23*	–0.30*	0.22*	0.42*	0.25*	0.44*	0.29*	0.41*	0.52*	0.74*	0.27*	0.53*	1.00

*Correlation coefficient was statistically significant at $p \leq 0.05$. Age in years, apnoea-hypopnoea index (AHI) in occurrences/h, SO_{2nadir} in %, thickness of skin-fat folds in mm, height in cm, weight in kg, body mass index (BMI) in kg/m^2, body circumferences in cm; WHR — waist to hip ratio

correlations between the thickness of particular skin-fat folds and the sum of the folds and the circumference of the neck were significant, they were lower than 0.4, which suggested a weak correlation. The strongest correlation between parameters characterizing adipose tissue distribution, body weight and BMI was reflected in the circumference of the waist and hips as well as their mutual correlation. The thickness of particular skin-fat folds, however, had little influence on weight and BMI. AHI, the most important parameter characterizing severity of OSA, correlated most significantly with the circumference of the neck, waist and hips (Table 2).

Data included in Table 1 present the results for population in general, due to the domination of male material.

In Table 3 in the subgroup of males, significant positive correlations were observed between the

Table 4. Values of coefficients of correlation measured with Spearman's rank correlation of the material in females

	Age	AHI	SO_{2nadir}	Arousal	Biceps	Triceps	Scapula	Hip	Sum of skin-fat folds	Neck	Waist	Hips	BMI	WHR
Age	1.00	0.44*	–0.61*	0.22	0.06	–0.21	–0.14	–0.12	–0.10	0.13	0.05	0.12	0.16	–0.06
AHI	0.44*	1.00	–0.80*	0.48*	0.12	0.09	0.18	0.25	0.20	0.42*	0.39*	0.23	0.39*	0.42*
SO_{2nadir}	–0.61*	–0.80*	1.00	–0.47*	–0.42	–0.40	–0.22	–0.25	–0.36*	–0.74*	–0.65*	–0.49*	–0.57*	–0.42*
Arousal	0.22	0.48*	–0.47*	1.00	–0.11	–0.05	–0.11	–0.26	–0.17	0.21	–0.03	–0.28	0.05	0.42*
Biceps	0.06	0.12	–0.42	–0.11	1.00	0.77*	0.69*	0.61*	0.84*	0.72*	0.71*	0.68*	0.69*	0.36*
Triceps	–0.21	0.09	–0.40	–0.05	0.77*	1.00	0.61*	0.59*	0.81*	0.69*	0.66*	0.56*	0.53*	0.50*
Scapula	–0.14	0.18	–0.22	–0.11	0.69*	0.61*	1.00	0.78*	0.91*	0.58*	0.65*	0.57*	0.57*	0.36*
Hip	–0.12	0.25	–0.25	–0.26	0.61*	0.59*	0.78*	1.00	0.88*	0.58*	0.70*	0.73*	0.63*	0.23
Sum of skin-fat folds	–0.10	0.20	–0.36	–0.17	0.84*	0.81*	0.91*	0.88*	1.00	0.72*	0.76*	0.70*	0.66*	0.40*
Neck	0.13	0.42*	–0.74*	0.21	0.72*	0.69*	0.58*	0.58*	0.72*	1.00	0.89*	0.72*	0.75*	0.66*
Waist	0.05	0.39*	–0.65*	–0.03	0.71*	0.66*	0.65*	0.70*	0.76*	0.89*	1.00	0.90*	0.91*	0.61*
Hips	0.12	0.23	–0.49*	–0.28	0.68*	0.56*	0.57*	0.73*	0.70*	0.72*	0.90*	1.00	0.88*	0.26
BMI	0.16	0.39*	–0.57*	0.05	0.69*	0.53*	0.57*	0.63*	0.66*	0.75*	0.91*	0.88*	1.00	0.44*
WHR	–0.06	0.42*	–0.42	0.42	0.36*	0.50*	0.36*	0.23	0.40*	0.66*	0.61*	0.26	0.44*	1.00

*Correlation coefficient was statistically significant at $p \leq 0.05$. Age in years, apnoea-hypopnoea index (AHI) in occurrences/h, SO_{2nadir} in %, thickness of skin-fat folds in mm, height in cm, weight in kg, body mass index (BMI) in kg/m^2, body circumferences in cm; WHR — waist to hip ratio

thickness of particular skin-fat folds, the sum of the folds, the circumference of the neck, waist and hips, BMI and the relation of the circumference of the waist and the circumference of the hips. The values of correlation coefficients ranged from 0.24 to 0.52.

Table 4, presenting the results for the subgroup of females, showed that similarly to males, there were significant correlations between parameters characterizing adipose tissue distribution. However, only body weight and BMI correlated significantly with AHI.

In females, AHI parameter significantly correlated with body weight and BMI; however, contrary to males, no statistically significant relations with morphometric parameters characterizing adipose tissue distribution were observed. Worth emphasizing is the fact that AHI quite strongly (0.44) correlated with age in females. It confirmed observations conducted by other researchers who stated that OSA was more severe in menopause females.

The analysis of significance of differences between mean values showed that OSA was more severe in males (higher AHI), the thickness of skin-muscle folds above the biceps and triceps as well as the sum of folds higher, and so were circumferences of the neck, waist and WHR. The value of BMI in Student's t-test was insignificant, however, it achieved the level of significance in Mann-Whitney U test. The parameters were also significantly correlated with the parameters determining sleep quality: positively with AHI and negatively with SO_{2nadir} and arousal index (Tables 2–4).

The analysis conducted with the application of stepwise regression method showed that AHI variable significantly correlated with a few variables, allowing making an appropriate model for almost all observations. The exogenous variables in the created regression model were: SO_{2nadir} ($\beta = -0.37$, $p < 0.0000$), arousal ($\beta = 0.16$, $p = 0.012$), BMI ($\beta = 0.2$, $p = 0.003$). In males, it was SO_{2nadir} ($\beta = 0.37$, $p < 0.0000$) and the neck circumference ($\beta = 0.41$, $p < 0.0000$) that had the strongest correlation with AHI. Whereas in females, the strongest exogenous variable in the regression model was not only SO_{2nadir} ($\beta = -0.42$, $p = 0.005$), but also BMI ($\beta = 0.33$, $p = 0.025$).

DISCUSSION

The conducted research confirmed the presence of significant differences influenced by sex and the existence of significant correlations between the studied parameters and the level of severity of sleep disorders, both in correlation and sleep regression analysis. Strong negative correlation between AHI and SO_{2nadir} is clear because the higher the index of breath occurrences was, the longer apnoea was. Similarly, strong but positive correlation concerned arousal index, which resulted from a higher number of sleep hypopnoea at higher breath occurrences (Table 3).

It should be emphasised that due to the fact that the majority of the research material was derived from males, the values of Spearman's rank correlation coefficient presented in Table 3 were similar to the values calculated for the whole population included in Table 2.

Males showed significantly higher waist circumference, the indicator of visceral obesity. Waist circumference also influenced the value of WHR that was also significantly higher in males than in females, despite the lack of significant difference in hip circumference. It should be emphasised that significantly higher neck and waist circumference in males did not correlate with the level of general adiposity, i.e. BMI, which did not show statistically significant differences influenced by sex. It can be suggested that waist circumference, as a predictor of visceral obesity, reflected in more severe OSA in males whose AHI was significantly higher than in females (Mann-Whitney U test). The conclusion was slightly weakened by the lack of significant differences between SO_{2nadir} and the arousal index between males and females.

Neck circumference and BMI are the most significant determinants of AHI [7, 8]. It was confirmed by the results of our research with reference to the whole material. However, neck circumference appeared to be significantly correlated with AHI only in males, both in the correlation and regression model. It confirmed the observations of other researchers, according to whom neck circumference was the strongest predictor of OSA [2, 4, 5, 8, 11, 14, 17]. However, lack of significant correlation of the parameter with AHI in females raised doubts.

The conducted research showed that AHI was significantly correlated with the circumference of the neck in males, whereas in females it correlated only with body weight and BMI. However, in females, the correlation was weaker than in males, which suggested different reasons for the mechanism of OSA occurrence in both sexes. The observation was not mentioned by other researchers dealing with this problem. Thus, it is justified to conduct further research to get to know mechanisms of OSA occurrence in humans.

The correlation between AHI and BMI, although weak (r = 0.38), was significant and the value of correlation coefficient achieved in the research turned out to be significant, as in the study of Patel et al. [17].

Similarly, neck circumference correlated stronger with AHI than BMI. A lot of authors mentioned the importance of neck circumference as the parameter more strongly correlated with AHI than with BMI. According to them, neck circumference was responsible for approximately 30% of the range of AHI variability [2, 4, 5, 8]. However, there was no data concerning the sex.

It should be noticed that mean values of BMI, both in males and females, classified the majority of patients in an overweight group (females) or mild obesity (males). It confirmed the observations that only a small group of patients diagnosed with OSA suffered from serious adiposity: approximately half of the patients had BMI lower than 30, thus the patients were not obese [14]. In the analysed material, the mean value of BMI for the upper quartile in female group amounted to 32.6, and in the male group — 32.98, it was 32.93 for the whole material. Most authors emphasised the influence of neck circumference on the occurrence and severity of OSA [21, 22]. Other researchers also underlined that OSA patients differed significantly from healthy volunteers only as far as neck circumference was concerned grouped according to BMI, however, they did not differ in waist circumference [7].

According to the majority of clinical observations, neck circumference, the sum of skin — fat folds, body weight and BMI were the best predictors of OSA [2, 5, 8, 7]. The conducted research showed that correlation between AHI and parameters characterizing adipose tissue distribution, especially the value of neck circumference, concerned only males. It may prove that in males the location of adipose tissue not only in the abdominal area but also in upper part of the body may be significantly correlated with OSA, whereas in females, the total weight of adipose tissue influence the occurrence and severity of the syndrome.

CONCLUSIONS

Anthropometric parameters connected with accumulation of adipose tissue in the upper part of the body were significantly correlated with severity of OSA syndrome in males. BMI was significantly correlated with severity of OSA in females.

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