

Małgorzata KRAKOWSKA-STASIAK<sup>1</sup>  
Dorota CIBOR<sup>2</sup>  
Kinga SAŁAPA<sup>3</sup>  
Danuta OWCZAREK<sup>2</sup>  
Tomasz MACH<sup>2</sup>

## Impact of body weight on clinical symptoms and endoscopic changes in patients with gastroesophageal reflux disease

Wpływ masy ciała na obraz kliniczny i endoskopowy u pacjentów z chorobą refluksową przełyku

<sup>1</sup>Department of Internal Medicine and Gastroenterology, 5<sup>th</sup> Military Hospital, Cracow, Poland  
Head:  
Prof. nadzw. dr hab. n. med. *Iwon Gryś*

<sup>2</sup>Department of Gastroenterology, Hepatology and Infectious Diseases, Jagiellonian University Medical College, Cracow, Poland  
Head:  
Prof. dr hab. n. med. *Tomasz Mach*

<sup>3</sup>Department of Bioinformatics and Telemedicine, Jagiellonian University Medical College, Cracow, Poland  
Head:  
Prof. dr hab. *Irena Roterman-Konieczna*

### Additional key words:

gastroesophageal reflux disease  
body mass index  
overweight

### Dodatkowe słowa kluczowe:

choroba refluksowa przełyku  
wskaźnik masy ciała  
nadwaga

**Introduction:** Gastroesophageal reflux disease (GERD) is connected with body mass index (BMI) according to some recent studies. However, the link between overweight and severity of GERD symptoms is still unclear.

**Objectives:** The aim of our study is to assess the influence of BMI on clinical presentation and occurrence of inflammatory changes in the esophagus in patients with GERD.

**Material and Methods:** 121 clinically diagnosed GERD patients: 66 males (54.5%) and 55 females (45.5%), aged 19 – 89 years were involved in the study. After the detailed anamnesis BMI was counted and gastroscopy was performed. All individuals who agreed for upper endoscopy were divided into three groups. 42 patients (34.7%) were classified as Non-Erosive Reflux Disease (NERD), 53 patients (43.8%) were diagnosed with Erosive Esophagitis (EE), 11 patients (9.1%) with Barrett's esophagus (BE). Among EE group 34 patients were diagnosed with grade A of esophagitis according to Los Angeles scale, 17 with grade B, 2 with grade C and none with grade D. The differences between groups were assessed using statistical analysis.

**Results:** The mean age of patients was 50.2±12.9 years and the mean BMI was 25.5±4.2 kg/m<sup>2</sup>. Patients with BE were older (61.2±12.0 years) than NERD (48.5±13.6 years); (p=0.028) and EE (50.4±11.4 years); (p=0.008). BE had higher BMI (27.0±4.4 kg/m<sup>2</sup>) as compared to NERD (24.0±3.3 kg/m<sup>2</sup>); (p=0.022) and EE (24.4±3.1 kg/m<sup>2</sup>); (p=0.048). Hiatal hernia was more frequent in EE and BE (79.2% and 90.9%, respectively) as compared to NERD (45.2%); (p<0.001). Patients EE and BE more frequently complained to heartburn (84.9% and 72.7%, respectively) than patients with no mucosal injury (42.9%); (p<0.001). Sleeping problems were encountered by patients with higher levels of BMI.

**Conclusion:** This study demonstrates that overweight predispose to esophageal inflammation and increase the frequency of heartburn and sleep problems in GERD patients.

**Wprowadzenie:** Według ostatnich badań choroba refluksowa przełyku jest powiązana ze wskaźnikiem masy ciała (BMI). Jednak związek pomiędzy nadwagą i nasileniem objawów refluksowych jest wciąż niejasny.

**Cel:** Celem pracy jest ocena wpływu BMI na obraz kliniczny i występowanie zmian zapalnych w przełyku u chorych z chorobą refluksową przełyku.

**Materiał i metody:** Do badania włączono 121 pacjentów z objawami choroby refluksowej przełyku: 66 mężczyzn (54,5%) i 55 kobiet (45,5%), w wieku 19-89 lat. Po przeprowadzeniu szczegółowego wywiadu chorobowego określono BMI oraz wykonano gastroskopię. Pacjenci, którzy wyrazili zgodę na gastroskopię, zostali podzieleni na 3 grupy. 42 pacjentów (34,7%) zdiagnozowano jako chorych z chorobą refluksową bez zapalenia przełyku (NERD), u 53 pacjentów (43,8%) rozpoznano zapalenie przełyku (EE), a u 11 (9,1%) przełyk Barretta (BE). Wśród chorych z zapaleniem przełyku u 34 pacjentów rozpoznano zapalenie w stopniu A według klasyfikacji z Los Angeles, u 17 w stopniu B, u 2 w stopniu C. Nie było chorych z zapaleniem przełyku w stopniu D. Różnice pomiędzy grupami oceniono za pomocą analizy statystycznej.

**Wyniki:** Średni wiek pacjentów wynosił 50,2±12,9 lat, średnie BMI 25,5±4,2 kg/m<sup>2</sup>. Pacjenci z przełykiem Barretta byli starsi (61,2±12,0 lat) niż pacjenci w grupie NERD (48,5±13,6 lat); (p=0,028) i EE (50,4±11,4 lat); (p=0,008). Średnie BMI w grupie BE było wyższe (27,0±4,4 kg/m<sup>2</sup>) niż w grupie NERD (24,0±3,3 kg/m<sup>2</sup>); (p=0,022) i EE (24,4±3,1 kg/m<sup>2</sup>); (p=0,048). Przepuklina rozworu przełykowego przepony częściej występowała w grupie EE i BE (odpowiednio 79,2% i 90,9%) w porównaniu do NERD (45,2%); (p<0,001). Pacjenci EE i BE częściej skarżyli się na zgagę (odpowiednio 84,9% i 72,7%) niż chorzy bez zmian zapalnych w przełyku (42,9%); (p<0,001). Problemy ze snem częściej występowały u chorych z wyższym BMI.

Adres do korespondencji:

Małgorzata Krakowska-Stasiak, MD  
Klinika Chorób Wewnętrznych i Gastroenterologii,  
5 Wojskowy Szpital Kliniczny z Polikliniką  
ul. Wrocławska 1-3, 30-903 Kraków, Polska  
e-mail: [krakowska.malgorzata@gmail.com](mailto:krakowska.malgorzata@gmail.com)  
tel: +48 12 6308 228

## Introduction

Gastroesophageal reflux disease (GERD) is one of the most common gastrointestinal disorders characterized by the symptoms of heartburn and regurgitation that occur when gastric acid or bile reflux from the stomach to the esophagus. It is estimated that symptoms of GERD occur every day in 5-10% inhabitants of developed countries [1]. The etiopathogenesis of GERD is multifactorial and includes impaired gastric emptying, impaired esophageal clearance and dysfunction of the lower esophageal sphincter (LES). Factors that might contribute to GERD exacerbation comprise: presence of hiatal hernia, pregnancy, medications or stress. Some studies have reported recently the association between GERD symptoms and body mass index (BMI) [2-7]. Obesity is believed to be a strong risk factor of Barrett's esophagus [8]. However, the link between overweight and severity of GERD symptoms is still unclear, as well as there are only limited papers that report connection between BMI and endoscopic changes in esophageal mucosa.

The aim of our study is to assess the influence of BMI on clinical presentation and occurrence of inflammatory changes in the esophagus in patients with GERD.

## Material and Methods

121 patients from the Outpatient Clinic of Gastroenterology, University Hospital in Cracow were involved in the study. The inclusion criteria comprised: age above 18 years-old and clinically diagnosed GERD. The exclusion criteria were: a history of surgery of upper gastrointestinal tract, diabetes, severe chronic diseases, malignancies, pregnancy. The study group consisted of 66 males (54.5%) and 55 females (45.5%), aged 19-89 years, mean age 50.2±12.9 years. The detailed anamnesis included the most common complaints, such as: heartburn, belching, disgust, regurgitation, abdominal and chest pain, nausea, hoarseness, cough and trouble sleeping. BMI was counted as patient's weight in kilograms divided by the square of his/her height in meters. Gastroscopy was performed to assess the presence and severity of the inflammatory changes in the esophagus according to the Los Angeles scale. 15 patients (12.4%) did not agree for gastroscopy. The rest of individuals was divided into three groups. 42 patients (34.7%) were classified as Non-Erosive Reflux Disease (NERD). 53 patients (43.8%) were diagnosed with Erosive Esophagitis (EE). The third group consisted of 11 patients (9.1%) with diagnosed Barrett's esophagus (BE). Among EE group 34 patients were diagnosed with grade A of esophagitis according to Los Angeles scale, 17 with grade B, 2 with grade C and none with grade D.

To describe the quantitative characteristics the average value with standard deviation, as well as with minimum and maximum values were used. The qualitative data was described as numbers and percentages. The relationship between two qualitative characteristics was verified by means of the chi-square test or exact Fisher test, as appropriate. To compare the average values between three groups one-way ANOVA

was performed with Tukey post-hoc test. Normality was assessed by the Shapiro-Wilk test, and homogeneity of variance by the Levene's test. Simple logistic regression was applied to evaluate the effect of BMI on presence of the tested symptoms. The results were presented as odds ratios with their 95% confidence intervals. The results were considered statistically significant if *P*-value does not exceed the level of significance  $\alpha = 0.05$ . The R software was used for calculation.

## Results

Characteristics of the studied groups are presented in table I and the most frequent complaints are presented in table II.

Statistically significant differences in the mean values between groups: NERD, BE and EE were demonstrated for the age ( $p=0.012$ ) and BMI ( $p=0.029$ ) of the respondents (Tab. I). The average age of patients

differed significantly between the EE and BE group ( $p=0.008$ ) and between NERD and BE group ( $p=0.028$ ). Patients with BE were older (61.2±12.0 years) than patients with NERD (48.5±13.6 years) and EE (50.4±11.4 years). Moreover, the results of the analysis showed that BMI differed significantly between group EE and BE ( $p=0.048$ ) and between group NERD and BE ( $p=0.022$ ). Patients who were diagnosed with BE had higher BMI (27.0±4.4 kg/m<sup>2</sup>) as compared to NERD group (24.0±3.3 kg/m<sup>2</sup>) and EE group (24.4±3.1 kg/m<sup>2</sup>).

In the study hiatal hernia occurred in 67.8% patients with GERD (Tab. II). There were statistically significant differences between occurrence of hiatal hernia in the three groups ( $p<0.001$ ). Hiatal hernia was more frequent in group EE and BE (79.2% and 90.9%, respectively) as compared to NERD group (45.2%).

It was shown that taking into consider-

**Table I**  
Characteristics of the studied groups.  
Charakterystyka badanych grup.

		GERD (N=121)	BE (N=11)	EE (N=53)	NERD (N=42)	p-value (B-EE-NERD)
Age [years]	mean ± SD	50.2±12.9	61.2±12.0	50.4±11.4	48.5±13.6	0.012 post-hoc: EE-B P=0.008 NERD-B P=0.028 NERD-EE P=0.802
	min-max	19-89	37-74	20-72	19-89	
sex	F	55 [45.5%]	3 [27.3%]	24 [45.3%]	20 [47.6%]	0.494
	M	66 [54.5%]	8 [72.7%]	29 [54.7%]	22 [52.4%]	
BMI [kg/m <sup>2</sup> ]	mean ± SD	25.5±4.2	27.0±4.4	24.4±3.1	24.0±3.3	0.029 post-hoc: EE-B P=0.048 NERD-B P=0.022 NERD-EE P=0.827
	min-max	15.8-39.5	17.8-34.0	19.7-33.1	15.8-30.6	
BMI	<25	64 [52.9%]	3 [27.3%]	34 [64.2%]	27 [64.3%]	0.077
	≥25	57 [47.1%]	8 [72.7%]	19 [35.8%]	15 [35.7%]	

**Abbreviations:** BE - Barrett's esophagus; BMI - body mass index; EE - erosive esophagitis; GERD - gastroesophageal reflux disease; F - female; M - male; NERD - non-erosive reflux disease; SD - standard deviation. **Skróty:** BE - przelyk Barreta; BMI - wskaźnik masy ciała, EE - zapalenie przelyku; GERD - choroba refluksowa przelyku; F - kobieta; M - mężczyzna; NERD - choroba refluksowa bez zapalenia przelyku; SD - odchylenie standardowe.

**Table II**  
The most frequent complaints and presence of hiatal hernia.  
Najczęstsze dolegliwości oraz obecność przepukliny rozworu przelykowego przepony.

	GERD (N=121)	BE (N=11)	EE (N=53)	NERD (N=42)	p-value (B-EE-NERD)
hiatal hernia	82 [67.8%]	10 [90.9%]	42 [79.2%]	19 [45.2%]	<0.001
heartburn	84 [69.4%]	8 [72.7%]	45 [84.9%]	18 [42.9%]	<0.001
belching	72 [59.5%]	3 [27.3%]	38 [71.7%]	20 [47.6%]	0.007
disgust	70 [57.9%]	5 [45.5%]	36 [67.9%]	22 [52.4%]	0.164
regurgitation	28 [23.1%]	1 [9.1%]	16 [30.2%]	9 [21.4%]	0.328
abdominal pain	62 [51.2%]	7 [63.6%]	28 [52.8%]	21 [50%]	0.722
chest pain	24 [19.8%]	4 [36.4%]	8 [15.1%]	8 [19%]	0.266
nausea	17 [14%]	1 [9.1%]	7 [13.2%]	6 [14.3%]	0.999
hoarseness	3 [2.5%]	1 [9.1%]	2 [3.8%]	0 [0%]	0.215
cough	6 [5%]	0 [0%]	3 [5.7%]	2 [4.8%]	0.999
trouble sleeping	26 [21.5%]	1 [9.1%]	10 [18.9%]	9 [21.4%]	0.770

**Abbreviations:** BE - Barrett's esophagus; EE - erosive esophagitis; GERD - gastroesophageal reflux disease; NERD - non-erosive reflux disease.

**Skróty:** BE - przelyk Barreta; EE - zapalenie przelyku; GERD - choroba refluksowa przelyku, NERD - choroba refluksowa bez zapalenia przelyku.

ation clinical symptoms only occurrence of heartburn ( $p<0.001$ ) and belching ( $p=0.007$ ) differed significantly between given groups. Patients with EE and BE more frequently complained to heartburn (84.9% and 72.7%, respectively) than patients with no mucosal injury (42.9%). In contrast, the incidences of belching were more frequent in EE group as compared to BE group (71.7% vs 27.3% respectively).

#### Analysis of the impact of BMI [kg/m<sup>2</sup>] on selected symptoms.

The influence of BMI on selected symptoms was verified taking into account all studied patients (GERD) as well as NERD and EE group separately. In case of BE group analysis was not performed due to the very low number of patients (N=11). It was also impossible to carry out the analyses in NERD group for hoarseness and cough also due to only a few occurrences. In most analyses BMI did not significantly affect the selected symptoms. An exception was 'trouble sleeping' in GERD ( $p=0.005$ ) and NERD ( $p=0.014$ ) group. Sleeping problems were encountered more frequently by patients with higher levels of BMI. The analysis with all patients showed that the increase of BMI by 1 kg/m<sup>2</sup> increased the odds of sleep difficulties 1.17 times (95%CI: 1.05-1.31). The odds ratio in NERD group was equal to 1.48 (95%CI: 1.12-2.11). In the EE group, BMI significantly influenced the occurrence of symptoms 'disgust'. The increase of BMI by 1 kg/m<sup>2</sup> increased the odd of that complaint 1.27 times (95%CI: 1.03-1.65). More detailed results are collected in table III.

#### Analysis of the relationship of BMI (below / above normal) with selected symptoms.

Next, the individuals were also divided into two groups according to BMI level: below (<25 kg/m<sup>2</sup>) and above normal (≥25 kg/m<sup>2</sup>). Table IV presents the occurrence of GERD symptoms in the dependence of BMI group. A statistically significant association was demonstrated only for BMI group and prevalence of disgust in EE group ( $p=0.012$ ). The fraction of patients with BMI below 25 kg/m<sup>2</sup> complaining for 'disgust' was 55.9%, while in patients with BMI above or equal 25 kg/m<sup>2</sup> was 89.5%. The odd for 'disgust' in group of people with BMI above or equal 25kg/m<sup>2</sup> is 6.71 times higher than the odds for 'disgust' in group of people with BMI lower than 25 kg/m<sup>2</sup> (95%CI: 1.33-33.71).

#### Discussion

The prevalence of GERD has increased during the last decade affecting 18%-27% of the population in North America, 9%-25% in Europe, 2%-8% in East Asia, 9%-33% in the Middle East, 11% in Australia and 23% in South America [9]. Heartburn and acid regurgitation are known to be the most common symptoms of GERD so in most cases the disease is easily identifiable on the basis of symptoms alone. However, it is difficult to diagnose the disease in patients with a decreased frequency of heartburn and with occurrence of atypical symptoms. In such cases the other methods such as impedance, 24-hour esophageal pH-metry as well upper endoscopy are used to diag-

**Table III**  
Results of simple logistic regression.  
Wyniki prostej regresji logistycznej.

		GERD (N=121)	EE (N=53)	NERD (N=42)
hiatal hernia	OR	1.06	1.14	1.03
	95% CI	0.97-1.18	0.91-1.49	0.85-1.25
	P	0.206	0.289	0.762
heartburn	OR	1.04	1.01	0.95
	95% CI	0.95-1.15	0.79-1.32	0.77-1.14
	P	0.425	0.938	0.566
belching	OR	1.07	1.10	1.10
	95% CI	0.97-1.18	0.90-1.37	0.91-1.36
	P	0.146	0.392	0.331
disgust	OR	0.97	1.27	0.89
	95% CI	0.84-1.07	1.03-1.65	0.72-1.08
	P	0.590	0.043	0.259
regurgitation	OR	1.02	1.10	1.10
	95% CI	0.92-1.13	0.91-1.34	0.87-1.42
	P	0.676	0.314	0.421
abdominal pain	OR	0.99	1.05	0.93
	95% CI	0.91-1.08	0.88-1.27	0.76-1.12
	P	0.842	0.572	0.429
chest pain	OR	1.09	0.90	1.18
	95% CI	0.98-1.22	0.66-1.15	0.92-1.56
	P	0.095	0.430	0.202
nausea	OR	1.03	0.93	1.06
	95% CI	0.91-1.16	0.68-1.21	0.81-1.41
	P	0.616	0.604	0.663
hoarseness	OR	0.84	0.75	---
	95% CI	0.58-1.13	0.32-1.26	---
	P	0.318	0.380	---
cough	OR	0.94	0.71	---
	95% CI	0.74-1.14	0.34-1.12	---
	P	0.542	0.229	---
trouble sleeping	OR	1.17	1.02	1.48
	95% CI	1.05-1.31	0.80-1.27	1.12-2.11
	P	0.005	0.877	0.014

Abbreviations: CI - confidence interval; EE - erosive esophagitis; GERD - gastroesophageal reflux disease; NERD - non-erosive reflux disease; OR - odds ratio.

Skróty: CI - przedział ufności; EE - zapalenie przełyku; GERD - choroba refluksowa przełyku; NERD - choroba refluksowa bez zapalenia przełyku; OR - iloraz szans.

nose GERD [6,7,10-13].

Based on our study the most common complains among GERD patients are heartburn (69.4%), belching (59.5%), disgust (57.9%) and abdominal pain (51.2%). One fifth of patients suffers from regurgitation (23.1%), trouble sleeping (21.5%) and chest pain (19.8%). The least likely are nausea (14%), cough (5%) or hoarseness (2.5%).

When comparing clinical symptoms related to GERD in different patients groups only heartburn and belching differed significantly. Patients with EE and BE complained more frequently about heartburn than patients with no mucosal injury. Possible explanation of this could be the role of gastric acid as a key factor in esophageal mucosal damage [14,15]. Kaibysheva et al using pH-metry have proved recently that weakly acidic reflux does not contribute significantly to esophageal mucosal damage, in contrast to acidic reflux [14]. Our findings confirm that heartburn – connected with acidic reflux, is more characteristic for EE and BE than NERD.

Similar connection was found for presence of hiatal hernia. In the study hiatal hernia occurred in 67.8% patients with GERD and

was more frequent in patients with EE and BE than NERD. This finding correlates with previous study about etiopathogenesis of esophagitis, where authors proved that hiatal hernia increases number of long-lasting reflux episodes and in consequence leads to the damage of esophageal mucosa [16,17].

Overweight is also considered as an important risk factor for GERD and is positively correlated with acidic reflux [2,18]. It was reported to be associated with EE and BE as well [2,8,19,20]. The excess of body weight, especially increase in the abdominal girth, produces a higher intra-abdominal pressure and higher gastric acid production, reduces lower esophageal sphincter pressure, reduces the intra-abdominal length of the lower esophageal sphincter, and induces esophageal motor dysfunction [21-24]. Moreover, altered body composition or increased level of fat tissue may play a role in activation of specific metabolic pathways of carcinogenesis [8,21,25,26]. As with GERD and EE, multiple data have shown an association between obesity, abdominal circumference and metabolic syndrome with BE [27-29]. According to other studies abdominal adiposity is an independent risk

factor for developing BE [30]. However, these data can differ between populations in different countries. For instance, Matsuzaki et al. reported that obesity, assessed by BMI, did not have an independent association with the risk of BE in a Japanese population [31]. A study in Canada by Veugelers and others also did not show an association between obesity and BE. They did, however, find an association of BMI with esophageal adenocarcinoma [32]. Based on our study we found that high BMI was associated with higher risk of BE. Patients with no mucosal injury or with esophagitis during gastroscopy had statistically lower BMI than patients with BE. These findings indicate that overweight might be a risk factor of BE in Poland. Similar connection was found for age. This is not surprisingly if taking into account that BE is a condition caused by long exposure to mucosa-damaging agents [33].

The other interesting result of our study is the effect of BMI of the emergence of sleeping problems in patients with GERD. The analysis with all patients showed that the increase of BMI by 1 kg/m<sup>2</sup> increased the odd of sleeping difficulties 1.17 times. The odds ratio in NERD group was even higher and equal to 1.48. Patients with symptoms of GERD commonly report poor sleep, and previous epidemiologic studies have established a link between nighttime heartburn and sleep disturbances [34-36]. There are also some reports showing a positive association between short sleep duration and metabolic syndrome [37-39], and our results support the theory that overweight predispose to sleep disorders among GERD patients. The link between BMI and frequency of other selected GERD symptoms among all analyzed patients was not found. Only in EE group BMI significantly influenced the occurrence of symptom 'disgust'. Overweight patients with EE complained of this symptom more frequently than people with normal BMI.

There are several limitations of this study. First is the small amount of patients with BE and several patients did not agree for endoscopy so we could not allocate them to specific group. Another one is the lack of information about body mass change during the period before the study, which could have an influence on occurrence or disappearance of GERD symptoms [40-42]. According to some published evidences, weight loss leads to reduced GERD symptoms, even among people with a normal BMI [40,43].

### Conclusions

In conclusion, this study demonstrates that overweight predispose to esophageal inflammation and increase the frequency of heartburn and sleep problems in GERD patients.

### References

1. Małecka-Panas E, Talar-Wojnarowska R, Gąsiorowska A: Choroba refluksowa przełyku. W: Interna Szczeklika. Wydawnictwo Medycyna Praktyczna. Kraków, 2014: 894-898.
2. Akyüz F, Uyanıkoglu A, Ermis F, Arıcı S, Akyüz Ü. et al: Gastroesophageal reflux in asymptomatic obese subjects: an esophageal impedance-pH study. *World J Gastroenterol.* 2015; 21: 3030-3034.
3. Nomura M, Tashiro N, Watanabe T, Hirata A, Abe

Table IV

### Occurrence of selected symptoms in the dependence of BMI.

Występowanie wybranych objawów w zależności od BMI.

	BMI	GERD (N=121)	EE (N=53)	NERD (N=42)
hiatal hernia	<25	41 [64.1%]	25 [73.5%]	13 [48.1%]
	≥25	41 [71.9%]	17 [89.5%]	6 [40.0%]
	P	0.355	0.290	0.611
heartburn	<25	43 [67.2%]	29 [85.3%]	12 [44.4%]
	≥25	41 [71.9%]	16 [84.2%]	6 [40.0%]
	P	0.572	0.999	0.780
belching	<25	34 [53.1%]	22 [64.7%]	12 [44.4%]
	≥25	38 [66.7%]	16 [84.2%]	8 [53.3%]
	P	0.130	0.131	0.580
disgust	<25	38 [59.4%]	19 [55.9%]	17 [63.0%]
	≥25	32 [56.1%]	17 [89.5%]	5 [33.3%]
	P	0.719	0.012	0.065
regurgitation	<25	14 [21.9%]	9 [26.5%]	5 [18.5%]
	≥25	14 [24.6%]	7 [43.8%]	4 [26.7%]
	P	0.727	0.430	0.698
abdominal pain	<25	32 [50.0%]	15 [44.1%]	15 [55.6%]
	≥25	30 [52.6%]	13 [68.4%]	6 [40.0%]
	P	0.773	0.089	0.334
chest pain	<25	11 [17.2%]	6 [17.6%]	4 [14.8%]
	≥25	13 [22.8%]	2 [10.5%]	4 [26.7%]
	P	0.439	0.696	0.425
nausea	<25	9 [14.1%]	5 [14.7%]	4 [14.8%]
	≥25	8 [14.0%]	2 [10.5%]	2 [13.3%]
	P	0.997	0.999	0.999
trouble sleeping	<25	10 [15.6%]	6 [17.6%]	4 [14.8%]
	≥25	16 [28.1%]	4 [21.1%]	5 [33.3%]
	P	0.096	0.999	0.242

Abbreviations: BMI - body mass index; EE - erosive esophagitis; GERD- gastroesophageal reflux disease; NERD - non-erosive reflux disease.

Skróty: BMI- wskaźnik masy ciała; EE- zapalenie przełyku; GERD - choroba refluksowa przełyku; NERD - choroba refluksowa bez zapalenia przełyku.

- I. et al: Association of symptoms of gastroesophageal reflux with metabolic syndrome parameters in patients with endocrine disease. *ISRN Gastroenterol.* 2014; 2014: 863206.
4. Lagergren J: Body measures in relation to gastro-oesophageal reflux. *Gut.* 2007; 56: 741-742.
5. Huseini M, Wood GC, Seiler J, Argyropoulos G, Irving BA. et al: Gastrointestinal symptoms in morbid obesity. *Front Med. (Lausanne)* 2014; 1: 49.
6. Chang P, Friedenberg F: Obesity & GERD. *Gastroenterol Clin North Am.* 2014; 43: 161-173.
7. Hajar N, Castell DO, Ghomrawi H, Rackett R, Hila A: Impedance pH confirms the relationship between GERD and BMI. *Dig Dis Sci.* 2012; 57: 1875-1879.
8. Caro SD, Cheung WH, Fini L, Haidry R, Keane M. et al: Activated metabolic pathways in Barrett's oesophagus according to body composition or BMI and progression to cancer. *22nd United European Gastroenterology Week, Vienna, 2014.*
9. El-Serag HB, Sweet S, Winchester CC, Dent J: Update on the epidemiology of gastro-oesophageal reflux disease: a systematic review. *Gut.* 2014; 63: 871-880.
10. Delavari A, Moradi G, Elahi E, Moradi-Lakeh M: Gastroesophageal reflux disease burden in Iran. *Arch Iran Med.* 2015; 18: 85-88.
11. Ayazi S, Hagen JA, Chan LS, DeMeester SR, Lin MW. et al: Obesity and gastroesophageal reflux: quantifying the association between body mass index, esophageal acid exposure, and lower esophageal sphincter status in a large series of patients with reflux symptoms. *J Gastrointest Surg.* 2009; 13: 1440-1447.
12. Promberger R, Lenglinger J, Riedl O, Seebacher G, Eilenberg W. et al: Gastro-oesophageal reflux disease in type 2 diabetics: symptom load and pathophysiologic aspects - a retro-pro study. *BMC Gastroenterol.* 2013; 13: 132.
13. Kłopotcka M, Budzyński J, Świątkowski M, Pul-kowski G: The relationship between oesophageal and gastric pH during 24-hours pH-metry in patients diagnosed with atypical chest pain. *Pol Arch Med Wewn.* 2005; 113: 111-118.
14. Kaibysheva V, Trukhmanov A, Ponomarev A, Storonova O, Konkov M. et al: Role of acid and non-acid reflux in esophageal mucosal damage (erosive esophagitis and Barrett's esophagus). *22nd United European Gastroenterology Week, Vienna, 2014.*
15. Winkelsatt L, Kandulski A, Malfratherer P: Model of two important steps in the pathogenesis of gastro-esophageal reflux disease: impact of acidic pH and protease-activated receptor-2 (PAR2) on mucosal IL-8 secretion. *22nd United European Gastroenterology Week, Vienna, 2014.*
16. Cibor D, Ciećko-Michalska I, Szulewski P, Mach T: Etiopathogenetic factors of esophagitis in patients with gastroesophageal reflux disease. *Przegl Lek.* 2007; 64: 1-4.
17. Suter M, Dorta G, Giusti V, Calmes JM: Gastro-oesophageal reflux and esophageal motility disorders in morbidly obese patients. *Obes Surg.* 2004; 14: 959-966.
18. Ricci G, Amella C, Forti E, Rossi A, Bersani G. et al: 24-h pH-metry and multichannel intraluminal impedance monitoring in obese patients with and without gastroesophageal reflux disease symptoms. *Obes Surg.* 2011; 21: 48-53.
19. El-Serag H: The association between obesity and GERD: a review of the epidemiological evidence. *Dig Dis Sci.* 2008; 53: 2307-2312.
20. Nomura M, Tashiro N, Watanabe T, Hirata A, Abe I. et al: Association of symptoms of gastroesophageal reflux with metabolic syndrome parameters in patients with endocrine disease. *ISRN Gastroenterol.* 2014; 2014: 863206.
21. Li CH, Hsieh TC, Hsiao TH, Wang PC, Tseng TC. et al: Different risk factors between reflux symptoms and mucosal injury in gastroesophageal reflux disease. *Kaohsiung J Med Sci.* 2015; 31: 320-327.
22. Acosta A, Camilleri M: Gastrointestinal morbidity in obesity. *Ann N Y Acad Sci.* 2014; 1311: 42-56.

23. Lagergren J: Influence of obesity on the risk of esophageal disorders. *Nature reviews Gastroenterology & hepatology* 2011; 8: 340-347.
24. Anggiansah R, Sweis R, Anggiansah A, Wong T, Cooper D, Fox M: The effects of obesity on oesophageal function, acid exposure and the symptoms of gastro-oesophageal reflux disease. *Alimentary pharmacology & therapeutics* 2013; 37: 555-563.
25. Chandar AK, Iyer PG: Role of obesity in the pathogenesis and progression of Barrett's esophagus. *Gastroenterol Clin North Am.* 2015; 44: 249-264.
26. Dítě P, Přinosilová J, Dovrtělová L, Kupka T, Nechutová H. et al: The role of metabolic syndrome in gastroenterology. *Vnitr Lek.* 2015; 61: 792-798.
27. El-Serag H, Kvapil P, Hacken-Bitar J, Kramer JR: Abdominal obesity and the risk of Barrett's esophagus. *Am J Gastroenterol.* 2005; 100: 2151-2156.
28. Leggett C, Nelsen E, Tian J, Schleck CB, Zinsmeister AR. et al: Metabolic syndrome as a risk factor for Barrett esophagus: a population-based case-control study. *Mayo Clinic proceedings Mayo Clinic* 2013; 88: 157-165.
29. Corley D, Kubo A, Levin T, Block G, Habel L. et al: Abdominal obesity and body mass index as risk factors for Barrett's esophagus. *Gastroenterology* 2007; 133: 134.
30. Singh S, Sharma AN, Murad MH, Buttar NS, El-Serag HB. et al: Central adiposity is associated with increased risk of esophageal inflammation, metaplasia, and adenocarcinoma: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol.* 2013; 11: 1399-1412.
31. Matsuzaki J, Suzuki H, Kobayakawa M, Inadomi JM, Takayama M. et al: Association of visceral fat area, smoking, and alcohol consumption with reflux esophagitis and Barrett's esophagus in Japan. *PLoS One* 2015; 10: e0133865.
32. Veugeliers PJ, Porter GA, Guernsey DL, Casson AG: Obesity and lifestyle risk factors for gastro-oesophageal reflux disease, Barrett esophagus and oesophageal adenocarcinoma. *Dis Esophagus* 2006; 19: 321-328.
33. Boeckxstaens G, El-Serag HB, Smout AJ, Kahrlas PJ: Symptomatic reflux disease: the present, the past and the future. *Gut.* 2014; 63: 1185-1193.
34. Shaker R, Castell DO, Schoenfeld PS, Spechler SJ: Nighttime heartburn is an under-appreciated clinical problem that impacts sleep and daytime function: the results of a Gallup survey conducted on behalf of the American Gastroenterological Association. *Am J Gastroenterol.* 2003; 98: 1487-1493.
35. Jansson C, Nordenstedt H, Wallander MA, Johansson S, Johnsen R. et al: A population-based study showing an association between gastroesophageal reflux disease and sleep problems. *Clin Gastroenterol Hepatol.* 2009; 7: 960-965.
36. Mody R, Bolge SC, Kannan H, Fass R: Effects of gastroesophageal reflux disease on sleep and outcomes. *Clin Gastroenterol Hepatol.* 2009; 7: 953-959.
37. Wu MC, Yang YC, Wu JS, Wang RH, Lu FH, Chang CJ: Short sleep duration associated with a higher prevalence of metabolic syndrome in an apparently healthy population. *Prev Med.* 2012; 55: 305-309.
38. Hall MH, Okun ML, Sowers M, Matthews KA, Kravitz HM. et al: Sleep is associated with the metabolic syndrome in a multi-ethnic cohort of midlife women: the SWAN Sleep Study. *Sleep* 2012; 35: 783-790.
39. Choi KM, Lee JS, Park HS, Baik SH, Choi DS, Kim SM: Relationship between sleep duration and the metabolic syndrome: Korean National Health and Nutrition Survey 2001. *Int J Obes. (Lond)* 2008; 32: 1091-1097.
40. Ness-Jensen E, Lindam A, Lagergren J, Hveem K: Weight loss and reduction in gastroesophageal reflux. A prospective population-based cohort study: the HUNT study. *Am J Gastroenterol.* 2013; 108: 376-382.
41. Singh M, Lee J, Gupta N, Gaddam S, Smith BK. et al: Weight loss can lead to resolution of gastro-oesophageal reflux disease symptoms: a prospective intervention trial. *Obesity (Silver Spring)* 2013; 21: 284-290.
42. Fraser-Moodie CA, Norton B, Gornall C, Magnago S, Weale AR, Holmes GK: Weight loss has an independent beneficial effect on symptoms of gastro-oesophageal reflux in patients who are overweight. *Scand J Gastroenterol.* 1999; 34: 337-340.
43. Jacobson BC, Somers SC, Fuchs CS, Kelly CP, Camargo CA Jr: Body-mass index and symptoms of gastroesophageal reflux in women. *N Engl J Med.* 2006; 354: 2340-2348.