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Overweight and obesity as risk factors in hypertension – Study of the working population

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Key words
Obesity; arterial hypertension; working population; diseases

Summary
Background: *Obesity is one of the major epidemiological problems in developed countries; it is also one of the main risk factors for hypertension. It is estimated that about 80% of hypertension cases in Poland are related to an increase in body mass.* **Objective:** *The main aim of the study was to investigate overweight and obesity in terms of being risk factors for arterial hypertension.* **Methods:** *The study population consisted of randomly selected working adults living in the Swietokrzyskie province in Poland. The research tools included a questionnaire inquiring about data concerning healthy habits, as well as measuring blood pressure, body mass, height and waist circumference.* **Results:** *The study group consisted of 599 people (55.3% females and 44.7% males) aged 18-67; 67.8% of the study subjects were white-collar workers and 36.2% were blue-collar workers; 44.9% of our respondents were overweight and 22.8% were obese. Hypertension occurred significantly more frequently ($p<0.01$) among blue-collar (54.4%) than among white-collar workers (43.2%). Our analysis showed a statistically significant difference in the prevalence of hypertension among employees of various economic sectors ($p<0.01$). Hypertension and body mass increase were more frequent among men ($p<0.001$). Hypertension occurred in people with higher levels of Body Mass Index (BMI) and Waist Circumference (WC) ($p<0.001$).* **Conclusion:** *The data confirm the correlation between frequency of overweight and obesity and prevalence of arterial hypertension Active and proper prevention of obesity among the working population could lower the risk of arterial hypertension.*

Riassunto
«Sovrappeso e obesità come fattori di rischio per l'ipertensione – Studio di una popolazione lavorativa». Introduzione: *L'obesità è uno dei principali problemi epidemiologici nei paesi sviluppati, ed è anche uno dei principali fattori di rischio di ipertensione. Si stima che circa l'80% dei casi di ipertensione in Polonia è in relazione con un aumento della massa corporea.* ***Obiettivi:*** *L'obiettivo principale dello studio è stato indagare sovrappeso e obesità come fattori di rischio per l'ipertensione arteriosa.* ***Metodi:*** *La popolazione allo studio era costituita da un campione casuale di lavoratori adulti che vivono nella provincia di Swietokrzyskie in Polonia. Gli strumenti di ricerca hanno incluso l'uso di un questionario per indagare le abitudini di vita, la misurazione della pressione arteriosa, della massa corporea, dell'altezza e della circonferenza al punto vita.* ***Risultati:*** *Il gruppo studiato era formato da 599 persone (55,3% femmine e 44,7% maschi) di età compresa tra 18-67. Il 67,8% dei soggetti erano impiegati e il*

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36,2% operai. Tra gli impiegati le donne avevano una frequenza significativamente maggiore (p <0,001) rispetto agli uomini (81,0% e 42,5% rispettivamente). In generale l'ipertensione era presente con frequenza significativamente maggiore (p <0,01) tra gli operai (54,4%) che tra gli impiegati (43,2%). Lo studio ha rivelato che il 44,9% degli intervistati era in sovrappeso e il 22,8% era obeso, senza differenze di prevalenza nei diversi settori. Ipertensione e aumento della massa corporea sono risultati più frequenti tra i maschi (p <0,001). L'ipertensione riguardava le persone con livelli più elevati di indice di massa corporea (BMI) e circonferenza della vita (WC) (p <0,001). ***Conclusione:*** *Lo studio conferma la relazione tra la frequenza di sovrappeso e obesità e la prevalenza di ipertensione arteriosa. La prevenzione attiva e corretta dell'obesità tra la popolazione lavorativa può attenuare il rischio di ipertensione arteriosa.*

Introduction

The working population of every European country benefits from occupational health services as a subsystem of health care differentiated by the range, form and structure, depending on the respective national legislative framework. The scope of these services is determined by multiple factors, including the level of financial resources allocated to this section of medicine, which in turn stems from the organization (6, 18) and financing arrangements of the healthcare system (37). According to WHO data published in 2009, for instance, whereas in Italy total expenditure on health as a proportion of GDP rose from 7.3% in 1996 to 8.8% in 2005, in Poland it remained relatively stable in the same period at approximately 6.0%. The structure of occupational health services is largely influenced by recent transition due to emerging challenges and the evolution of the role of occupational health physicians (9, 11, 12). Nowadays it is emphasized that *'the key to maintain the effective functioning of the workforce is the concept of well-being, which encompasses more than just one's state of health; it is also a reflection of one's satisfaction with work and life', '…For the health components of well-being, there is a growing body of evidence on the effectiveness of workplace intervention for occupational outcomes (e.g. musculoskeletal disorders, mental health) and personal factors (e.g. smoking, being overweight)'* (31). The activities performed by occupational health physicians should include a wide range of tasks in the field of health promotion and health education, which has often been emphasized in Italian literature on the subject (3, 7, 21, 22, 30).

Occupational health physicians tend to encounter an increasing number of obese patients. The scale of obesity is enormous. '*The World Health Organization Regional Office for Europe recently stated that 300 million people in the world are obese. The prevalence of obesity has increased by 25.0% in the last 20 years. In Europe 14 million people are overweight, 6 million obese…*' (32). There is no doubt that obesity constitutes a risk for several vascular, metabolic and neoplastic diseases (24). The prevalence of overweight and obesity is also widespread among healthcare workers (2). Because of the high prevalence, this phenomenon deserves more in-depth research studies based on state-of-the-art methodology. Obesity is defined as an increase in body weight due to an excessive accumulation of fatty tissue exceeding correct values established for age, gender and race. In 1997 the WHO recognised obesity as a chronic state, requiring treatment, that facilitates the development of other diseases and is associated with higher mortality (14, 36). Obesity therefore became a serious medical problem and is getting more and more widespread, turning into an epidemic in developed countries (28). Nowadays the most frequently used indicator of the degree of obesity is the Quetelet's indicator BMI (BMI – Body Mass Index). According to the World Health Organization's classification, overweight is diagnosed when the BMI remains in the range of 25-29.9 kg/m², and obesity begins when the level of 30 kg/m² is exceeded. However, this indicator does not provide diagnostically significant information about the distribution of fatty tissue. In order to assess the visceral kind of obesity, we use a simple anthropometric parameter: waist circumference

(17, 23). The impact of the obesity epidemic on health is related not only to the disease itself, but also to the consequences of many illnesses, which comprise obesity as a confirmed risk factor. One of the most significant diseases is hypertension. The epidemiology of obesity, like the epidemiology of hypertension, indicates the existence of a strong cause-and-effect relationship between both diseases. Research has shown that a high value of hypertension is more frequent in overweight or obese persons. It is estimated that 80% of hypertension in Poland occurs in people with BMI >25 kg/m² (4, 8, 10, 15, 25). According to the 2003 recommendations of the European Society of Hypertension/European Society of Cardiology (ESH/ESC), confirmed in 2007 by Polish and European experts, blood pressure below 120 mm Hg is considered to be optimal for systolic blood pressure (SBP) and below 80 mm Hg for diastolic blood pressure (DBP). The correct pressure should be, respectively, 120-129 mm Hg for SBP and/or 80-84 mm Hg for DBP, while high normal blood pressure should be 130-139 mm Hg for the SBP and/or 85-89 mm Hg for the DBP (1, 19, 38).

Aim

The aim of this study was to assess the correlation between the incidence of overweight and obesity and hypertension in a working population in the Swietokrzyskie province. The aim of a detailed analysis was the evaluation of the prevalence of abdominal obesity and its relationship with the occurrence of hypertension in the study sample.

Materials and methods

The study conducted in the period from June to December 2009 comprised a sample of 599 persons (331 women, 268 men), occupationally active, aged 18 to 67 years, selected at random from the population employed in the Swietokrzyskie province. The research tool was a self-designed interview questionnaire consisting of 34 questions related to the subjects' lifestyle, which were divided into thematic blocks. A condition of enrolment was the consent of the person selected for the study. All study participants had their body mass (kg) and body height (cm) measured, together with waist circumference (cm), and measurement of blood pressure was performed twice, according to current expert recommendations. BMI and the presence of abdominal obesity were assessed on the basis of the collected data and waist circumference. The classification of obesity according to the aforementioned parameters is presented in table 1. Hypertension was diagnosed when systolic blood pressure was ≥ 140 mm Hg and/or diastolic blood pressure was ≥ 90 mm Hg. The classification of blood pressure according to degrees of hypertension is presented

Table 1 - The classification of obesity according to body mass index and waist circumference, together with the risk of metabolic complications

Degree of obesity	BMI (kg/m²)		Risk of complications
Normal	18.5-24.9		Small
Overweight	25.0-29.9		Insignificantly increased
Obesity I	30.0-34.9		Increased
Obesity II	35.0-39.9		Severe
Obesity III	>40		Very severe
Degree of obesity	Waist (cm) women	Waist (cm) men	Risk of complications
Normal	<80	<94	Small
Overweight	80-88	94-102	Increased
Obesity	>88	>102	Severe

The risk of complications in case of the type 2 diabetes, hypertension and circulatory system diseases
Source: Obesity: Preventing and Managing the Global Epidemic – Report of WHO Consultation of Obesity, Geneva, Switzerland, 3-5 June, 1997

Table 2 - Classification of blood pressure according to degrees of hypertension

Category	Systolic pressure [mm Hg]		Diastolic pressure [mm Hg]
Optimal pressure	<120	and	<80
Correct pressure	120-129	and/or	80-84
High correct pressure	130-139	and/or	85-89
Degree 1. hypertension (mild)	140-159	and/or	90-99
Degree 2. hypertension (moderate)	160-179	and/or	100-109
Degree 3. hypertension (heavy)	≥180	and/or	≥110
Isolated systolic hypertension	≥140	and/or	<90

Source: 2007 ESH/ESC Guidelines for the Management of Arterial Hypertension; The Task Force for the Management of Arterial Hypertension of the ESH and of the ESC

in table 2. The results obtained, after encoding, were inserted into an Excel spreadsheet. Statistical analysis comprised descriptive methods and the methods of statistical inference.

The following characteristics were calculated for the measurable features: the arithmetic mean ($\bar{x}$), standard deviation (s), the median (Me) and the coefficient of variation (v%), providing also the minimum and maximum values. The chi^2 test of independence was used in order to compare the incidence of individual variations of the characteristics within the study groups and in order to examine the relationship between the characteristics used. All calculations were made at a level of significance of $p<0.05$. The rectilinear correlation coefficient r was used to study the relationship between the measurable characteristics and the t-Student test made it possible to assess its significance. The indicators calculated for small samples were presented in the form of fractions, and in the case of large samples they were expressed as percentage.

Results

The characteristics of the sample taking into account the location and dispersion measures for individual features are presented in table 3.

67.8% of the study subjects were white-collar workers and 36.2% were blue-collar workers. Women performed white-collar jobs significantly more frequently ($p<0.001$) than men (81.0% and 42.5% respectively). The majority of our study subjects had a job with fixed hours (74%). Women were employed at fixed hours more often than men (77.6% compared to 69.6%) ($chi^2=5.221$, $p<0.05$).

Men and women also differed significantly according to the employment sector in which they worked ($chi^2=89.337$, $p<0.001$). Most women worked in manufacturing – 26%, administration – 17.5% and education – 15.1%, whereas over half of the male subjects (52%) worked in manufacturing.

The results indicate that only 37.7% of the subjects in the study group had correct and optimal systolic blood pressure. In addition, 19.9% of respondents were characterised by a high correct blood pressure. Mild hypertension occurred in 28.4% of respondents, and all other persons were characterised by moderate (11.5%) and severe (2.5%) hypertension. The average systolic blood pressure for the entire study population was 135 mm Hg.

Analysis of the relationship between systolic pressure and gender revealed statistically significant relationships of moderate strength between these traits ($chi^2=69.944$, $p<0.001$, $C=0.32$). It was found that significantly more men than women were characterised by both mild and also moderate and severe hypertension. However women more frequently had an optimal and correct blood pressure. High normal blood pressure in both gender groups occurred with similar frequency (table 4).

More than half of the respondents had an optimal or correct diastolic blood pressure (53.0%), and a correct high blood pressure occurred in 12.5% of patients; 34.5% of respondents suffered from hypertension, with 10.5% having moderate hypertension and 3.5% severe hypertension. The average di-

Table 3 - Characteristics of study sample (No=599) and structure of the study subjects by sex, employment type and economic sector

Investigated feature	min	max	x	Me	Mo	s	V(%)
Age [years]	18	67	45.8	48.0	52,0	10.4	22.7
BMI [kg/m²]	17	51,9	27.1	26.6	27,1	4.31	15.9
Waist circumference [cm]	54	145	90.1	90.0	90	13.5	15.0
Blood pressure [mm Hg] systolic	90	210	135.0	130.0	120	19.1	14.1
diastolic	60	140	84.3	80.0	80	11.3	13.4

Job type	Sex				Total	
	Females		Males			
	No.	%	No.	%	No.	%
White-collar	268	81.0	114	42.5	382	63.8
Blue-collar	63	19.0	154	57.5	217	36.2
Total	331	100.0	268	100.0	599	100.0
$chi^2 = 94.666$; $p<0.001$						
Fixed hours	257	77.6	186	69.4	443	74.0
On shifts	74	22.4	82	30.6	156	26.0
Total	331	100.0	268	100.0	599	100.0
$chi^2 = 5.221$; $p<0.05$						

Economic sector	Sex				Total	
	Females		Males			
	No.	%	No.	%	No.	%
Economic sector						
Administration	58	17.5	34	12.7	92	15.4
Assets and securities	11	3.3	1	0.4	12	2.0
Construction	14	4.2	21	7.8	35	5.8
Education	50	15.1	17	6.3	67	11.2
Trade	12	3.6	17	6.3	29	4.8
Manufacturing	86	26.0	139	52.0	225	37.6
Health service	46	13.9	2	0.7	48	8.0
Transport	18	5.4	22	8.2	40	6.7
Service industry	36	11.0	15	5.6	51	8.5
Total	331	100.0	268	100.0	599	100.0
$chi^2= 89.337$; $p <0,001$						

x – arithmetic mean, Me – median, Mo – modal; s – standard deviation; v – coefficient of variation, min – minimum value, max – maximum value for the individual characteristics in the whole group

astolic blood pressure for the entire population was 84.3 mm Hg. A statistically significant weak correlation between diastolic blood pressure and gender was revealed (chi^2=42.380, p<0.001, C=0.26). As in the case of systolic blood pressure incidence analysis, significantly more men than women were characterized by hypertension (mild, moderate and severe). The detailed distribution of the data here discussed is shown in table 5.

Analysis of the relationship between systolic blood pressure and job type indicated that optimal, correct and high correct pressure was significantly more common among white-collar workers than blue-collar workers (chi^2=27.720, p<0.01), Among the blue-collar workers, moderate and severe hypertension was significantly more frequent (table 6).

We obtained a statistically significant relationship between job type (white collar/blue collar) and systolic hypertension (chi^2=13.915; p<0.001) in our sample. Systolic hypertension was significantly more prevalent among blue-collar workers (52.5%) than white-collar workers (36.8%) (table 7).

Table 4 - Structure of the study subjects in terms of systolic blood pressure and gender

Systolic blood pressure	Women		Men		Total	
	No.	%	No.	%	No.	%
Optimal pressure	79	23.9	18	6.7	97	16.2
Correct pressure	86	26.0	43	16.0	129	21.5
High correct pressure	63	19.0	56	20.9	119	19.9
Mild hypertension	83	25.1	87	32.5	170	28.4
Moderate hypertension	15	4.5	54	20.2	69	11.5
Severe hypertension	5	1.5	10	3.7	15	2.5
Total	331	100.0	268	100.0	599	100.0

Table 5 - Structure of the study subjects in terms of diastolic blood pressure and gender

Diastolic blood pressure	Women		Men		Total	
	No.	%	No.	%	No.	%
Optimal pressure	98	29.6	41	15.3	139	23.2
Correct pressure	111	33.5	67	25.0	178	29.8
High correct pressure	36	10.9	39	14.6	75	12.5
Mild hypertension	61	18.4	62	23.1	123	20.5
Moderate hypertension	20	6.0	43	16.0	63	10.5
Severe hypertension	5	1.5	16	6.0	21	3.5
Total	331	100.0	268	100.0	599	100.0

Table 6 - Structure of the study subjects by diastolic blood pressure and job type (white-collar/blue-collar)

Diastolic blood pressure	White-collar		Blue-collar		Total	
	No.	%	No.	%	No.	%
Severe hypertension	4	1.1	11	5.1	15	2.5
Moderate hypertension	31	8.1	38	17.5	69	11.5
Mild hypertension	105	27.4	65	29.9	170	28.4
High correct pressure	78	20.4	41	18.9	119	19.9
Correct pressure	95	24.9	34	15.7	129	21.5
Optimal pressure	69	18.1	28	12.9	97	16.2
Total	382	100.0	217	100.0	599	100.0

chi^2= 27.720; p<0.001

Table 7 - Structure of study subjects by systolic blood pressure (RRS) and job type (white-collar/blue-collar)

RRS	Job type				Total	
	White-collar		Blue-collar			
	No.	%	No.	%	No.	%
Yes	140	36.6	114	52.5	254	42.4
No	242	63.4	104	47.5	345	57.6
Total	382	100.0	217	100.0	599	100.0

chi^2= 13.915; p<0.001

Table 8 - Structure of study subjects by diastolic blood pressure (RRD) and job type (white-collar and blue-collar)

RRD	Job type				Total	
	White-collar		Blue-collar			
	No.	%	No.	%	No.	%
Severe hypertension	8	2.1	13	6.0	21	3.5
Moderate hypertension	35	9.2	28	12.9	63	10.5
Mild hypertension	79	20.7	44	20.3	123	20.5
High correct pressure	41	10.7	34	15.6	75	12.5
Correct pressure	126	33.0	52	24.0	178	29.8
Optimal pressure	93	24.3	46	21.2	139	23.2
Total	382	100.0	217	100.0	599	100.0

chi^2= 14.918; p<0.001

Table 9 - Diastolic hypertension and job type (white-collar/blue collar)

RRD	Job type				Total	
	White-collar		Blue-collar			
	No.	%	No.	%	No.	%
Yes	122	32.0	85	39.2	254	42.4
No	260	68.0	132	60.8	345	57.6
Total	382	100.0	217	100.0	599	100.0

chi^2= 3.201; p>0.05

Optimal and correct diastolic blood pressure occurred significantly more often among white-collar than blue-collar workers (chi^2=14.918, p<0.01). Severe and moderate diastolic hypertension was observed significantly more frequently among blue-collar workers. Mild hypertension was almost equally prevalent in both categories, whereas high correct RRD was more widespread among blue-collar workers, just like hypertension – table 8.

No statistically significant difference occurred between the job type (white-collar/blue-collar) and diastolic hypertension (p>0.05). Diastolic hypertension was observed among white-collar and blue-collar workers with similar frequency (32% and 39%) – table 9.

Statistical analysis indicated a statistically significant difference in the prevalence of general hypertension, systolic hypertension and diastolic hypertension as well as both types of hypertension among males and females in the white-collar category (p<0.25; p<0.01; p<0.001). It was observed that each type of hypertension was significantly more common among male study subjects. However, there was no statistically significant difference in this field between males and females in the blue-collar job category concerning any type of hypertension (p>0.05). Regardless of the job category, males tended to suffer significantly more often from systolic hypertension (p<0.01), both hypertension types combined (p<0.001) and general hypertension (p<0.001) – tables 10, 11.

A comparison of blue-collar and white-collar workers (males and females included) indicated that diastolic hypertension was significantly more prevalent among blue-collar workers (15.7%) than among white-collar workers (11.5%) – p>0.05. Nevertheless, both types of hypertension taken together (RRS + RRD) occurred more often among white-collar workers (p<0,01), The respective percentage amounted to 2.3% and 6.2%. We did not find any statistically significant differences in hypertension prevalence between blue-collar and white-collar females (p>0.05), whereas diastolic hypertension prevalence was higher in white-collar (12.5%) than in blue-collar workers (p<0.01). Generally, hypertension (RRS + RRD) occurred signif-

Table 10 - Hypertension prevalence by job type and sex

Hypertension	Blue-collar				White-collar				Total			
	Females (No.=63)		Males (No.=154)		Females (No.=268)		Males (No.=114)		Females (No.=331)		Males (No.=268)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
RRS	6	9.5	28	18.2	25	9.3	19	16.7	31	9.4	47	17.5
RRD	1	1.6	4	2.6	11	4.1	14	12.3	12	3.6	18	6.7
RRS+RRD	18	28.6	61	39.6	54	20.2	42	36.8	72	21.8	103	38.4
Total	25	39.7	93	60.4	90	33.6	75	65.8	115	34.8	168	62.7

Table 11 - Comparison of males and females for hypertension prevalence depending on job type

Hypertension	Comparison: Females/males					
	Blue collar		White-collar		Total	
	chi^2 test value	significance (p)	chi^2 test value	significance (p)	chi^2 test value	significance (p)
RRS	2.536	p>0.05	4.226	**p<0.05**	8.732	**p<0.01**
RRD	0.002	p>0.05	8.742	**p<0.01**	2.974	p>0.05
RRS+RRD	2.354	p>0.05	11.845	**p<0.001**	19.925	**p<0.001**
Total	0.016	p>0.05	66.047	**p<0.001**	46.395	**p<0.001**

Table 12 - Comparison of hypertension prevalence between blue-collar and white-collar workers (for total population and males and females separately)

Hypertension	Comparison: blue collar/white collar					
	Females		Males		Total	
	chi^2 test value	significance (p)	chi^2 test value	significance (p)	chi^2 test value	significance (p)
RRS	0.002	p>0.05	0.104	p>0.05	2.104	p>0.05
RRD	0.345	p>0.05	8.319	**p<0.01**	5.230	**p<0.05**
RRS+RRD	2.126	p>0.05	0.212	p>0.05	8.507	**p<0.01**
Total	0.837	p>0.05	0.369	p>0.05	6.945	**p<0.01**

icantly more frequently (p<0.01) among blue-collar workers (54.4%) than among white-collar workers (43.2%) – table 12.

Our statistical analysis confirmed a statistically significant difference in hypertension prevalence among representatives of various employment sectors (p<0.01). Hypertension was most common in the construction industry (the fraction was 0,48, so it concerned almost half of the study subjects) followed by manufacturing (fraction: 0,36) and trade (0,34). Hypertension occurred significantly more often among construction workers than in the following sectors: administration, property markets and financial services, education, healthcare and service industry (p<0.05; p<0.01). There was no significant difference in hypertension prevalence in the following sectors: administration, assets and securities, construction, education, trade, manufacturing, health services, transport, service industry (p>0.05), while it was significantly higher among workers in the manufacturing sector compared to the aforementioned sectors (p<0.05; p<0.01) – table 13.

A comparison of all employment sectors combined did not give a statistically significant difference in the prevalence of overweight and obesity in the following sectors: administration and health care, education and manufacturing, construction and manufacturing (p<0.05) – table 14

Table 13 - Hypertension prevalence in the study sample by employment sector

Employment sector		Hypertension		Total
		Yes	No	
Administration	No.	23	69	92
	F	0.25	0.75	1.00
Assets and securities	No.	2	10	12
	F	0.17	0.83	1.00
Construction	No.	17	18	35
	F	0.49	0.51	1.00
Education	No.	13	54	67
	F	0.19	0.81	1.00
Trade	No.	10	19	29
	F	0.34	0.66	1.00
Manufacturing	No.	82	143	225
	F	0.36	0.64	1.00
Health services	No.	6	42	48
	F	0.13	0.87	1.00
Transport	No.	12	28	40
	F	0.30	0.70	1.00
Service industry	No.	10	41	51
	F	0.20	0.80	1.00

chi^2= 26.013; $p<0.01$

Table 14 - Structure of respondents in terms of gender and BMI levels

BMI	Women		Men		Total	
	No.	%	No.	%	No.	%
Underweight	2	0.6	2	0.8	4	0.7
Normal	138	41.7	51	19.0	189	31.6
Overweight	131	39.6	138	51.5	269	44.9
Obesity I	49	14.8	62	23.1	111	18.5
Obesity II	7	2.1	13	4.8	20	3.3
Obesity III	4	1.2	2	0.8	6	1.0
Total	331	100.0	268	100.0	599	100.0

The research has shown that 67.7% of the study group members were characterised by excessive body weight; the sample was dominated by people who were overweight (44.9%), whereas those with obesity accounted for 22.8% of total respondents. It was also found that women had a normal body weight significantly more frequently than men, while the latter are more prone to develop conditions of overweight or obesity – especially to I and II degree. A statistically significant, weak correlation between BMI and the gender of respondents was observed (chi^2 = 38.013, $p<0.001$, C = 0.24). The structure of the respondents in terms of gender and BMI values is shown in table 15.

Analysis of the relationship between BMI and age of the respondents indicated a statistically significant correlation between the measured traits (chi^2=33.330, $p<0.001$). The incidence of overweight and obesity, expressed by means of fractions, increased with the respondents' age, reaching in the case of the oldest respondents respectively 0.46 (overweight) and 0.32 (I degree obesity). It is

Table 15 - Prevalence of overweight and obesity in the study sample by employment sector

Employment sector		BMI			Total
		Normal	Owerweight	Obesity	
Administration	No.	29	44	19	92
	F	0.32	0.48	0.20	1.00
Assets and securities	No.	4	6	2	12
	F	0.33	0.50	0.17	1.00
Construction	No.	8	14	13	35
	F	0.23	0.40	0.37	1.00
Education	No.	28	28	9	67
	F	0.42	0.42	016	1.00
Trade	No.	8	13	8	29
	F	0.28	0.44	0.28	1.00
Manufacturing	No.	58	108	59	225
	F	0.26	0.48	0.26	1.00
Health services	No.	23	19	6	48
	F	0.48	0.40	0.12	1.00
Transport	No.	13	19	8	40
	F	0.32	0.48	0.20	1.00
Service industry	No.	20	18	13	51
	F	0.39	0.35	0.26	1.00

chi^2= 23.053; p>0.05

worth noting that the incidence of II and III degree obesity is similar in all age groups (figure 1).

A statistically significant correlation between BMI and systolic blood pressure levels was found (chi^2=99.634, p<0.001, C=0.38), as well as between BMI and diastolic blood pressure (chi^2=66.204, p<0.001, C=0.32). In both cases, the subjects with BMI indicating overweight or obesity were more

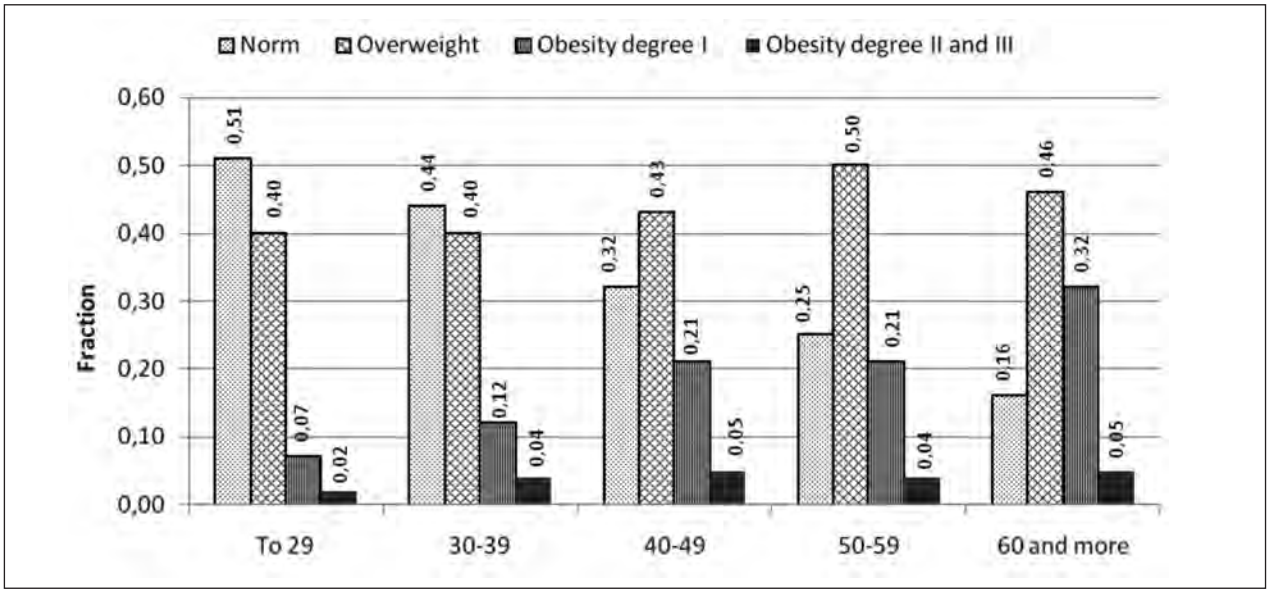

Figura 1 - Relationship between BMI level and age in the study group

prone to developing hypertension than the patients with standard body weight (figures 2, 3). It was observed that both systolic and diastolic blood pressure correlated with age ($p<0.001$).

Analysis of the study group, which was based on waist circumference, showed that 35.3% of the subjects were overweight and a further 28.7% had abdominal obesity. The structure of the men and women under study, in terms of their waist circumferences, is shown in figure 4. A correlation was also found between waist circumference and systolic blood pressure of women ($R^2 = 0.1475$) – figure 5, and waist circumference and diastolic blood pressure of women ($R^2 = 0.1083$) – figure 6. No correlation of this kind was observed in male subjects.

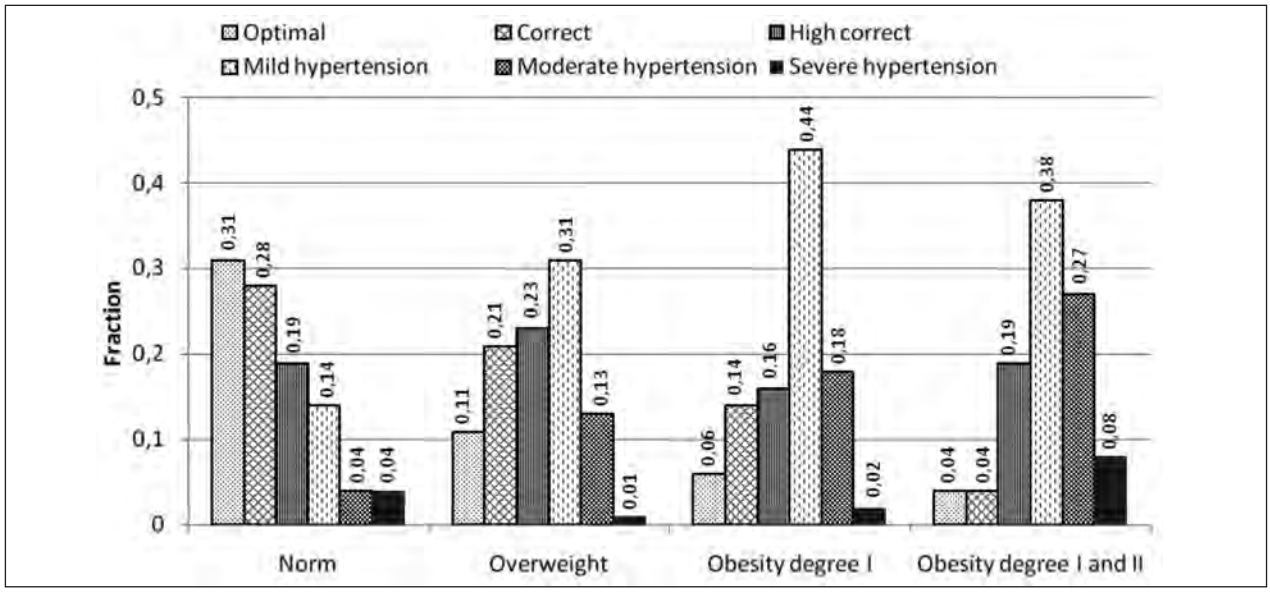

Figura 2 - Relationship between BMI level and systolic pressure in the study group

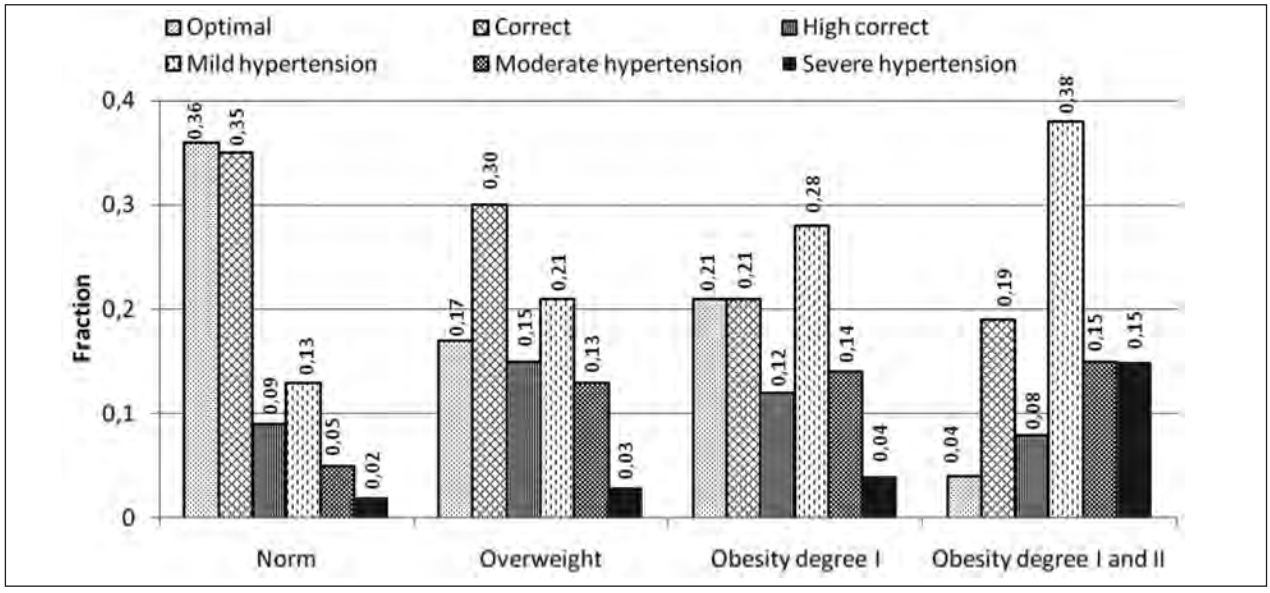

Figura 3 - Relationship between BMI level and diastolic pressure in the study group

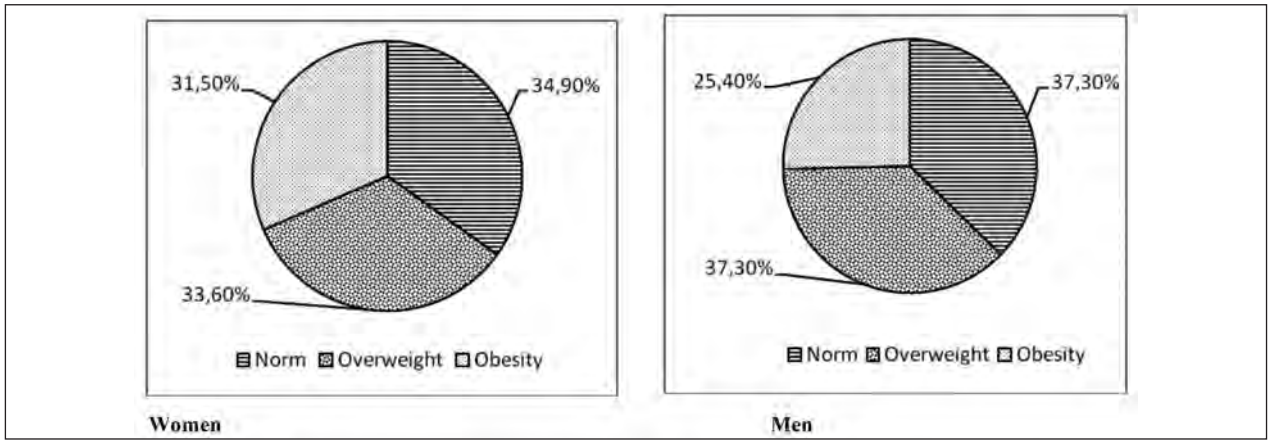

Figura 4 - Structure of the women and men studied in relation to their waist circumference

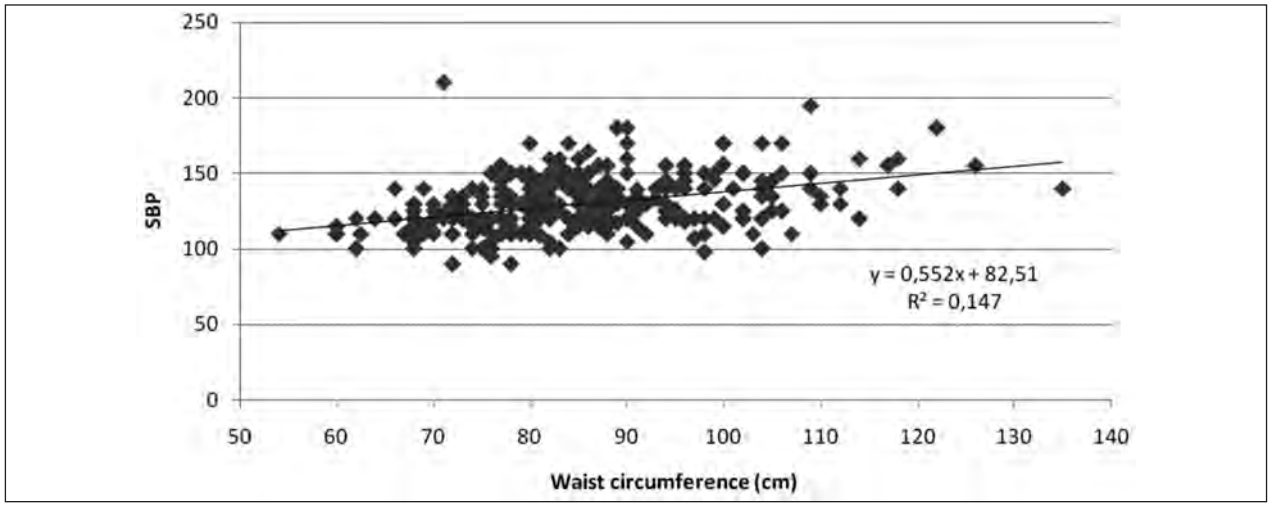

Figura 5 - Relationship between waist circumference and height of systolic pressure of women in the study group

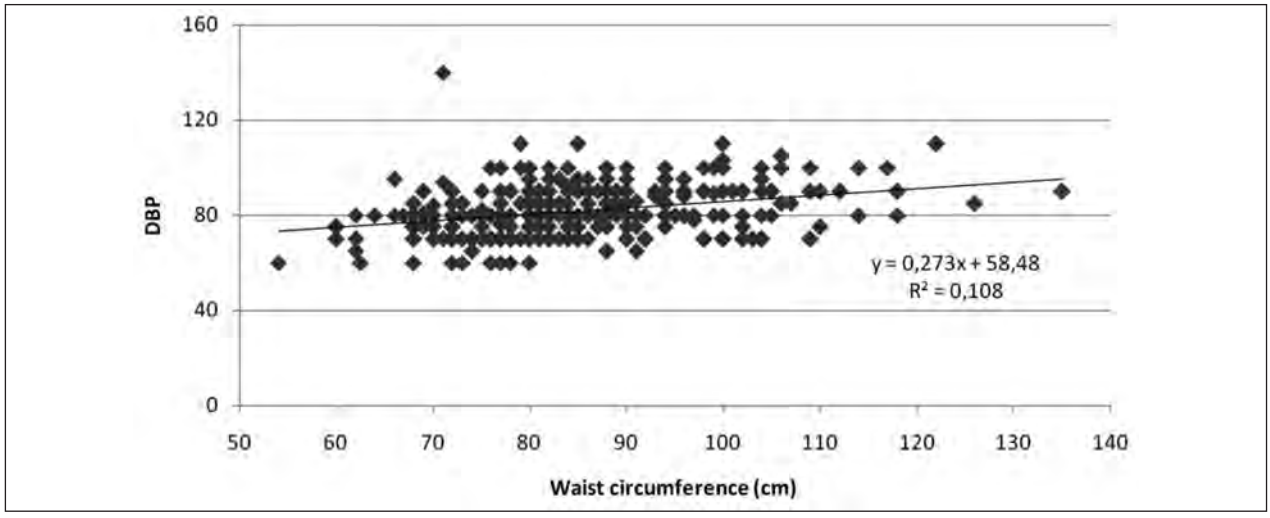

Figura 6 - Relationship between waist circumference and level of diastolic pressure in the study group

Discussion

According to the data from the NHANES study (National Health and Nutrition Examination Survey) it was shown that excessive weight affected 65.7% of the U.S. population, 30.6% of which was found to be obese, and 5.1% gigantically obese. The incidence of obesity in Europe is estimated to be 10-20% in men and 10-25% in women. According to the NATPOL PLUS study, excessive body weight is a feature of 53% of the Polish population and the LIPIDOGRAM 2004 study revealed that 48% of men were overweight and 32.78% were obese, while in case of women, these values were respectively 39.16% and 31.22%. According to the WOBASZ national survey, carried out from 2003 to 2005 in the Swietokrzyskie province, 26.5% of women and 38.6% of men were found to be overweight, and respectively 20.5% and 20.4% were found to be obese (8, 10, 38).

The study showed that the percentage of overweight people in the working population of the Swietokrzyskie province was 44.9% (39.6% women and 51.5% men), while the percentage of obese people was 22.8% (18.1% women and 28.7% men); comparable results were obtained in the LIPIDOGRAM 2004 study . An increase in the prevalence of overweight subjects among both genders can be observed, together with a decrease in the number of obese women, compared to the WOBASZ study. Analysis of the research conducted in Poland indicates that the percentage of people with excessive body weight was lower in the previous years, compared to the currently observed situation, especially in the case of males. The percentage of overweight and obesity in men found by the POL-MONICA Warszawa study was about 67% in the early 1990's and increased to about 72% in 2001, whereas it decreased in the case of women, falling from about 64% to 60%. A similar trend was observed with the CINDI-WHO project, carried out in Lodz in the 18-64 years age group. In the period from 1991 to 2001, the incidence of overweight in men increased from 37.7% to 41% and obesity from 13.5% to 16.4%; an opposite trend was observed in women: the percentage of overweight cases decreased from 32.6% to 26.9% and for obesity the results ranged from 21.2% to 16.9% (13).

The results of numerous scientific studies conducted in other countries revealed an association between BMI and arterial hypertension values and also provided evidence of the influence of obesity on the development of arterial hypertension (33). In the HOPE study, where the average value of the BMI indicator was 28 kg/m², 47% of subjects had arterial hypertension. A very significant correlation was observed between visceral obesity and presence of arterial hypertension. The results on the NHANES study demonstrated that hypertension was more frequently the problem of persons with both increased BMI and waist circumference, which indicate overweight, than of persons with the high BMI and normal waist circumference (27). According to the WOBASZ project, the incidence of hypertension in Poland was about 36%. Men were more likely to suffer from hypertension (41%) than women (32.9%), nevertheless optimal blood pressure values were found only in 12% of men and 30% of women, while the NATPOL PLUS study revealed the presence of hypertension in 29% of the entire population. In the light of the aforementioned data the results of this study are not promising, since the average systolic blood pressure was found to be 135 mmHg, and the average diastolic pressure 84.3 mmHg. Analysis of the correlation between blood pressure and gender of the respondents revealed that 42.4% of the subjects had increased systolic pressure, but was more characteristic in men (56.4%) than in women (31.1%). In the case of increased diastolic blood pressure values, frequencies were respectively 34.6%, 45.1% and 25.9%. The results obtained in men were especially worrying. Similar data were forthcoming from the PENT study, where hypertension was diagnosed in 44.2% of the respondents aged 18 years and more (43% women and 45% men), as well as from the WISHE study, where hypertension was diagnosed in 56% of men and 60% of women, nevertheless the study was conducted in a study group over 65 years of age (16. 26). Hypertension in blue collars can be attributed, at least in part, to the different life-style and maybe also to the different sex distribution in the examined population.

The study also confirmed the existence of a correlation between systolic blood pressure and diastolic blood pressure values, and BMI values, although the relationship was stronger in the first case. An increased systolic pressure was observed in 45% of overweight patients and in 65% of obese subjects, while diastolic pressure was increased in 37% and 50% of the respondents respectively. Similar results were obtained in the Skrzypek-Wanha et al study, where it was observed that the largest percentage of patients with correct blood pressure values was found in the group having a BMI <25, while in the group of obese subjects persons with correct blood pressure were in a minority (34). Also in the Framingham study it was demonstrated that 70% of men and 60% of women suffering from arterial hypertension were obese, and the NHANES III study confirmed the correlation between BMI values and levels of arterial pressure. According to the IDEA study, abdominal obesity affected 29% of men and 48% of women in the world (29, 35). The WOBASZ study indicated that in Poland 28.3% of men and 40.4% of women had developed abdominal obesity. In the aforementioned studies it was found out that the percentage of people who were overweight and suffering from abdominal obesity was lower, compared to Poland – in the case of women the results were respectively 33.6% and 31.5%, while in the case of men they were 37.3% and 25.4%. Similarly to the findings of the Nurses' Health Study research, the OT indicator correlated significantly with blood pressure values in women. However, no such correlation was observed in men (39).

The results of this study also confirmed the correlation between the levels of arterial blood pressure and the age of the respondents. A similar correlation between the aforementioned variables was revealed in the research conducted by Maciak et al and in the Nurses' Health Study (19, 20).

The results of the studies indicate that special attention should be paid to the need to undertake preventive action among working people. The aim of such actions would be to limit the incidence of overweight and obesity and, as a result, reduce the consequences, such as obesity-related arterial hypertension. It is advisable to facilitate the implementation of occupational health promotion in the workplace.

Conclusions

The high prevalence of overweight and obesity, as well as hypertension, is an significant health problem in the population of people working in the Swietokrzyskie province;

Statistically significant relationships ($p<0.001$) were demonstrated between the incidence of overweight and obesity and hypertension in the study group.

There is an urgent need to take active measures aimed at the prevention of obesity among occupationally active people, which can reduce the risk of hypertension.

No potential conflict of interest relevant to this article was reported

References

1. 2007 Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). J Hypertens 2007; *25*: 1105-1187
2. Abbate C, Giorgianni C, Munaò F, et al: Evaluation of Obesity in Healthcare Workers. Med Lav 2006; *97:* 13-19
3. Abbritti G, Muzi G, Latini L, et al: La promozione della salute in ambiente di lavoro: quali prospettive nella situazione italiana? Med Lav 2000; *91:* 515-530
4. Aronne LJ: Classification of Obesity and Assessment of Obesity-Related Health Risk. Obes Res 2002; *10*: 105S-115S
5. Biela U, Pajak A, Kaczmarczyk-Chalas K, et al: The Incidence of Overweight and Obesity in Men and Women Aged 20-74 Years. The WOBASZ Programme Results. Kardiol Pol 2005; *63*: S1-S4 (in Polish)
6. Bryla M, Rydlewska-Liszkowska I, Smolen M: Industrial Health Care Complexes – Basic Institutions of the Working Population Health Care System in Poland. Med Lav 1988; *79:* 298-302
7. Calvaruso C: Investire in salute. nuove politiche di sanità pubblica per la promozione della salute et l'educazione sanitaria. I nuovi orizzonti dell'educazione sanitaria e della promozione della salute: politiche e reti per la salute. Atti della *Conferenza Nazionale di Educazione e Promozione della Salute*, Pisa 8-10 giugno 2000. Università degli Studi di Perugia. Centro Sperimentale per l'Educazione

Sanitaria interuniversitario. Perugia: Centro Stampe dell'Università degli Studi di Perugia, 2000: 41-47
8. Chrostowska M, Szczech R, Narkiewicz K: Obesity-Related Hypertension. Kardiologia na co Dzien 2007; *3*: 106-112 (in Polish)
9. Corda B, Borchini R, Taborelli S, et al: Attribuzioni e nuove responsabilità del medico competente. Med Lav 2007; *98*: 475-481
10. Czyzewski L: Overweight and Obesity as Risk Factors for Hypertension. Problemy Pielegniarstwa 2008; *16*: 128-135 (in Polish)
11. Facci R: The Occupational Physician in the Post-modern World. Med Lav 2006; *97*: 438-439
12. Indulski JA: Occupational Medicine on the Turn of the 21st Century: Changes and Their Determinants. Medycyna Pracy 1997; *48*: 355-365 (in Polish)
13. Jarosz M, Rychlik E: Overweight and Obesity among Adults in Poland. 1983-2005. Adv Med Sci 2008; *53*: 158-166
14. Jasiel-Wojculewicz H, Chrostowska M, Narkiewicz K: Obesity – Chosen Epidemiological and Prognostic Aspects. Kardiologia na co Dzien 2007; *3*: 79-83 (in Polish)
15. Kaleta D, Ruszkowska-Majzel J, Kwasniewska M, Drygas W: Overweight and Obesity as Risk Factors of Certain Chronic Diseases – Characteristic Elements of the Phenomenon and Preventive Recommendations. Kardiodiabetologia 2007; *2*: 19-23 (in Polish)
16. Kawecka-Jaszcz K, Posnik-Urbanska A, Jankowski P: The Incidence of Hypertension with Reference to Gender in the Light of Epidemiological Studies in Poland. Nadcisnienie Tetnicze 2007; *11*: 377-383 *(*in Polish)
17. Kinalska I, Kowalska I, Telejko B, et al: Obesity and Cardiovascular Complications in Diabetes. Przeglad Kardiodiabetologiczny 2007; *2*: 54-60 (in Polish)
18. La Scalza A, Donatini A, Orzella L, et al: Organizational Structure. [in:] Italy. Health System Review. Health Systems in Transition 2009. *11*: 17-38
19. Maciak A, Maniecka-Bryla I, Bryla M: The Prevalence of Hypertension among the Participants of the Early Detection Programme for the Prevention of Cardiovascular Diseases in the Medium-sized Town. Problemy Higieny i Epidemiologii 2009; *90*: 325-331 (in Polish)
20. Malnick SDH, Knobler H: The Medical Complications of Obesity. QJM 2006; *99*: 565-579
21. Masanotti G, Briziarelli L: La promozione della salute nei luoghi di lavoro (PSL): una risposta efficace ai cambiamenti nel mondo del lavoro. Proceedings – Part II. *VIth European Conference on Health Promotion and Education. Equity. Solidarity and Responsibility for Health*, June 18-21, 2003. Perugia. Supplemento n. 2 al 2/2004 di Educazione Sanitaria e Promozione della Salute. Perugia: Fondazione Angelo Celli, 2004: 495-504
22. Modolo MA: L'educazione sanitaria nella promozione della salute. I nuovi modelli per l'educazione sanitaria. Atti del *Convegno per i 45 anni del Centro Sperimentale per l'Educazione Sanitaria interuniversitario*, Perugia, 8-9 ottobre 1999. Perugia: Centro Stampa dell'Università degli Studi di Perugia, 2000: 27-38
23. Obesity: Preventing and Managing the Global Epidemic. Report of WHO Consultation of Obesity. World Health Organization. Geneva. Switzerland, 3-5 June, 1997
24. Perbellini L: L'attività lavorativa come fattore di rischio per l'obesità… e il contrario. Med Lav 2004; *95*: 211-222
25. Piechota G, Malkiewicz J, Karwat ID: Obesity as the Cause or Result of Disability. Przeglad Epidemiologiczny. 2005; *59*: 155-161 (in Polish)
26. Podolec P, Karch I, Pajak A, et al: The Review of Polish Epidemiological Studies in Cardiology. Kardiol Pol 2006; *64*: 1031-1037
27. Porier P, Giles TD, Bray GA, et al: Obesity and Cardiovascular Disease: Pathophysiology. Evaluation. and Effect of Weight Loss. Arteriosclerosis. Thrombosis and Vascular Biology: 2006; *26*: 968-976
28. Psurek A, Szymborska-Kajanek A, Wrobel M, Strojek K: Obesity and Cardiometabolic Risk. Przewodnik Lekarski 2008; *3*: 10-17 (in Polish)
29. Rejman A, Olszanecka-Glinianowicz M, Mizia-Stec K, Zahorska-Markiewicz B: The Incidence of Hypertension in the Population of Obese Patients of the Metabolic Diseases Clinic. Nadcisnienie Tetnicze 2006; *10*: 511-517 (in Polish)
30. Salerno S, Capacci F, Carnevale F, Tartaglia R: Attività del medico del lavoro in un servizio pubblico di prevenzione. Un caso italiano. Med Lav 1997; *88*: 108-120
31. Schulte P, Vainio H: Well-being at Work - Overview and Perspective. Scand J Work Environ Health 2010; *36*: 422-429
32. Sideti E, Mangiaracina P, Paolini P, Tringali G: Body Mass Index. Family Lifestyle. Physical Activity and Eating Behavior in a Sample of Primary School Students in a Small Town of Western Sicily. Ital J Public Health 2009; *6*: 205-217
33. Skoczylas A: The Treatment of Hypertension among Obese People. Wiadomosci Lekarskie 2006; *59*: 403-406
34. Skrzypek-Wanha J, Sosnowski M, Kozakiewicz K, et al: The Effectiveness of Preventive Action in the High-risk Coronary Artery Disease Population. Part II. The Distribution of Blood Pressure with Reference to

the Body Weight. Nadcisnienie Tetnicze 2002; *6*: 17-23 (in Polish)
35. Suchecka-Rachon K, Rachond: Obesity – Essentials Elements of the Metabolic Syndrome. Kardiologia na co Dzien 2007; *3*: 120-124 (in Polish)
36. Szymocha M, Bryla M, Maniecka-Bryla I: Obesity Epidemic in the 21st century. Zdrowie Publiczne 2009; *119*: 207-212
37. Thomson S, Foubister T, Mossaiolos E: Financing Health Care in the European Union. Challenge and Policy Responses. European Observatory on Health Systems and Policies. World Health Organization. Copenhagen 2009, 156-159, 175-179
38. Tykarski A, Grodzicki T: ESH/ESC 2007 Recommendations on the Treatment of Hypertension – What's New?. Nadcisnienie Tetnicze 2007; *11*: 261-303 (in Polish)
39. Zhang C, Rexrode KM, van Dam RM, et al: Abdominal Obesity and Risk of All-Cause. Cardiovascular. and Cancer Mortality: Sixteen Years of Follow-Up in US Woman. Circulation 2008; *117*: 1658-1667