

OVERWEIGHT, OBESITY, AND RELATED DISEASES AMONG WORKERS WITH DIFFERENT WORKLOAD

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Summary

A person's weight depends on major factors like genetics, diet, and physical activity. Physical activity in adults is defined mainly by workload – light, moderate or heavy. The aim was to explore associations between weight and chronic non-infectious diseases in workers with different physical activity. The subjects included in the study were 224 male and 249 female employees, divided by workload based on their job description. Body mass index (BMI) and disease incidence were calculated, and statistical analysis was performed. The highest percentage of overweight and obese subjects was found in men with light workload. The mean BMI for men (27.434.85) was significantly higher than that for women (25.875.06). Analysis of obesity-associated diseases showed that in workers with higher BMI there was a higher incidence of endocrine disorders, musculoskeletal and related neurological diseases. Diseases of the circulatory system were highly prevalent in both overweight/obese and underweight employees. In conclusion, physical activity at work contributes to changes in BMI in the working population. Obesity-associated circulatory, endocrine and musculoskeletal diseases were highly prevalent in the groups with higher BMI. The prevalence in employees without diseases was in inverse relation to BMI.

Keywords: overweight, obesity, workload, chronic non-infectious diseases

Introduction

The rising prevalence of overweight, obesity, and obesity-related diseases is one of the major health problems of modern society. It poses a significant threat especially in developing and low-income countries, due to increasing cost of both treatment and disability [1]. Currently, over half of the adult population in Bulgaria is overweight or obese, as well as one-fourth of children and young adults under 20 years [2].

Obesity and, to a lesser extent, overweight, are linked to significant non-infectious diseases like diabetes, cardiovascular diseases, musculoskeletal disorders, depression, etc. Hundreds of studies are carried out each year in order to define the exact role of obesity in the mechanisms of insulin resistance and diabetes [3], hypertension, coronary heart

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disease and stroke [4-6], musculoskeletal symptoms [7, 8] etc.

Defining and categorizing obesity has always been a difficult task [9]. The Body Mass Index (BMI) is an easily applied indicator of the normal proportion between a person's weight and height, and a tool for measuring overweight and obesity most commonly used worldwide. Devised in the middle of the 19th century by the Belgian mathematician Adolphe Quetelet, it is calculated as the individual's body mass divided by the square of their height, with the value expressed in units of kg/m². BMI value depends on major subjective factors like genetics, diet, and physical activity. Physical activity in adults is defined mainly by workload – light, moderate or heavy – into three categories (according to the classification by the General Labour Inspectorate, Bulgaria):

Category 1 (light physical work, energy expenditure up to 3 kcal/min) – sedentary, standing or moving work which does not require systemic physical exertion or lifting and carrying of heavy loads. Such are the main occupations in garment production, electronics, administration, and finance.

Category 2 (moderate physical work, energy expenditure 3-5 kcal/min) – work associated with constant walking, carrying of small weights (up to 10 kg) and work done in a constant standing position. These cover the main occupations in weaving industry, cold metal working, welding and painting, mechanical woodworking, mechanical and electrical maintenance.

Category 3 (heavy physical work, energy expenditure more than 5 kcal/min) – work associated with systematic exertion, constant movement and/or handling of significant (more than 10 kg) weights. Such are the main occupations in blasting, foundry and steel industry, assembling of heavy machinery and installations.

Our aim in this study was to define the BMI for workers with different physical workload and the prevalence of obesity-associated diseases among them.

Materials and Methods

Employees (224 males and 249 females) from different industries – garment industry, iron casting, metal working were studied. They were divided by gender and workload based on their occupations. Females were divided into groups

according to the workload: with light workload (administration, sewing machine operator, garment packer, quality control, forklift driver, crane operator); with moderate workload (ironing worker, cutter, knitter, textile finisher, and casting core machine operator, cleaner); with heavy workload (heavy casting core maker, emery worker, casting packer). The male workers were divided as follows: men with light workload (administration, management, forklift driver, crane operator), with moderate workload (textile finisher, dyer, textile printer, maintenance worker, quality control, emery worker, metal working machine tuner), and with high workload (moulder, caster, melting worker, casting cleaner). The mean age of women was 46.710.5 years and of men – 44.511.9 years. In the groups with heavy workload, the mean age was significantly lower – 42 years for women and 39.5 years for men.

Body mass index was calculated for each worker. Information on obesity-associated diseases (we focused on endocrine and metabolic diseases, diseases of the circulatory system, diseases of the musculoskeletal system and related nervous diseases) in the studied workers was obtained from periodic health exams organized by the Occupational Medical Service. All data was analyzed using Statsoft Statistica v.8.

Results

All mean group values of the Body Mass Index defined by gender and workload were in the overweight range - BMI from 25 to 30 kg/m² (Figure 1). BMI mean group values for male workers with different levels of physical activity did not show statistically significant differences, although mean BMI for men decreased with increased workload. In the female workers, a trend was visible of an increase in BMI with increasing workload, although not statistically significant. Mean BMI for men (27.434.85) was significantly higher than that of women (25.875.06), $p=0.0007$. This difference was associated with gender and not with age, because there was no significant difference in the mean age of males and females. The biggest difference in mean BMI between men and women was observed in the group with light workload.

Workers with BMI within the normal range predominated in the female group – 46% of all workers observed (Figure 2). The highest number

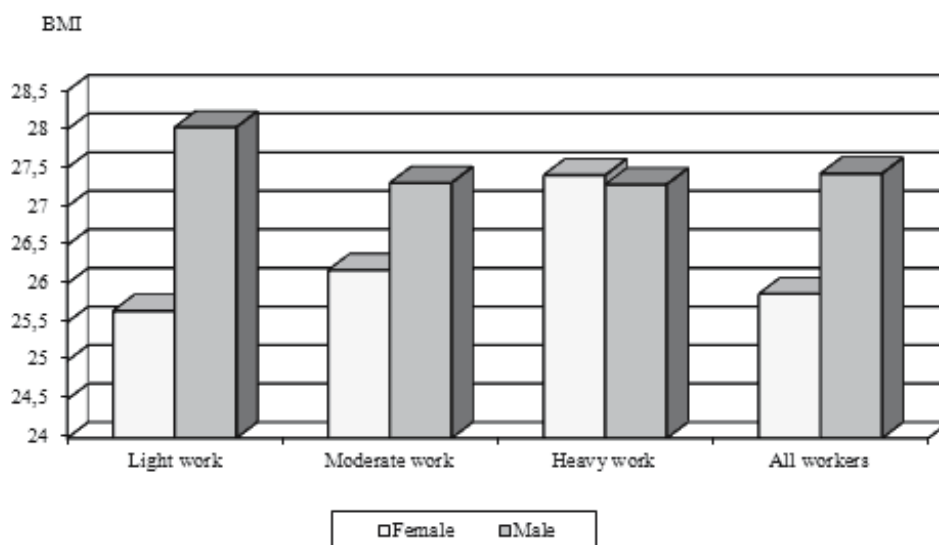


Figure 1. Mean BMI in female and male workers with different workload.

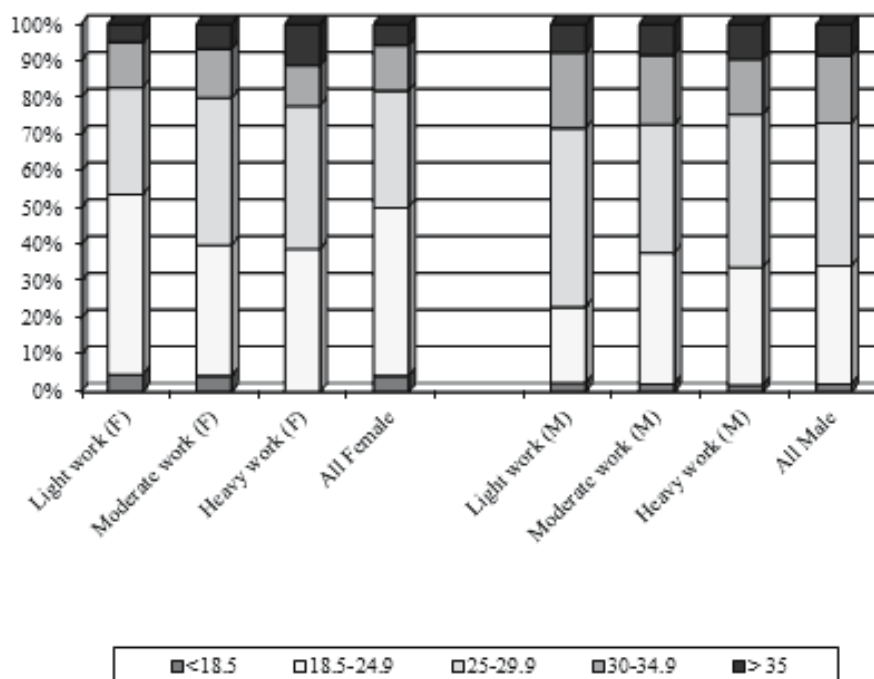


Figure 2. Distribution of workers' BMI in groups based on gender and workload

of women with normal BMI was in the group with light workload (49%). In males, overweight workers predominated – 39%; and the highest numbers were in the subgroup with light workload – 49%. Most men with normal BMI were in the subgroup with moderate workload

(36%), followed by workers with heavy workload (32%). In the group of men with light workload only 20% of the workers had normal weight.

A significant correlation was found between BMI and age ($r=0.15$; $p=0.001$), more

pronounced in the female group ($r=0.28$; $p=0.000005$).

Analysis of data on diseases associated with overweight and obesity (Figure 3) showed that increase of BMI was associated with increased incidence of endocrine disorders (mainly represented by type 2 diabetes and dyslipidemias), as well as cases of musculoskeletal and related neurological diseases (e.g. damages of vertebral disks and associated nerve roots and plexuses). Diseases of the circulatory system were highly prevalent in employees with overweight and obesity, as well

as in the underweight group. Increase in BMI was associated with decreased rate of workers without disease (the “Health Index”), and there was no healthy person in the group with severe obesity (BMI over 40 kg/m²).

Distribution of obesity-associated diseases by BMI showed that about 70% of the circulatory and endocrine diseases were found in workers with overweight and obesity (Table 1). Approximately 60% of the registered musculoskeletal disorders were in the groups with BMI over 25 kg/m².

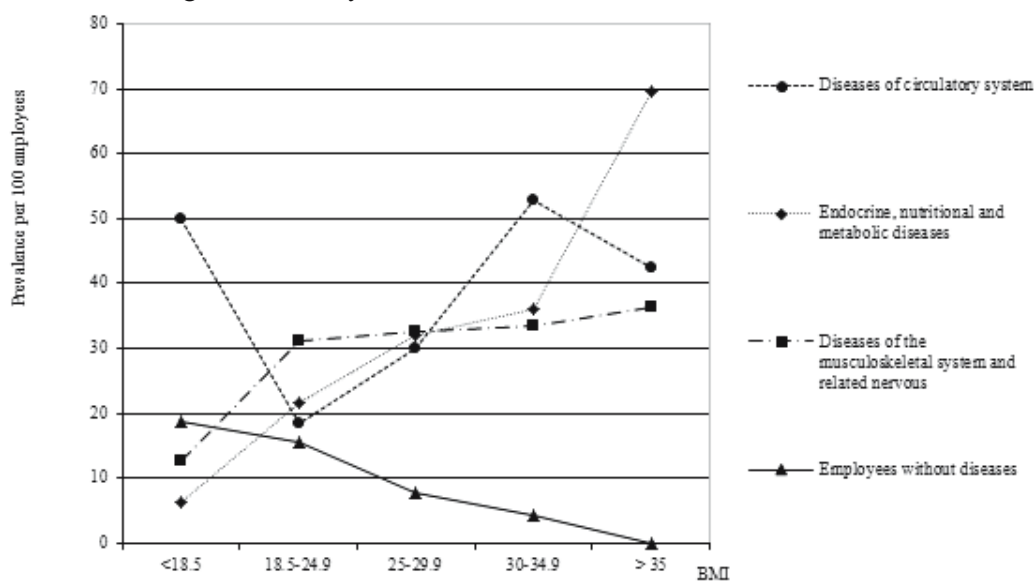


Figure 3. Obesity-associated disease prevalence according to BMI

Table 1. Distribution of associated diseases among workers with different BMI [%]

BMI (kg/m ²)	Diseases of the circulatory system		Endocrine, nutritional and metabolic diseases		Musculoskeletal and related nervous diseases		Employees without diseases	
	F	M	F	M	F	M	F	M
Underweight (<18.5)	9.8	1.4	0	1.2	2.4	0	6.3	0
Normal Weight (18.5-24.9)	24.6	26	33.3	25.6	39.3	39	60.4	35.9
Overweight (25-29.9)	37.7	36.2	28.9	45.1	32.2	39	27.1	37.2
Obese (30-34.9)	16.4	26.1	22.2	13.4	19	12.5	3	23.3
Severely Obese (>35)	11.5	10.1	15.5	14.6	7.1	9.4	6.2	4.7

Discussion

In our study, the percentage of male workers with overweight/obesity (65.6%) was higher than the national average (59.7%) which was due to the

high number of subjects with BMI over 25 in the group with light workload [2]. The percentage of female workers with overweight/obesity was almost equal to the national average – 49.8% against 48.8%.

In the male group, mean group BMI decrease with increasing workload was directly influenced by the increased energy consumption associated with heavy physical labor. The highest mean BMI in men with light workload was a direct result of insufficient physical activity. For women, the mean group BMI levels showed the opposite – increase in BMI with increased workload. Higher BMI in women with heavy physical work could be explained with increased muscle mass in response to high demands of work tasks and women's adaptation. Due to a significant drawback of BMI (not distinguishing whether higher weight is due to fat or muscle tissue), increased weight of women with heavy workload presented as overweight or obese. Despite this peculiarity, the number of females with normal body weight was still predominant.

The increased prevalence of diseases associated with increased BMI could very easily be explained by obesity, but working environment and ergonomic factors in the surveyed industries could be a major factor. A large number of the workers we studied were exposed to noise that appears to be an additional stressor and a cause of cardiovascular diseases [10]. Excessive heat, typical of the iron casting and hot metal working industries, leads to metabolic disorders and dyslipidemias [11]. Musculoskeletal disorders are also multifactorial and, apart from obesity, are associated with a number of ergonomic and organizational failures [12, 13]. In our study the relationship between BMI and obesity-associated diseases is clearly visible, but future research should clarify the importance and severity of each factor (lifestyle and occupational) in the prevalence and progression of cardiovascular, musculoskeletal and endocrine diseases.

Conclusions

Our analysis showed that physical activity at work contributed to changes in BMI in both males and females. Mean BMIs for all groups, divided by gender and workload, were in the overweight range (25-29.9 kg/m²). Men with light workload were at highest risk of obesity. BMI correlated with aging, especially for the female workers. Obesity-associated circulatory, endocrine and musculoskeletal diseases were highly prevalent in the groups with higher BMI. The health index (prevalence of employees without diseases) was in inverse proportion to

BMI.

Our small study adds a perspective to the large number of publications giving proof of the significant impact of overweight/obesity on workers' health, which is further worsened by the growing trend of aging workforce in Europe and Bulgaria. Urgent measures need to be implemented at the workplace to preserve and promote workers' health. These measures should be a main task of the Occupational Medical Services in Bulgaria, but also of all employers in the country.

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