# PREVALENCE OF RISK FACTORS IN CARDIOVASCULAR DISEASES IN SELECTED POPULATION OF THE CZECH REPUBLIC

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**SUMMARY**

*Objectives:* The aim of the study is to describe current prevalence of selected risk factors in the Czech general population in a particular region and to compare the data with recently published results in the selected population of Czech soldiers. The work also deals with the advantages and disadvantages of methods determining overweight and obesity.

*Methods:* Within medical preventive examinations the data of 1,051 individuals (482 men, 569 women) were obtained. In this group anthropometric parameters such as height, body weight, Body Mass Index (BMI), and waist circumference were monitored. From biochemical parameters the following values were monitored: glycaemia, uric acid, total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides. Demographic data such as age, gender and achieved education were processed.

*Results:* Average BMI values in men were in the overweight range. Monitored average BMI values in women were up to standards. Monitored anthropometric parameters significantly increased with the age of examined individuals. The highest values of BMI and waist circumference were found in the over-50 age group. Selected biochemical parameters also increased with the age of examined individuals. Education did not have significant influence on the values of selected parameters. A statistically significant positive correlation was found between the values of BMI and waist circumference. The correlation coefficient in men was $r = 0.804$, $p < 0.001$, and in women $r = 0.858$, $p < 0.001$.

*Conclusion:* The work confirmed differences in anthropometric parameters between the civilian and military Czech male population due to a higher muscle mass percentage in the military population. The work also confirmed the significance of further anthropometric methods in diagnostics of overweight and obesity. The number of individuals with anthropometric and biochemical parameters out of the physiological range is increasing in the over-50 age category.

*Key words:* cardiovascular diseases, overweight, obesity, anthropometry, preventive measures

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## INTRODUCTION

Cardiovascular disease (CVD), particularly ischaemic heart disease, is the number one cause in total morbidity and mortality in the Czech Republic. Ischaemic heart disease results in approximately 40% of all deaths due to cardiovascular causes (1). Increased concentrations of total cholesterol and LDL-cholesterol in plasma, decreased concentrations of HDL- cholesterol, arterial hypertension, smoking cigarettes, diabetes mellitus, and obesity are considered causal risk factors of CVD (1). According to BMI value more than 55% of inhabitants in the Czech Republic suffer from overweight and obesity (2). In the last 20 years a decrease in standardized cardiovascular mortality has been observed in the Czech Republic. This decrease is caused on one hand by new and more effective ways of treatment, on the other hand also by changes in the lifestyle, better eating habits, and by more consistent application of the principles of primary and secondary prevention by the first contact doctors (1, 3). This work is aimed at current prevalence of selected risk factors in the Czech general population in a particular region. It responses to a recently published study concerning the selected population of military professionals (4). It also verifies obesity criteria in standard screening which have been discussed in recent years (5–7).

## MATERIALS AND METHODS

The group of patients was recruited randomly within medical preventive examinations which were performed in several general practitioner's surgeries from 2014 to 2016 in the Capital City of

Prague, in the Prague Municipal Districts 5 and 10. In this group anthropometric parameters such as height, body weight, body mass index (BMI), and waist circumference were monitored. The body weight was determined in each proband wearing only underwear and without shoes under standard conditions that means on an empty stomach in the morning. To determine the body weight standard stand-on scales were used. The height measurement was performed using altimeter, the measured person was always without shoes. BMI was calculated as the ratio of body weight in kg to the squared height in meters (8). The waist circumference was measured at half the distance between the bottom edge of the lower rib and iliac crest of the hip bone at a horizontal level. Waist circumference values were defined according to the cardiometabolic risk. There is a moderate risk in waist circumference >94 cm, possibly 80 cm (risk level 1), and a high risk (risk level 2) in waist circumference higher than 102 cm in men and 88 cm in women (9).

From biochemical parameters the following values were monitored: glycaemia, uric acid, total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides (TG). A venous blood sample was withdrawn on an empty stomach and parameters were determined in certified laboratories using standard laboratory methods. Demographic data such as age, gender, achieved education, and the size of permanent residence place were processed. The statistical data analysis was carried out using the software Stata13 (StataCorp, USA). The frequency analysis of the group was carried out using the same software. The comparison of results was performed using a Student's t-test. The significance level was determined in all analyses as $p \leq 0.05$.

## RESULTS

From 2014 to 2016 the data of 1,051 individuals, 482 men and 569 women, were randomly obtained within medical preventive examinations. The average age of the examined group was 45.6 ± 14.7 years in men and 44.8 ± 13.7 years in women.

Average BMI values in men were in the overweight range. Monitored average BMI values in women were up to standards. Average values in waist circumference in men and women did not exceed the limits of high cardiometabolic risk (Table 1).

Table 2 shows the number of individuals with normal body weight, overweight and obesity. There is also shown the distribution of individuals according to the waist circumference value.

Monitored anthropometric parameters significantly increased with the age of examined individuals. Table 3 shows the growth in the values of BMI and waist circumference in separate age categories.

If the group was divided into two age categories, under the age of 40 (n = 412) and over the age of 40 (n = 639), the values of BMI and waist circumference were statistically significantly different ($p < 0.001$). The highest values of BMI and waist circumference were found in the group over the age of 50 (Tables 3 and 4).

Selected biochemical parameters also increased with the age of examined individuals (Table 4). Comparing the two above mentioned age groups showed that the levels of glycaemia and total cholesterol statistically significantly differed ($p < 0.001$) in both genders. The rest of biochemical parameters (LDL-cholesterol, non-HDL-cholesterol and triglycerides) were statistically significantly different ($p < 0.001$) only in women.

As expected, selected anthropometric parameters (height, body weight, waist circumference, BMI) were statistically significantly different depending on the proband's gender ($p < 0.05$). Differences in selected biochemical parameters (glycaemia, LDL-cholesterol, HDL-cholesterol, and triglycerides) were small. Only in total cholesterol there was observed no difference ($p = 0.73$) (Table 1).

Education influenced the values of selected parameters only in the group of women. If the group was divided into a group of individuals with university education (n = 443) and in the group of individuals with lower than university education (n = 608), statistically significantly lower values were observed in the values of BMI and waist circumference ($p < 0.001$). From biochemical parameters the statistically significantly lower values were observed in the values of glycaemia, total cholesterol and non-HDL-cholesterol ($p < 0.05$) in the group of individuals with university education (Table 5).

Table 6 shows individuals with increased biochemical parameters values. The highest percentage of increased values was found in the values of total cholesterol and LDL-cholesterol.

Statistically significant positive correlation was found between BMI and waist circumference values. The correlation coefficient in men was $r = 0.804$, $p < 0.001$, and in women $r = 0.858$, $p < 0.001$.

***Table 1.*** *Average values of separate parameters in men and women according to gender (N = 1,051)*

| Variables | Men (n = 482) | | Women (n = 569) | | p |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Weight (kg) | 88.3 | 15.3 | 69.8 | 14.8 | < 0.001 |
| Height (cm) | 180.2 | 7.4 | 167.0 | 6.8 | < 0.001 |
| BMI (kg/m$^2$) | 27.1 | 4.1 | 25.0 | 5.0 | < 0.001 |
| Waist circumference (cm) | 97.1 | 14.3 | 84.5 | 15.7 | < 0.001 |
| Glycaemia (mmol.l$^{-1}$) | 5.13 | 0.94 | 4.99 | 0.73 | 0.009 |
| Total cholesterol (mmol.l$^{-1}$) | 5.13 | 0.96 | 5.11 | 0.95 | 0.735 |
| LDL cholesterol (mmol.l$^{-1}$) | 3.04 | 0.74 | 2.91 | 0.75 | 0.004 |
| HDL cholesterol (mmol.l$^{-1}$) | 1.36 | 0.37 | 1.53 | 0.46 | < 0.001 |
| non-HDL cholesterol (mmol.l$^{-1}$) | 3.77 | 0.97 | 3.58 | 0.96 | 0.002 |
| TG (mmol.l$^{-1}$) | 1.47 | 0.80 | 1.25 | 0.60 | < 0.001 |

***Table 2.*** *Distribution of men and women in BMI categories and in separate risk categories according to waist circumference (N = 1,051)*

| | | Men (n = 482) | | Women (n = 569) | |
|---|---|---|---|---|---|
| | | n | % | n | % |
| BMI (kg/m$^2$) | Normal | 149 | 30.9 | 324 | 56.9 |
| | Overweight | 235 | 48.8 | 152 | 26.7 |
| | Obesity | 98 | 20.3 | 93 | 16.3 |
| Waist circumference (cm) | Normal | 207 | 43.0 | 250 | 43.9 |
| | Risk I (> 94/80 cm) | 124 | 25.7 | 97 | 17.1 |
| | Risk II (> 102/88 cm) | 151 | 31.3 | 222 | 39.0 |

***Table 3.*** *Average values of separate parameters according to age*

| Age group | | BMI (kg/m$^2$) | | Waist circumference (cm) | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| Less 30 years | M | 25.0 | 4.3 | 91.8 | 14.3 |
| | F | 22.6 | 4.7 | 76.9 | 13.3 |
| 30–39 years | M | 26.7 | 4.1 | 95.0 | 12.2 |
| | F | 23.4 | 4.3 | 80.5 | 13.7 |
| 40–49 years | M | 27.6 | 4.0 | 97.4 | 13.7 |
| | F | 25.1 | 4.8 | 83.6 | 15.8 |
| 50–59 years | M | 28.5 | 4.3 | 101.5 | 15.3 |
| | F | 27.1 | 5.1 | 90.7 | 16.1 |
| Over 60 years | M | 27.4 | 3.5 | 99.1 | 14.5 |
| | F | 26.7 | 4.7 | 90.6 | 13.9 |

***Table 4.*** *Average values of separate parameters according to age (N = 1,051)*

| Variables | | Less than 40 years (n = 412) | | Over 40 years (n = 639) | | p |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| BMI (kg/m$^2$) | M | 26.1 | 4.3 | 27.8 | 3.9 | < 0.001 |
| | F | 23.1 | 4.5 | 26.2 | 5.0 | < 0.001 |
| Waist circumference (cm) | M | 93.8 | 13.1 | 99.2 | 14.6 | < 0.001 |
| | F | 79.1 | 13.7 | 88.0 | 15.9 | < 0.001 |
| Glycaemia (mmol.l$^{-1}$) | M | 4.90 | 0.59 | 5.45 | 1.2 | < 0.001 |
| | F | 4.83 | 0.54 | 5.24 | 0.89 | < 0.001 |
| Total cholesterol (mmol.l$^{-1}$) | M | 4.94 | 0.93 | 5.26 | 0.96 | < 0.001 |
| | F | 4.82 | 0.78 | 5.29 | 0.99 | < 0.001 |
| LDL cholesterol (mmol.l$^{-1}$) | M | 2.98 | 0.73 | 3.08 | 0.74 | 0.144 |
| | F | 2.76 | 0.64 | 3.00 | 0.80 | < 0.001 |
| HDL cholesterol (mmol.l$^{-1}$) | M | 1.34 | 0.34 | 1.38 | 0.39 | 0.191 |
| | F | 1.50 | 0.44 | 1.56 | 0.46 | 0.107 |
| Non-HDL cholesterol (mmol.l$^{-1}$) | M | 3.60 | 0.92 | 3.88 | 0.99 | 0.002 |
| | F | 3.33 | 0.82 | 3.74 | 1.00 | < 0.001 |
| TG (mmol.l$^{-1}$) | M | 1.36 | 0.73 | 1.53 | 0.84 | 0.021 |
| | F | 1.12 | 0.52 | 1.33 | 0.64 | < 0.001 |

## DISCUSSION

BMI value is the main parameter in assessing overweight and obesity in the long term (8). According to this parameter 48.8% of men and 26.7% of women in the examined group suffer from overweight and 20.3% of men and 16.3% of women suffer from obesity. If only the BMI value is considered, it could mean that nearly 70% of men have been diagnosed with overweight or obe-

***Table 5.*** *Average values of separate parameters according to education (N = 1,051)*

| Variables | | Lower than university education (n = 608) | | University education (n = 443) | | p |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | |
| BMI (kg/m$^2$) | M | 27.2 | 4.6 | 27.0 | 3.7 | 0.311 |
| | F | 25.7 | 5.2 | 24.0 | 4.7 | < 0.001 |
| Waist circumference (cm) | M | 97.2 | 15.0 | 97.0 | 15.0 | 0.881 |
| | F | 86.4 | 16.4 | 81.6 | 14.0 | < 0.001 |
| Glycaemia (mmol.l$^{-1}$) | M | 5.1 | 1.8 | 5.09 | 0.77 | 0.207 |
| | F | 5.05 | 0.79 | 4.91 | 0.62 | 0.015 |
| Total cholesterol (mmol.l$^{-1}$) | M | 5.11 | 0.97 | 5.15 | 0.95 | 0.608 |
| | F | 5.18 | 0.98 | 5.00 | 0.88 | 0.027 |
| LDL cholesterol (mmol.l$^{-1}$) | M | 3.04 | 0.73 | 3.05 | 0.75 | 0.877 |
| | F | 2.94 | 0.77 | 2.86 | 0.71 | 0.204 |
| HDL cholesterol (mmol.l$^{-1}$) | M | 1.39 | 0.39 | 1.34 | 0.34 | 0.108 |
| | F | 1.54 | 0.46 | 1.52 | 0.45 | 0.617 |
| Non-HDL cholesterol (mmol.l$^{-1}$) | M | 3.72 | 0.94 | 3.82 | 1.01 | 0.271 |
| | F | 3.64 | 0.98 | 3.48 | 0.91 | 0.043 |
| TG (mmol.l$^{-1}$) | M | 1.36 | 0.68 | 1.34 | 0.74 | 0.725 |
| | F | 1.29 | 0.61 | 1.19 | 0.59 | 0.060 |

***Table 6.*** *Percentage of individuals with risk values of biochemical parameters (N = 1,051)*

| Variables | Risk values Men (n = 482) | | Risk values Women (n = 569) | |
|---|---|---|---|---|
| | n | % | n | % |
| Total cholesterol (> 5.0 mmol.l$^{-1}$) | 255 | 52.9 | 279 | 49.0 |
| TG (> 1.7 mmol.l$^{-1}$) | 120 | 24.9 | 90 | 15.8 |
| LDL (> 3.0 mmol.l$^{-1}$) | 228 | 47.3 | 216 | 38.0 |
| HDL (< 1.0 or < 1.3 mmol.l$^{-1}$) | 229 | 47.5 | 34 | 6.0 |
| Glycaemia (> 5.6 mmol.l$^{-1}$) | 91 | 18.9 | 73 | 12.8 |
| Uric acid (> 420 or > 340 μmol.l$^{-1}$) | 80 | 16.6 | 11 | 1.9 |

sity. The obtained total of individuals with higher body weight corresponds to the values obtained in the civilian population not only in the Czech Republic but also abroad. In 2009, a representative sample of the Czech population (n = 2,058) showed overweight in 34% of individuals and obesity in 23% of individuals. It was observed that the most risky period for increasing body weight is between the age of 50 and 59 when hypertension and diabetes is most frequently diagnosed (2). Prevalence of overweight and obesity in Spain was observed in 6,124 probands and it was diagnosed in 74% of them (10). The same incidence of overweight and obesity of 34% was observed in the American population (11).

In comparison with the civilian population followed in our group, the percentage of Czech male soldiers in separate categories according to BMI is different. According to the last observation in 2015, 17% of men were diagnosed as obese. On the contrary, more than 58% of male soldiers are categorized as overweight. So, there is a lower number of male soldiers with the BMI values over 30 kg/m$^2$ in the Czech Armed Forces (4).

This high percentage in overweight is given mostly by the number of individuals with higher body weight due to their increased muscle mass (12). The same results were obtained in the military population of other armies (13, 14).

As expected and in accord with the results of other authors (4, 12, 15), the values of anthropometric parameters of obesity in the monitored group are increasing depending on the age of examined individuals. The highest BMI values were registered in the 50–59 age category. To the contrary, the highest waist circumference values were registered in the over-60 age category. This piece of knowledge can support the idea that the waist circumference value is better for assessing the classes of obesity, because in the over-60 age category the adipose tissue around the waist is increasing and the muscle mass is decreasing.

By assessing the waist circumference, the percentage of men with increased values was lower than by assessing the BMI. Overweight was observed in 49% of men, but only 26% of them had an increased waist circumference in the range of a moderate risk. The waist circumference higher than 102 cm was found in 31.3% of men. This fact showed a big difference from the Czech military population in which the waist circumference over 102 cm was found only in 15% of Czech male soldiers (4).

To the contrary, in the female subpopulation, in which such an amount of muscle mass cannot physiologically be found and in which a smaller variability in the muscle mass percentage is observed, the values of waist circumference and BMI are approximately in similar percentage values. The above mentioned results confirm the assumption that according to the BMI value male individuals with a normal body fat percentage and increased muscle mass are also included into the category of overweight. Thus, the BMI criterion itself is not sufficient, especially for assessing the overweight. It is necessary to extend the current assessment algorithm by further parameters, especially by the waist circumference value and the total body fat percentage. These parameters can complete appropriately the BMI values and thus better identify individuals with the risk of obesity and associated complications (5–7). According to other authors the waist circumference value is a better risk indicator for the incidence of diabetes mellitus or metabolic syndrome than the BMI value (16, 17). It is also suitable to combine the BMI value and impedance techniques (18).

Nearly half of the monitored men had higher LDL-cholesterol levels, but the average value of the monitored parameter was at the upper bound of the physiological range (3.04 mmol.l$^{-1}$). In the group of men a higher HDL-cholesterol level was observed in nearly 50% of cases, which, in accord with other studies, poses an independent protective factor for cardiovascular diseases (19, 20).

Increased glycaemia level was observed in nearly 19% of men. To the contrary, monitored parameters increased over the physiological range were observed in women to a lesser extent. Average values of selected biochemical parameters were in both men and women in the physiological ranges.

In comparison with other data, in the group of 6,154 Czech male soldiers (average age in the group was 40.4 ± 6.9 years), the average LDL-cholesterol level was 3.3 mmol.l$^{-1}$. Other monitored biochemical parameters were in the group of Czech male soldiers on average in the physiological ranges (4). In the group of 2,508 Czech men and women (51% of women), higher LDL-cholesterol level was observed in 40% of individuals (21).

Some of the above mentioned anthropometric and biochemical parameters were reciprocally compared to determine the size of correlation between them. It concerned anthropometric parameters such as body weight, BMI and waist circumference; and biochemical parameters such as glycaemia, total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides values.

As assumed, a very tight positive correlation between the BMI value and the waist circumference value was observed in men and in women. It can be proved that this correlation is less tight in men. This fact confirmed again a greater significance of variability of muscle mass percentage in the BMI parameter in men. In view of a higher muscle mass percentage in men and based on the observed differences in correlations between genders it is possible to state that the BMI value is more usable for a female population, to the contrary, the waist circumference value is a more significant value in men.

Further interesting correlations between separate anthropometric and biochemical parameters were not observed or were not statistically significant. It was found out that in the examined group monitored anthropometric parameters such as body weight, waist circumference and BMI influence the values of glycaemia or lipid profile at the statistical significance level of $p < 0.05$ neither in men nor in women.

## CONCLUSION

The prevalence of some risk factors in cardiovascular diseases is shown on a chosen sample of the population from a particular region of the Czech Republic.

In accord with works of other authors, it was confirmed that in the over-50 age group the number of individuals with anthropometric and biochemical parameters out of the physiological range is increasing (21, 22). The work confirmed differences in anthropometric parameters between the civilian and military Czech male population which are caused by a higher muscle mass percentage in the military population. The work also confirmed significance of further anthropometric methods in diagnostics of overweight and obesity in dependence on gender (23).

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**Conflict of Interests**

None declared

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