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Comparison of the risk of cardiovascular diseases, stroke, and diabetes among the selected group of football referees and the group of general population men from Northern Poland – a pilot study

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Abstract. – OBJECTIVE: We aimed at comparing the total body fat and visceral adipose tissue content in football referees and in the control group of general population men. An assessment of compliance with health promoting behavior in both groups was carried out.

PATIENTS AND METHODS: This study, conducted in Northern Poland, involved 112 men. The study group comprised 56 men, football referees. The control group consisted of randomly chosen general population men, not engaged in any sport activities. Assessment of compliance with health promoting behavior among football referees and general population men was based on ultrasound imaging using the BodyMetrix System device (IntelaMetrix, Poland). The study employed a survey questionnaire comprised of the original section and two standardized questionnaires: the Health Behavior Inventory (HBI) and the NEO-Five Factor Inventory (NEO-FFI): the Health Behavior Inventory (HBI) and the NEO-Five Factor Inventory (NEO-FFI).

RESULTS: The visceral adipose tissue content in the study group (football referees) was found to be low, and the excess of body fat was 0-0.25 kg. In the control group, the trunk fat volume was found to be higher by more than 8% as compared with the study group. Also, the level of visceral adipose tissue was high, and the excess of body fat was 0-4 kg.

CONCLUSIONS: Thanks to properly planned and systematically continued physical activity, despite non-compliance with certain pro-health principles (increased sweet supply and consumption of alcoholic beverages), football referees are characterized by the correct body fat volume and low level of visceral adipose tissue. The parameters were found to be markedly higher in the control group of randomly selected men from the general population. The risk of diabetes, stroke, and cardiovascular diseases among football referees was found to be very low.

Key Words:
Adipose tissue, Risk for cardiovascular diseases, Football referees.

Introduction

Apart from facilitating and improving life conditions, civilization progress creates numerous threats to human health. A high industrialization level, the increasingly rapid pace of life, environmental pollution, poor lifestyle (improper diet, use of various kinds of stimulants, physical inactivity), stressful situations and, particularly, inadequate disease prevention are conducive to the development of numerous diseases of affluence. Obesity, which is considered a disease of affluence, is a tremendous threat[1-3]. It is a pathologically increased volume of adipose tissue which disturbs the functioning of the body and is considered to be the cause of numerous health complications in the modern world, e.g., cardiovascular diseases (coronary heart disease, hypertension, and myocardial infarction), insulin resistance, type 2 diabetes, endocrine disorders, and neoplasms. Two basic phenotypes

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of obesity can be distinguished: visceral (abdominal – waist circumference ≥80 cm in women and ≥94 in men) and gynoid (accumulation of adipose tissue in the area of thighs and hips)[4,5]. The studies show a substantial cause and effect relationship between the patterns of health-oriented behaviors and health status. The mechanism of health-oriented behaviors depends on biological, psychological, social, and civilizational factors. Health promoting actions – properly balanced diet, excluding or limiting the use of stimulants, avoiding stressful situations, limiting excessive physical effort, taking preventive actions, such as regular blood tests, and monitoring body weight, arterial blood pressure and adipose tissue parameters etc. – have a beneficial effect on health status[6,7].

Health promoting activities also include being physically active, which significantly reduces cardiovascular risk factors, such as excessive adipose tissue content and elevated levels of lipoprotein LDL fraction (low-density lipoprotein), diabetes, and hypertension. When taking preventive measures in individuals at risk for cardiovascular disease, obesity or diabetes, as well as in patients with recurrent cardiovascular disorders, the type of exercise should be analyzed and adjusted individually to age, sex, and current health status. The form of physical activity can incorporate various activities – running, quick march, swimming, cycling – in numerous configurations and varied intensity[8]. The 2010 guidelines of the World Health Organization list physical activity as an important tool in improving population's health status[9].

In the prevention of diseases of affluence, in addition to enhancing pro-health behaviors, it is particularly important to systematically monitor the parameters of adipose tissue, especially the amount of visceral fat, since its excess is not only a marker of obesity, but also a cause of numerous life-threatening diseases[10,11].

Athletes are generally considered to be individuals mindful of their health status, engaged in regular physical activity, and following the health promoting principles[12]. Football referees belong to a group of athletes as officiating at sporting events necessitates maintaining proper fitness and health. Depending on specialization, the work of a football referee is considered light work and, when active physical participation in sporting events is required, a medium light work[13]. On average, a football referee officiates 47 football matches per season (season of two rounds: spring and autumn) and covers the distance of 9-13 km in each match. Physical activity is accompanied by intense mental effort due to the required high degree of focus. Sound health and fitness are the basic requirements for a football referee to officiate sporting events[13-16].

The regulations of professional advancement or degradation to the 3rd or the 4th division of the Collegium of Football Referees of the West-Pomeranian Football Association, specifically paragraph 4, define that "the title of a football referee can be awarded to an individual characterized by good physical fitness, athletic silhouette, and impeccable moral standing". Football referees take fitness exams at least two times per sporting season. The fitness exam comprises a speed test and an interval running test, and the minimum passing requirements must be met[15]. The aims of our study were:

1. Comparison of the total body fat and visceral adipose tissue content in football referees and the control group of general population men.
2. Assessment of the risk of diabetes, stroke, and cardiovascular diseases in the studied groups based on ultrasound imaging using the BodyMetrix System device (IntelaMetrix, Poland).
3. Assessment of compliance with health promoting behaviors among football referees and general population men.

Patients and Methods

This study, conducted in Northern Poland, involved 112 men. The study group comprised 56 men, football referees, with a mean age of 32. The control group consisted of randomly chosen general population men, not engaged in any sport activities, with a mean age of 47.

The study employed a survey questionnaire comprised of the original section and two standardized questionnaires: the Health Behavior Inventory (HBI) aimed at the assessment of health-oriented behaviors and the NEO-Five Factor Inventory (NEO-FFI) – the five-factor inventory of personality. The body fat and body composition analysis were performed with non-invasive methods. To determine the percentage trunk fat content and the volume of visceral adipose tissue the Bioelectrical Impedance Analysis (BIA), i.e., measuring the electrical resistance, was used. The analysis was conducted with the use of the Abdominal Fat Analyzer VisCan AB 140 (Tanita Corporation, Tokyo, Japan) equipped with an im-

Table I. Percentage trunk fat content according to the manufacturer of TANITA AB-140 ViScan.

Low	Average			High
6-21.5%	21.5-25.3%	25.3-33.0%	33.0-36.9%	36.9-52.3%

pedance meter with 4 abdominal electrodes. The range of visceral fat in degrees and the percentage of body fat according to the manufacturer TANITA AB-140 ViScan are presented in Table I and Table II. According to the manufacturer's recommendation, the body composition and the analysis of adipose tissue parameters were conducted using the Jackson-Pollock method with measurements taken at 7 sites: in the area of the pectoral muscle, subscapular site, suprailiac measurement, the triceps muscle, waist – around the navel, anterior iliac spine and the central section of the quadriceps muscle, using the BodyMetrix set (ultrasound method), equipped with a scanner and BodyView 2D software (IntelaMetrix, Poland). Moreover, waist to hip ratio (WHR) employed to identify the obesity type was determined[17].

Statistical Analysis

Statistical analysis was conducted in the R software environment, version 3.6.1. The distribution of the results for individual variables was obtained with the Shapiro-Wilk W-test. As most of the distributions deviated from normal, the non-parametric Mann-Whitney U-test was applied. For qualitative variables, either Fisher's exact test or a chi-squared test was used. *p*-values of less than 0.05 were considered as significant. The results are presented as median (M), lower and upper quartiles (Q_1–Q_3), arithmetic mean, and standard deviation (±SD).

Results

The study group comprised men (football referees) at the mean age of 32, and the control group were men (not football referees) at the mean age of 47. Both groups included men (comparable numbers) who were married, single, and only two men (one in each group) were widowers. The men from the study group had higher educational attainment. The number of unemployed men in the control group was higher than in the study group. Football referees lived in smaller localities, and 35% of men in the study group and 66% of the control group lived in a city of over 100,000 inhabitants.

Table III shows the body composition of men in both groups. The analysis of the parameters showed a markedly higher WHR, higher percentage content of non-adipose mass and body water in the study group. BMI, trunk fat content, the level of visceral adipose tissue, total body fat (marked in kg and as percentage) and the amount of excessively developed adipose tissue were significantly higher in the control group.

Table IV shows the health-oriented behavior in both analyzed groups. Health-oriented behavior in both analyzed groups was comparable. No statistically significant differences were shown.

Table V shows personality traits as assessed by five-factor NEO-FFI in both groups. The personality analysis of the men in both groups showed that football referees were less conscientious than the men in the control group.

Table VI shows self-reported health status in both groups. Football referees declared higher self-assessed health status.

Table VII shows the incidence of chronic diseases in both groups. The analysis showed that the incidence of chronic diseases was lower in the study group. Arterial hypertension was more frequently reported in the control group ($p<0.001$).

Table VIII shows the number of smokers in both groups. The study group (football referees) included fewer smokers (Table VI).

Table IX shows limiting the consumption of food products in both groups. The men from the control group more frequently limited the consumption of the following products: sugar and sweets, bread, potatoes, groats, pasta, rice, fish as well as meat and cold meats, raw vegetables, raw fruits, dairy products, fat and high-fat foods. The

Table II. Visceral fat content in grades according to the manufacturer of TANITA AB-140 ViScan.

Normal		Elevated level		Extremely elevated level	
1.0-5.0	5.5-9.5	10.0-12.0	12.5-14.5	15.0-17.0	over 17.5

Table III. Association of circ_001680 expression with clinicopathologic characteristics of glioma.

Measurement		Group		p
		Study group	Control group	
Trunk fat content [%]	mean ± SD	22.61 ± 6.51	30.2 ± 8.55	$p < 0.001$*
	median	22.5	30.65	
	Q1-Q3	18.65-27.35	25.95-35.58	
Visceral fat level [grade]	mean ± SD	8.79 ± 4.19	14.47 ± 6.43	$p < 0.001$*
	median	8.25	14.5	
	Q1-Q3	5.5-11	9.62-18.5	
BMI [kg/m²]	mean ± SD	24.84 ± 3.08	28.19 ± 4.7	$p < 0.001$*
	median	24.25	27.55	
	Q1-Q3	23.3-26.6	24.77-30.55	
WHR	mean ± SD	1.01 ± 0.09	0.96 ± 0.08	$p < 0.001$*
	median	1.03	0.95	
	Q1-Q3	1-1.06	0.9-1	
Total body fat [%]	mean ± SD	16.12 ± 3.4	19.39 ± 3.61	$p < 0.001$*
	median	16	20	
	Q1-Q3	14-18.25	17.25-21	
Non-adipose mass [%]	mean ± SD	22.64 ± 0.92	21.76 ± 1.04	$p < 0.001$*
	median	23	22	
	Q1-Q3	22-23	21-22	
Body water content [%]	mean ± SD	60.91 ± 2.85	58.83 ± 2.75	$p < 0.001$*
	median	61	59	
	Q1-Q3	59-63	57-60.75	
Excess of adipose tissue [%]	mean ± SD	0.59 ± 1.28	2.76 ± 2.87	$p < 0.001$*
	median	0	2	
	Q1-Q3	0-0.25	0-4	

p – U Mann-Whitney test. *Statistically significant relationship ($p < 0.05$).

study group exhibited no limitation concerning fish, meat and cold meats, raw vegetables and fruits, however the individuals in this group also did not limit the consumption of sugar, sweets and fat.

Table X shows the percentage of men consuming beer in both groups. Football referees drank beer more frequently than men from the control group.

Table IV. Health-oriented behavior of the men in both groups.

HBI		Group		p
		Study group	Control group	
HBI total score	mean ± SD	76.9 ± 13.79	80.93 ± 14.44	$p = 0.149$
	median	77	81.5	
	Q1-Q3	65-88	69.23-91	
Correct dietary habits	mean ± SD	3.19 ± 0.71	3.46 ± 0.85	$p = 0.055$
	median	3.17	3.5	
	Q1-Q3	2.67-3.71	2.71-4.17	
Prophylactic behaviour	mean ± SD	3.14 ± 0.68	3.25 ± 0.87	$p = 0.616$
	median	3.17	3.25	
	Q1-Q3	2.79-3.67	2.67-3.81	
Positive attitude	mean ± SD	3.37 ± 0.55	3.59 ± 0.61	$p = 0.059$
	median	3.5	3.55	
	Q1-Q3	3-3.67	3.21-4	
Health practices	mean ± SD	3.12 ± 0.7	3.19 ± 0.74	$p = 0.648$
	median	3	3.25	
	Q1-Q3	2.67-3.67	2.67-3.67	

p – U Mann-Whitney test, all $p > 0.05$.

Table V. Personality traits as assessed by the five-factor NEO-FFI in both groups.

NEO-FFI		Group		p
		Study group	Control group	
Neuroticism	mean ± SD	18.48 ± 6.73	18.14 ± 7.41	$p = 0.859$
	median	19	18	
	Q1-Q3	12.75-23	13.25-24.75	
Extraversion	mean ± SD	30.75 ± 4.52	29 ± 5.07	$p = 0.077$
	median	31	29	
	Q1-Q3	28-33.25	25.25-33	
Openness to experience	mean ± SD	23.41 ± 5.19	25.31 ± 5.76	$p = 0.058$
	median	24	25	
	Q1-Q3	20.75-26	22-29	
Agreeableness	mean ± SD	27.25 ± 5.7	29.35 ± 5.19	$p = 0.053$
	median	28	29.5	
	Q1-Q3	23-31	26-33	
Conscientiousness	mean ± SD	32.43 ± 6.31	34.25 ± 6.66	$p = 0.037$*
	median	33	35	
	Q1-Q3	28.75-36	31-38	

p – U Mann-Whitney test. *Statistically significant relationship ($p < 0.05$).

Table VI. Self-reported health status in both groups.

Self-reported health status	Group			p
	Study group	Control group	Total	
Very good	23 (41.07%)	15 (22.73%)	38 (31.15%)	$p = 0.041$
Good	29 (51.79%)	37 (56.06%)	66 (54.10%)	
Satisfactory	4 (7.14%)	13 (19.70%)	17 (13.93%)	
Poor	0 (0.00%)	1 (1.52%)	1 (0.82%)	
Very poor	0 (0.00%)	0 (0.00%)	0 (0.00%)	

p – exact Fisher test ($p < 0.05$).

Table VII. The incidence of chronic diseases in both groups.

Chronic diseases	Group			p
	Study group	Control group	Total	
Circulatory diseases	1 (1.79%)	2 (3.03%)	3 (2.46%)	$p = 1$
Arterial hypertension	1 (1.79%)	20 (30.30%)	21 (17.21%)	$p < 0.001$*
High cholesterol	1 (1.79%)	3 (4.55%)	4 (3.28%)	$p = 0.624$
Respiratory system diseases	2 (3.57%)	4 (6.06%)	6 (4.92%)	$p = 0.686$
Digestive system diseases	2 (3.57%)	0 (0.00%)	2 (1.64%)	$p = 0.209$
Musculoskeletal system diseases	0 (0.00%)	5 (7.58%)	5 (4.10%)	$p = 0.062$
Osteoporosis	0 (0.00%)	1 (1.52%)	1 (0.82%)	$p = 1$
Genito-urinary tract diseases	1 (1.79%)	4 (6.06%)	5 (4.10%)	$p = 0.373$
Gout	0 (0.00%)	1 (1.52%)	1 (0.82%)	$p = 1$
Neurological diseases	0 (0.00%)	0 (0.00%)	0 (0.00%)	$p = 1$
Neoplastic diseases	0 (0.00%)	3 (4.55%)	3 (2.46%)	$p = 0.249$
Eyesight diseases	0 (0.00%)	4 (6.06%)	4 (3.28%)	$p = 0.124$
Hearing diseases	1 (1.79%)	0 (0.00%)	1 (0.82%)	$p = 0.459$
Diabetes	1 (1.79%)	4 (6.06%)	5 (4.10%)	$p = 0.373$
Other	3 (5.36%)	3 (4.55%)	6 (4.92%)	$p = 1$
No illnesses	43 (76.79%)	31 (46.97%)	74 (60.66%)	$p = 0.002$*

p – Chi-square test or exact Fisher test. *Significant differences between the study and control group ($p < 0.05$).

Table VIII. The number of smokers in both groups.

Smoking	Group			p
	Study group	Control group	Total	
No	29 (51.79%)	19 (28.79%)	48 (39.34%)	$p = 0.002$
Occasionally	13 (23.21%)	10 (15.15%)	23 (18.85%)	
Yes	14 (25.00%)	37 (56.06%)	51 (41.80%)	

p – Chi-square test or exact Fisher test. *Significant differences between the study and control group ($p < 0.05$).

Table IX. The number of smokers in both groups.

Declared limitation of:	Group			p
	Study group	Control group	Total	
The amount of consumed food	8 (14.29%)	18 (27.27%)	26 (21.31%)	$p = 0.128$
Sugar and sweets	8 (14.29%)	23 (34.85%)	31 (25.41%)	$p = 0.017$*
Bread, potatoes, groats, pasta, rice	4 (7.14%)	15 (22.73%)	19 (15.57%)	$p = 0.034$*
Fish	1 (1.79%)	10 (15.15%)	11 (9.02%)	$p = 0.024$*
Meat and cold meats	2 (3.57%)	18 (27.27%)	20 (16.39%)	$p = 0.001$*
Raw vegetables	0 (0.00%)	8 (12.12%)	8 (6.56%)	$p = 0.007$*
Raw fruits	1 (1.79%)	9 (13.64%)	10 (8.20%)	$p = 0.02$ *
Dairy products	3 (5.36%)	14 (21.21%)	17 (13.93%)	$p = 0.024$*
Fat	2 (3.57%)	16 (24.24%)	18 (14.75%)	$p = 0.003$*
High-fat foods	3 (5.36%)	16 (24.24%)	19 (15.57%)	$p = 0.009$*
Other	0 (0.00%)	2 (3.03%)	2 (1.64%)	$p = 0.499$

p – Chi-square test or exact Fisher test. *Significant differences between the groups ($p < 0.05$).

Table XI shows the percentage of men consuming wine and other alcoholic beverages in both groups. The consumption of wine and other alcoholic beverages was markedly higher among football referees than in the control group.

Table XII shows the percentage of men consuming spirits in both groups. The study group showed a higher level of spirits consumption than the control group.

Table XIII shows the risk of selected diseases of affluence (cardiovascular disease, stroke, and diabetes) in both groups. The analysis of adipose tissue parameters whose elevated levels constitute a significant risk factor for the development of cardiovascular disease, stroke, and diabetes showed statistically significant differences — all three parameters determining the risk of the aforementioned diseases were markedly higher in the control group.

Table X. The percentage of men consuming beer.

	Group			p
	Study group	Control group	Total	
Never or almost never	5 (8.93%)	22 (33.33%)	27 (22.13%)	p=0.015
Once a month or less frequently	12 (21.43%)	8 (12.12%)	20 (16.39%)	
Several times a month	22 (39.29%)	16 (24.24%)	38 (31.15%)	
Several times a week	9 (16.07%)	13 (19.70%)	22 (18.03%)	
Every day	6 (10.71%)	5 (7.58%)	11 (9.02%)	
Several times a day	2 (3.57%)	1 (1.52%)	3 (2.46%)	
No answer	0 (0.00%)	1 (1.52%)	1 (0.82%)	

p – exact Fisher test ($p < 0.05$).

Table XI. The percentage of men consuming wine and other alcoholic beverages.

Wine and alcoholic drinks	Group			p
	Study group	Control group	Total	
Never or almost never	5 (8.93%)	22 (33.33%)	27 (22.13%)	$p = 0.015$
Once a month or less frequently	12 (21.43%)	8 (12.12%)	20 (16.39%)	
Several times a month	22 (39.29%)	16 (24.24%)	38 (31.15%)	
Several times a week	9 (16.07%)	13 (19.70%)	22 (18.03%)	
Every day	6 (10.71%)	5 (7.58%)	11 (9.02%)	
Several times a day	2 (3.57%)	1 (1.52%)	3 (2.46%)	
No answer	0 (0.00%)	1 (1.52%)	1 (0.82%)	

p – exact Fisher test ($p < 0.05$).

Table XII. The percentage of men consuming spirits.

Vodka and spirits	Group			p
	Study group	Control group	Total	
Never or almost never	7 (12.50%)	23 (34.85%)	30 (24.59%)	$p = 0.038$
Once a month or less frequently	27 (48.21%)	21 (31.82%)	48 (39.34%)	
Several times a month	15 (26.79%)	11 (16.67%)	26 (21.31%)	
Several times a week	5 (8.93%)	5 (7.58%)	10 (8.20%)	
Every day	1 (1.79%)	3 (4.55%)	4 (3.28%)	
Several times a day	1 (1.79%)	1 (1.52%)	2 (1.64%)	
No answer	0 (0.00%)	2 (3.03%)	2 (1.64%)	

p – exact Fisher test ($p < 0.05$).

Discussion

The development of civilization can have both negative and positive effects on human health and the environment. Consequently, a change in lifestyle is associated with a change in eating habits (the quality, quantity, and type of food consumed, frequent consumption of processed, high-calorie, and unhealthy products). Combined with physical inactivity, this leads to a positive energy balance and consequently to the accumulation of excess body fat (overweight and obesity), which poses a significant threat to health and life. The aim of this study was to compare the health status of male football referees and non-football referees from Northern Poland. To analyze the risk of cardiovascular disease, stroke, and type 2 diabetes, body fat parameters were determined in both groups of men. Additionally, health-promoting behaviors were compared between the two groups. The

Table XIII. The risk of selected diseases of affluence (cardiovascular disease, stroke, and diabetes) in both groups.

Parameter		Group		p
		Study group	Control group	
Risk of heart diseases (scale 1-5)	mean ± SD	1.11 ± 0.07	1.22 ± 0.13	$p < 0.001$*
	median	1.1	1.2	
	quartile	1.1-1.1	1.1-1.3	
Risk of stroke (scale 1-5)	mean ± SD	1.17 ± 0.13	1.37 ± 0.22	$p < 0.001$*
	median	1.1	1.3	
	quartile	1.1-1.2	1.2-1.5	
Risk of diabetes (scale 1-20)	mean ± SD	1.4 ± 0.46	2.12 ± 0.89	$p < 0.001$*
	median	1.2	1.9	
	quartile	1-1.6	1.4-2.5	

p – U Mann-Whitney test. *Statistically significant relationship ($p < 0.05$).

available literature lacks such studies focused on comparing the body fat content of football referees and a control group of men from the general population in terms of the risk of selected cardiovascular diseases, stroke, and diabetes.

Owing to the fact that the individuals from the study group (football referees) must meet high fitness and health criteria required for this profession, they are physically active and so they strengthen their muscular system, and follow the principles of a healthy lifestyle, it can be assumed that the study group would be characterized by better results of the total body fat content as compared with the control group[18]. The analysis of the determined adipose tissue parameters showed that the study group (football referees) was characterized by a significantly lower trunk fat content – 22.5% (within the lower range of the average values indicated in the measurement method) and a low visceral adipose tissue content – 8.25 grade. In the control group, the median of trunk fat content was 30.65% and the visceral fat content was 14.5 grade (high level). Moreover, body composition analysis showed significant differences between the groups. In the group of football referees, the excessive body fat content ranged from 0 kg to 0.25 kg, and in the control group from 0 kg to 4 kg. The comparison of the measurements obtained by means of two different devices confirmed a markedly higher body fat content in the men from the control group. It can be assumed that intense aerobic activity (running while officiating at football matches) has a beneficial effect on maintaining the low level of adipose tissue content. Kim et al[19] conducted a study on 27 obese men (aged 30-60) not engaged in any form of regular physical activity. The participants of the study were divided into two groups – each was prescribed a 12 weeklong exercise regimen. The first group (13 individuals) did aerobic exercises (outdoor running) three times a week. The second group (14 individuals) performed strength-training exercises three times a week. During the study, all men exercised under the supervision of trainers and followed a uniform, in terms of calorific value, diet developed by a dietitian. Analysis of the results showed that the introduced exercises contributed to the reduction of body fat. Strength-training exercises resulted in the reduction of adipose tissue by approximately 4%, whereas aerobic exercises (running) by almost 6%. In both study groups, the cardiovascular fitness improved. Our study also demonstrated that systematic running by football referees has a positive effect on both the reduction of body fat and keeping it on a low level.

The values of the waist-hip ratio (WHR) and the percentage of lean mass were significantly higher in the men in the study group. Presumably, it is related to the nature of the physical activity including frequent trunk rotation during alternate fast and short-distance running and quick march – a form of physical activity characteristic for football referees. An increased WHR in the study group most likely resulted from stronger and more developed abdominal oblique muscles, consequently increasing the waist circumference in relation to the hip circumference. Ramírez-Vélez[20] investigated a population of 6095 adult men, aged 18-40, to assess the relationship between muscle efficiency and a cardiometabolic risk indicator and a lipid-metabolic risk indicator of cardiovascular diseases. The cardiometabolic risk factor was the sum of WHR, total cholesterol, LDL cholesterol, HDL cholesterol, and blood pressure. The indicator of cardiovascular risk was determined on the basis of the levels of triglycerides, LDL, HDL and glucose. The authors demonstrated an inversely proportional relationship between the efficiency of the muscular system (muscle strength) and the cardiometabolic and lipid-metabolic risk indicators. Intensive training and muscle development reduce the risk of cardiovascular diseases[19].

The health behaviors and personality of the men in both groups were also investigated and standardized questionnaires – the HBI and the NEO-FFI – were used for this purpose. The analysis of the answers given by the subjects did not show any significant differences in health behaviors between the groups. However, surprisingly, the individuals from the study group were found to be less conscientious.

Risk factors for cardiovascular disease, stroke, and diabetes are also family history of cardiovascular disease and smoking. The analysis of the responses included in the original part of the questionnaire revealed that the men in the study group (football referees) assessed their health more positively than the men in the control group. They also did not have a family history of overweight and obesity. In the control group, hypertension was the most frequently mentioned chronic disease. There were smokers in both groups, however in the control group the share of smokers was as many as 71%. D'Ascenzi et al[21] investigated the occurrence of risk factors for cardiovascular diseases in a group of 1058 individuals (656 men and

402 women) engaged in various sport activities. The authors demonstrated that in the population of athletes under study, significant risk factors for developing cardiovascular diseases were smoking (44%) and hypertension (25%)[21].

The men in the control group were more likely to limit their intake of sugar, sweets, and fat, but also fish, vegetables, fruit, and dairy products. Football referees did not reduce the consumption of fish, raw vegetables, meat and cold meats, raw fruit, dairy products, and fat. Football referees declared the reduction of sugar and sweets to a lesser extent than the control group, whereas the declared consumption of alcoholic beverages, beer, wine, and spirits was higher. It may be that the consumption of high-calorie products and stimulants was balanced by a regular physical activity on the part of football referees, which resulted in a lower adipose tissue content. This has been confirmed by Jonker et al [21] in their study on 12 diabetic patients (7 men and 5 women), who were prescribed a 6-month regimen of individual moderate-intensity exercise followed by a 12-day trekking. The authors determined the total body fat and the visceral adipose tissue content using magnetic resonance imaging (MR) a week before the patients started the exercises and after the completion of the exercise regimen. The authors demonstrated the relationship between physical activity and the reduction of visceral adipose tissue and liver-produced triglycerides in patients who were not on a special low-calorie diet[22].

Regular physical activity, in the form of running combined with quick march, may have a positive effect on lowering the body fat content and can significantly reduce the risk of developing diseases of affluence due to excessive accumulation of adipose tissue. This is especially true for people who do not follow the principles of a healthy lifestyle and tend to eat sweets and use other stimulants.

On the basis of the body fat content measurements, the present study indicates a very low potential risk for cardiovascular diseases, stroke and diabetes in the study group. The risk was found to be higher in the control group, even though the individuals from this group declared lower consumption of fats and products containing fats in comparison with the study group. This may confirm the crucial role of physical activity in reducing the risk of developing affluence-related diseases.

Football referees should be considered as individuals who systematically engage in various forms of physical activity owing to their duties. Sound health and fitness in this group are regularly verified during fitness tests organized by the Collegium of Football Referees. Conversely, the control group is not monitored in terms of fitness and physical performance. Additionally, age difference, dietary mistakes and lack of necessity or motivation to be physically active on a regular basis may cause the elevated body fat content in men from the control group, thus resulting in an increased risk of the diseases discussed in this paper.

Limitations

The pilot study should be continued with a larger population of football referees, individuals engaged in regular physical activity either professionally or as amateurs (particularly those engaged in e.g., trekking) as well as physically inactive individuals. This, to compare the physically active population with a larger group of people leading a less active lifestyle in terms of adherence to a well-balanced diet and the burden of risk factors for the development of diseases of affluence. The extended study might help to develop an aerobic and strength-training exercise algorithm to reduce the incidence of affluence-related diseases associated with excessive body fat.

Conclusions

Thanks to properly planned and systematically continued physical activity, despite non-compliance with certain pro-health principles (increased sweet supply and consumption of alcoholic beverages), football referees are characterized by the correct body fat volume and low level of visceral adipose tissue. The parameters were found to be markedly higher in the control group of randomly selected men from the general population.

The risk of diabetes, stroke, and cardiovascular diseases among football referees was found to be very low, whereas in the control group – presumably owing to physical inactivity as well as increased total body fat and visceral adipose tissue – the risk for the development of these diseases was significantly higher.

The risk for the development of the diseases may increase in football referees once they retire – owing to the habit of eating sweets and drinking alcohol i.e., non-compliance with health promoting principles.

Conflict of Interest
The Authors declare that they have no conflict of interests.

Informed Consent
All patients signed consciously and voluntarily consent to participate in this study.

Ethics Committee Approval
The approval of the Bioethics Committee for this type of research is not required.

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