International Journal of Medical, Medicine and Health Sciences
ISSN: 2517-9969
Vol:7, No:12, 2013

Variations in % Body Fat, the Amount of Skeletal Muscle and the Index of Physical Fitness in Relation to Sports Activity/Inactivity in Different Age Groups of the Adult Population in the Czech Republic

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***Abstract*—**The aim of this study was to describe typical changes in several parameters of body composition – the amount of skeletal muscle mass (SMM), % body fat (BF) and body mass index (BMI) - in selected age categories (30+ years) of men and women in the Czech Republic, depending on the degree of sports activity. Study (n = 823, M = 343, F = 480) monitored differences in BF, SM and BMI in five age groups (from 30-39 years to 70+ years). Physically inactive individuals have ($p < 0.05$) higher % BF in comparison with physically active individuals (29.5 ± 0.59 vs. 27 ± 0.38%), higher BMI (27.3 ± 0.32 vs. 26.1 ± 0.20 kg/m^2), but lower SM (39.0 ± 0.33 vs. 40.4 ± 0.21%). The results indicate that with an increasing age, there is a trend towards increasing values of BMI and % BF, and decreasing values of SMM.

***Keywords*—**Body composition, body fat, physical activity, skeletal muscle.

I. Introduction

INCREASING age of adult population causes differences in several parameters of body composition. Previous monitored trends indicate decrease amount of skeletal muscle mass (SMM), increase amount of body fat (BF) and also increase body mass index (BMI). Described negative changes can be reduced by sport activity.

Chosen studies claim that the amount and quality of skeletal muscle mass (SMM) has an important role in adult population especially at physiological parameters and quality of life [8]. They also examine an influence of gender and age on progress of loss of amount and quality of skeletal muscle mass [4], [5], [7], [8], [10] and indicate significant differences between men and women progressing from 3rd decade of life [8]. There are also significant differences in decrease amount of skeletal muscle mass between upper and lower part of body [8]. Positive effect of physical activity on degeneration process [2], [3], [6], [12] and prevalence of lifestyle diseases has been proven [1], [11], [13].

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Measurements were carried out within the project"Creating a research team for the purpose of determining the level of physical activity (inactivity) in selected age groups of the population of men and women in the Czech Republic" (CZ.1.07/2.3.00/20.0044) which is funded by the European Social Fund and the state budget of the Czech Republic.

II. Methodology

A. Subject Characteristics

This cross-sectional study was performed on 823 participants. Participants consisted of adult men (*n* 343) and women (*n* 480) who were divided into 5 age groups (30-39 years; 40 – 49 years; 50 – 59 years; 60 – 69 years; 70 + years old). Subjects (volunteers) were recruited from general public through public organized meetings or posted fliers. All participants gave informed consent before participation in accordance with the ethical guidelines of the respective institutional review boards. Measurements were carried out within the project in the years 2011-2013

B. Measurement

The amount of body fat mass (BF), body mass Index (BMI), skeletal muscle mass (SMM) and weight were measured by the bioimpedance method via the device InBody720 (Body composition analyzer, Biospace - USA) [9]. Subjects were dressed in light clothing, barefoot. Body height was measured to the nearest 0.1cm with a wall-mounted stadiometer. Personal characteristics and physical activity/inactivity were investigated through an unstandardized questionnaire.

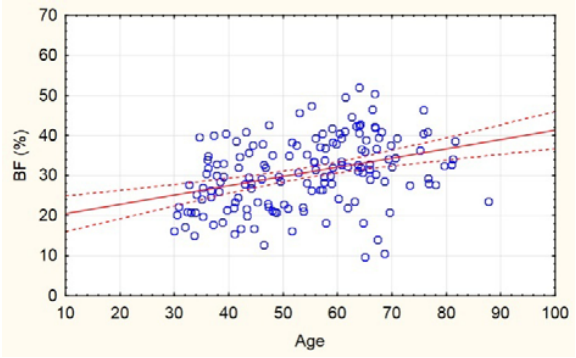
C. Analysis

The differences between men and women were tested for significance by a paired *t*-test. An analysis of covariance was used to compare BF, BMI and SMM in the men and women when it was necessary to adjust for other gender differences, age, and physical activity. Differences were compared with two- or three-way analysis of variance (ANOVA), where elevated BF, BMI and SMM in the men and women (when it was necessary to adjust for other gender differences, age, and physical activity) were the main factors.

III. Results

Results are presented in Tables I-III and on Figs. 1-3. The documented data show a general tendency towards higher BF, higher BMI and lower proportion of SMM with increasing age, both in men and women (Fig. 1). Physically inactive individuals have a statistically higher BF (29.5±0.59% vs. 27.0±0.38%; $p < 0.05$), higher BMI (27.3±0.32% vs. 26.1±0.20%), and lower proportion of SMM (39.0±0.33% vs. 40.4±0.21%) (Table III). Within the same age groups, we can

detect significant differences between inactive and active people in all cases except BF in the age category 70+ years old, SMM in 40-49 and 70+ years old, and BMI in 60-69 year old.



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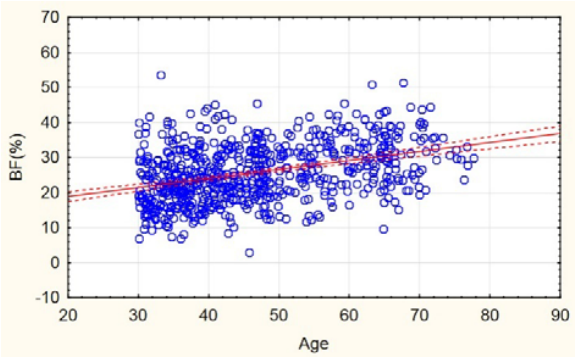

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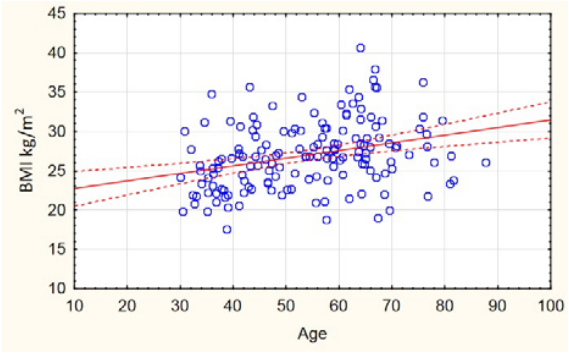

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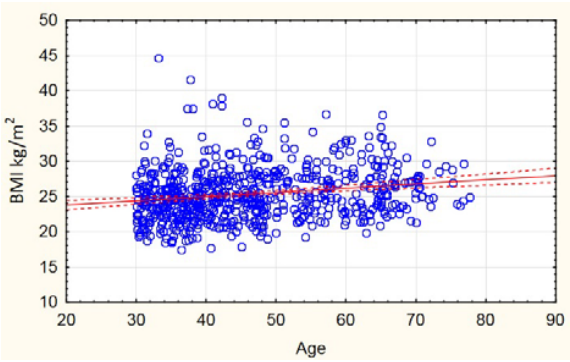

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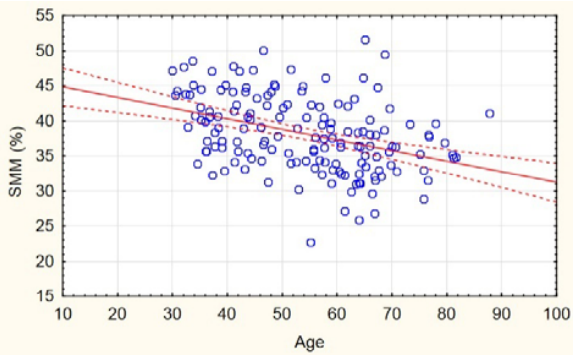

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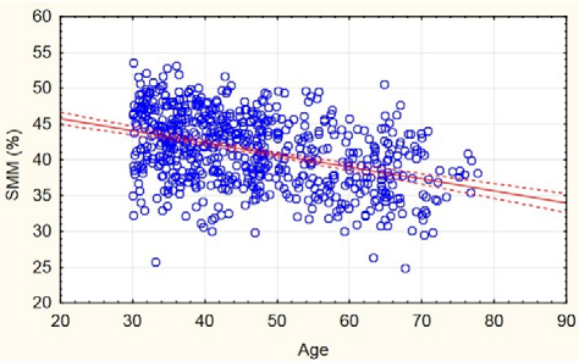

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Fig. 1 A general tendency towards higher BF (a,b), higher BMI (c,d) and lower proportion of SMM (e,f) with increasing age, both in inactive (a,c,e) n=155 versus active (b,d,f) n=668 men and women

In the physically inactive group of men, there is no statistically significant difference in BF between the youngest age category 30-39 years (20.0%), and categories 40-49 (23.0%) and 50-59 years (24.5%). The increase of BF starts to be apparent only in the age group 60-69 years (26.6%; $p < 0.05$). The values of BMI don't differ across age categories (except 40-49 vs. 60-69 year olds) and remain within the range 27.2-30.4 kg/m^2. However, the two oldest age groups have the highest BMI values and it is understandable that the lack of age-related trends is undoubtedly influenced by the small number of participants. The proportion of SMM begins to

decrease significantly since the age category 60-69 years, when it falls to 41.1%.

TABLE I
SUBJECT CHARACTERISTICS

gender	age group	*n*	Relative BF (%)		BMI, (kg/m^2)		Relative SMM (%)	
Men - inactive								
	30-39	8	20,0438	± 2.3	27,4263	±1.2	45,5691	±1.3
	40-49	17	23,0371	±1.6	27,2124	±0.9	43,5001	±0.9
	50-59	10	24,497	±2.1	27,847	±1.1	42,6678	±1.2
	60-69	12	26,6383	±1.9	30,3875	±1.0	41,1183	±1.1
	70+	8	31,425	±2.3	29,1663	±1.2	37,4701	±1.3
Women - inactive								
	30-39	23	28,4904	±1.4	23,1157	±0.7	39,1011	±0.8
	40-49	16	32,0025	±1.6	25,9231	±0.9	37,286	±0.9
	50-59	23	35,0578	±1.4	26,6348	±0.7	35,0544	±0.8
	60-69	30	37,2403	±1.2	28,4573	±0.6	33,9609	±0.7
	70+	8	36,5375	±2.3	26,3388	±1.2	34,0031	±1.3
Men - active								
	30-39	123	18,2773	±0.6	25,4246	±0.3	46,3937	±0.3
	40-49	82	20,8668	±0.7	27,1444	±0.4	44,6896	±0.4
	50-59	38	22,0147	±1.1	27,2116	±0.6	44,0571	±0.6
	60-69	38	25,3966	±1.1	27,7571	±0.6	41,6021	±0.6
	70+	7	28,6629	±2.5	28,5071	±1.3	39,4154	±1.4
Women - active								
	30-39	127	27,1286	±0.6	23,6643	±0.3	39,9867	±0.3
	40-49	110	27,8046	±0.6	24,1115	±0.3	39,7041	±0.3
	50-59	63	31,9605	±0.8	25,2822	±0.4	37,128	±0.5
	60-69	62	33,0666	±0.8	25,6273	±0.5	36,2286	±0.5
	70+	18	34,4422	±1.5	25,8561	±0.8	35,1855	±0.9

Values are group means; ±SD; *n* - no. of subjects; BF –relative body fat; BMI - body mass index; SMM - relative skeletal muscle mass

TABLE II
THE DISTRIBUTION OF THE PARTICULAR COMPONENTS ACCORDING TO GENDER AND PHYSICAL ACTIVITY

gender		*n*	BF (%)		BMI (kg/m^2)		SMM (%)	
men								
	inactive	55	25,12823	±0.9	28,40787	±0.5	42,06505	±0.5
	active	288	23,04366	±0.6	27,20895	±0.3	43,23159	±0.3
women								
	inactive	100	33,86572	±0.7	26,09393	±0.4	35,88108	±0.4
	active	380	30,88051	±0.4	24,90826	±0.2	37,64657	±0.2

Values are group means; ± SD; *n* - no. of subjects; BF – relative body fat; BMI - body mass index; SMM - relative skeletal muscle mass

The percentage of fat in physically inactive women begins to differ between 30-39 year old (28.5%) and 50-59 year old (35.1%), and reaches 37.2% in the age category 60-60 years. Trends in BMI are more pronounced than in physically inactive men and the increase of BMI is significant since the age group 40-49 years. BMI increases by 5.4 kg/m^2 between age groups 30-39 and 60-69 years. The decrease of SMM is already apparent between 30-39 and 50-59 years old women, and reaches 5.1% in the two oldest age groups.

In physically active men, the range of values (standard deviation) is narrower, and hence we can detect a significant, age-related increase in BF since the age group 30-39 years. However, physically active men are still leaner. The percentage of fat in the youngest age group 30-39 years is 1.76% lower than in the same age group of inactive men, and in the oldest age group 70+ years the difference reaches 2.77%. An increase of BMI between the two youngest age groups can be found as well, but the subsequent changes with increasing age are very small. There are no significant differences between the age group 30-39 years and the three older age categories. Although physically active men have higher proportion of SMM, the magnitude of the age-related loss is similar like in inactive men, and due to a smaller SD, it is already obvious between the two youngest age groups.

TABLE III
THE DISTRIBUTION OF THE PARTICULAR COMPONENTS ACCORDING TO PHYSICAL ACTIVITY

	n	BF (%)		BMI kg/m^2		SMM (%)	
inactive (A)							
	155	29.49	±0.6	27.25	±0.3	38.97	±0.3
active (B)							
	668	26.96	±0.4	26.06	±0.2	40.43	±0.2

Values are group means; ± SD; *n* - no. of subjects; BF – relative body fat; BMI - body mass index; SMM - relative skeletal muscle mass

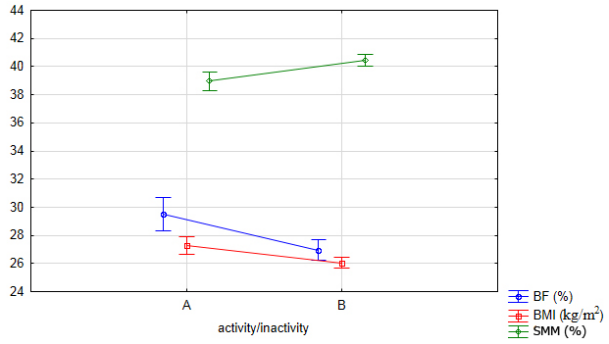
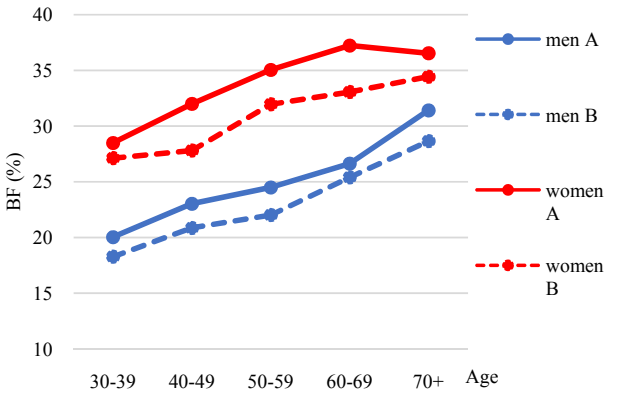


Fig. 2 The distribution of the particular components according to physical activity



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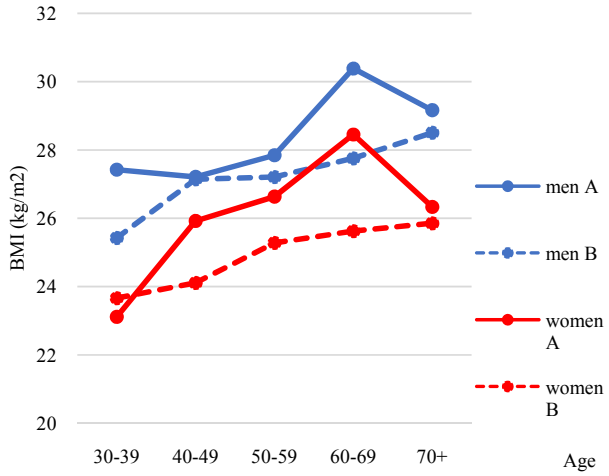

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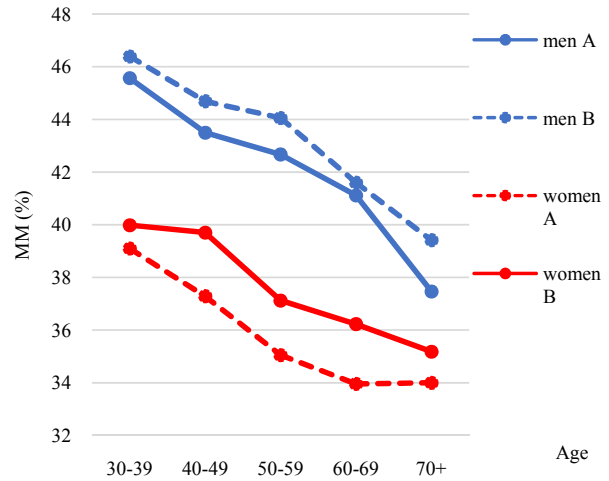

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Fig. 3The distribution of the particular components according to physical activity (B) and inactivity (A) according to age

The results in physically active women show that the increase of BF and BMI, and decrease of SMM is statistically significant since the age 50-59 years. In comparison with inactive women, the age-related differences are most pronounced in BF. Physically active women aged 60-69 years have 4.1% less body fat than physically inactive women from the same age group

III. Conclusion

Our results demonstrate quite unequivocally that age-related changes in body composition are characterized by rising values of BMI and BF, and decreasing values of SMM. The magnitude of these changes is similar in all groups, irrespectively of the involvement in physical activity. However, physically active men and women have significantly lower BF and higher SMM even at an advanced age. The trend is less clear in the case of BMI, because BMI is a less objective indicator of body composition. Women seem to benefit from an active lifestyle more than men, as indicated by greater differences in BF and SMM between inactive and active women across the whole age range.

References

[1] Björntorp, P., de Jounge, K., Krotkiewski, M., Sullivan, L., Sjöström, L., & Stenberg, J. (1973). Physical training in human obesity. III. Effects of long-term physical training on body composition. *Metabolism*, *22*(12), 1467-1475.

[2] Evans, W. J., & Hurley, B. F. (1995). Age, gender, and muscular strength. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *50*(Special Issue), 41-44.

[3] Frontera, W. R., Meredith, C. N., O'reilly, K. P., Knuttgen, H. G., & Evans, W. J. (1988). Strength conditioning in older men: skeletal muscle hypertrophy and improved function. *Journal of applied physiology*, *64*(3), 1038-1044.

[4] Fukagawa, N. K., Poehlman, E. T., Toth, M. J., Fishman, P. S., Vaitkevicius, P., Gottlieb, S. S., ... &Fonong, T. (1995). Sarcopenia in aging humans: the impact of menopause and disease. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 50(Special Issue), 73-77.

[5] Gallagher, D., &Heymsfield, S. B. (1998). Muscle distribution: variations with body weight, gender, and age. *Applied radiation and isotopes*, *49*(5), 733-734.

[6] Holloszy, J. O., Tseng, B. S., Marsh, D. R., Hamilton, M. T., & Booth, F. W. (1995). Strength and aerobic training attenuate muscle wasting and improve resistance to the development of disability with aging. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 50(Special Issue), 113-119.

[7] Hurley, B. F. (1995). Age, gender, and muscular strength. *The Journals of Gerontology.Series A, Biological Sciences and Medical Sciences, 50 Spec No*, 41-44.

[8] Janssen, I., Heymsfield, S. B., Wang, Z., & Ross, R. (2000). Skeletal muscle mass and distribution in 468 men and women aged 18–88 yr. *Journal of Applied Physiology*, *89*(1), 81-88.

[9] Johnstone AM, et al. Measurement of body composition changes during weight loss in obese men using multi-frequency bioelectrical impedance analysis and multi-compartment models. Obes Res Clin Pract (2012), http://dx.doi.org/10.1016/j.orcp.2012.07.006

[10] Lexell, J., Downham, D., &Sjöström, M. (1986). Distribution of different fibre types in human skeletal muscles: fibre type arrangement in m. vastuslateralis from three groups of healthy men between 15 and 83 years. Journal of the neurological sciences, 72(2), 211-222.

[11] Maraldi, C., Volpato, S., Penninx, B. W., Yaffe, K., Simonsick, E. M., Strotmeyer, E. S., ...& Pahor, M. (2007). Diabetes mellitus, glycemic control, and incident depressive symptoms among 70-to 79-year-old persons: the health, aging, and body composition study. *Archives of internal medicine*,*167*(11), 1137.

[12] Ross, R., Rissanen, J., Pedwell, H., Clifford, J., &Shragge, P. (1996). Influence of diet and exercise on skeletal muscle and visceral adipose tissue in men.Journal of Applied Physiology, 81(6), 2445-2455.

[13] Swank, A. M., Funk, D. C., Manire, J. T., Allard, A. L., & Denny, D. M. (2010). Efect of resistence training and aerobic conditioning on muscular strength and submaximal fitness for individuals with chronic heart failure: Influence of age and gender. *Journal of Strength and Conditioning Research*, *24*(5), 1298-305.