Proceeding

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Isometric strength of the upper extremities in Czech men older than 18 years

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ABSTRACT

Vilím, M., Hlavoňová, D. & Grasgruber, P. (2014). Isometric strength of the upper extremities in Czech men older than 18 years. *J. Hum. Sport Exerc., 9*(Proc1), pp.S519-S525. The aim of this study was to compare isometric strength of the upper extremities in a sample of men from the Czech republic (n=638). Only the dominant upper limb was tested. The examined subjects were 18 years old or older. The measured values (in kilograms) were obtained via hand-held dynamometry testing (a digital hand-held dynamometer). The results of the hand-held dynamometry testing were compared across six age categories (18-29, 30-39, 40-49.... 70+ years). It was found that isometric strength of the dominant upper limb in men increases up to the age group 30-39 years and then declines. The highest average value (55.6 kg) was found in the age group 30-39 years, and expectably, the lowest values (34.4 kg) were documented in the age category 70+ years. The largest decline in isometric strength (-8.8 kg) was found between the age groups 60-69 years and 70+ years. **Key words**: ISOMETRIC STRENGTH, UPPER LIMB, HAND DYNAMOMETRY, DOMINANT HAND.

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INTRODUCTION

Some authors (Spirduso, 1995; Shepherd, 1997; Williams, 2001) agree that the maximum isometric force increases up to the age 29 years. After this age it remains constant up to the age ~40 years. A rapid decline occurs in the age range 40-70 years. Aniansson and Shepard (Shephard, 1997) report that in 65 year olds, strength will decrease by 18-23% (0,7 - 0,9% per year) and the average decline is 37% (0.8% per year) in men aged 80 - 90 years. Isometric strength is preserved better than dynamic stength, and eccentric strength better than concentric strength (Spirduso, 1995).

Between 2003-2005, Zvonař (2006) conducted a survey of health condition, motor performance and physical activity in middle-aged and older men (n=48). The number of probands in each age category is shown in Table. 1. The results of tests of static strength in hand flexors (hand grip strength) are shown on Figure 1.

From the results it is evident that static strength of hand flexors decreases with an increasing age. The largest decrease (-9 kg) can be found between the age category 50 - 59 years and 60+ years (Figure 1).

A similar survey was conducted in 2010 by Zvonař and Vespalec (Zvonař & Vespalec, 2010). The examined group consisted of 133 men and its age range was 31-60 years. The results are presented on Figure 2.

Table 1. *Number of probands in each age category (Zvonař, 2006)*

age categories	n
30 - 39 years	7
40 - 49 years	17
50 - 59 years	12
60+ years	6
total	**42**

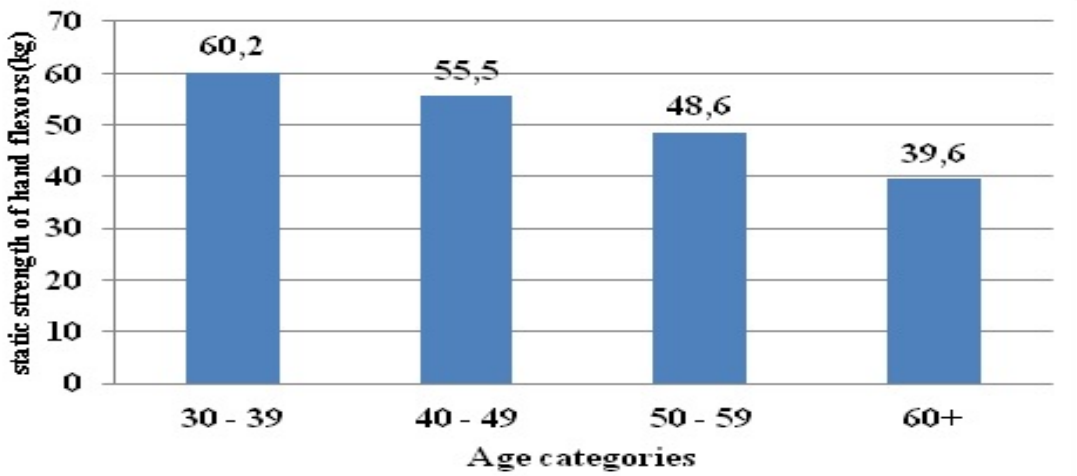

Figure 1. *Static Strength of hand flexors (Zvonař, 2016), edited*

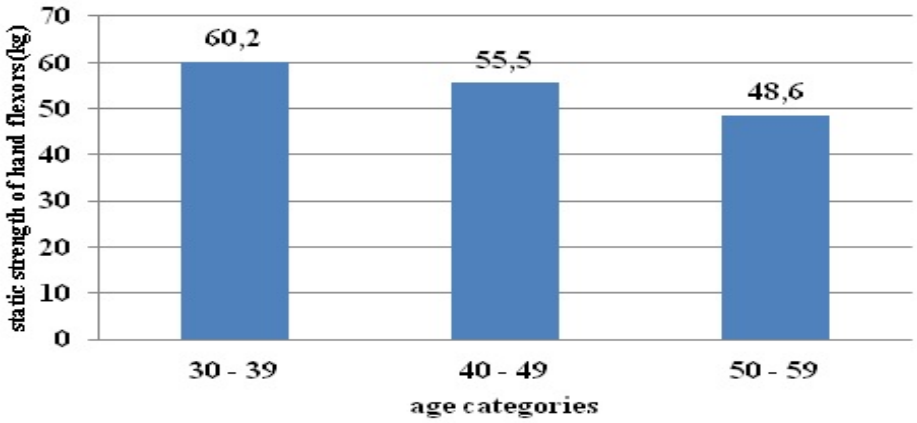

Figure 2. *Static Strength of hand flexors (Zvonař & Vespalec, 2010), edited*

The strength of hand flexors decreases with an increasing age, similarly like in the study of (2006). But this time, a more significant decrease was observed between the age groups 41-50 years and 51-60 years (-9.8 kg).

Similarly, Červinka (2010) tested 89 men between 2006-2008. The number of tested men in each age category is shown in Table 2. The average results are shown on Figure 3.

Table 2. *The number of probands in each age category (Červinka, 2010)*

age categories	n
30 - 39 years	9
40 - 49 years	20
50 - 59 years	36
60+ years	18
total	**89**

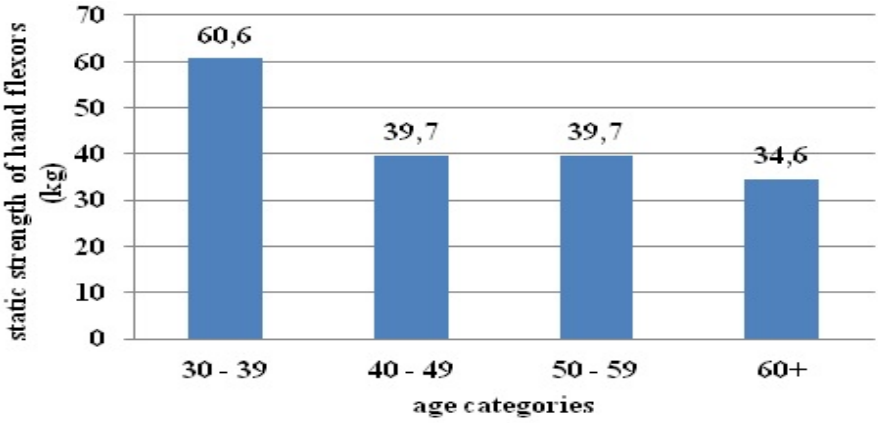

Figure 3. *Static Strength of hand flexors (hand grip Strength) (Červinka, 2010), edited*

The largest decrease of static strength in hand flexors was documented between age categories 30-39 and 40-49 years. The decline was surprisingly high (-20.9 kg.).

Table 3. *Static strength of hand flexors (Hrnčiariková et al., 2011)*

n = 38	**right upper hand**	**left upper hand**
strength of hand flexors (kg)	41.1	36.7

Hrnčiariková et al. (2011) conducted a study "Anthropometric examination and measurement of muscle strength in elderly patients." We report only results of the control group, which consisted of employees of the University Hospital in Hradec Králové. The tested group consisted of 38 men aged 29 years on average (age range 20-45 years). Average values are shown in Table 3.

The aim of this study was to compare isometric strength of the upper extremities in predefined age groups of Czech men. We focused on the strength of the dominant upper limb.

METHODOLOGY

Characteristics of the examined sample

The measurement of isometric strength of the upper extremities (hand grip strength) was conducted in 638 men. These men were volunteers, selected at random during various public actions, and came from the whole territory of the Czech Republic. All were at least 18 years old or older. The number of probands in each age category is shown in Table 4.

Table 4. *The number of probands in each age category*

age category	**n**
18 - 29 years	250
30 - 39 years	153
40 - 49 years	113
50 - 59 years	61
60 - 69 years	64
70+ years	27
total	**668**

Organization of the measurements

The results were obtained in the period between August 2011 - June 2013. The measurements were a part of a project, which was aimed at identifying the level of physical activity in the population of the Czech Republic (CZ.1.07/2.3.00/20.0044).

Methods of data collection, processing and analysis

The values of isometric strength of the upper extremities are obtained via hand dynamometry testing. The purpose of this test is to measure the static strength of hand flexors (hand grip strength) by a hand dynamometer (mechanical or digital). The tested subject grasps the dynamometer and performs a maximum contraction of the palms. The intensity of the contraction, not its length, is the most important. It is not allowed to lean the tested hand against any other part of the body or an external object. The tested subject has two attempts (four in total), both for the left and right hand. Only the more successful attempt is recorded. The measured data are expressed in kilograms or Newtons.

In our study, the measurements were carried out via a digital hand dynamometer MIE Medical Research. The measured values are presented in kilograms.

The obtained results were processed using mathematical-statistical and graphical methods. For the processing of the measured values, we used Microsoft Office Excel 2007 and the statistical program STATISTICA, version 9.0, from StatSoft. For better clarity and lucidity, the data were presented in tables and graphs.

RESULTS AND DISCUSSION

The results of the hand dynamometry testing are presented on Figure 4. The measured values are in kilograms. More detailed statistics are in Table 5 and on Figure 5.

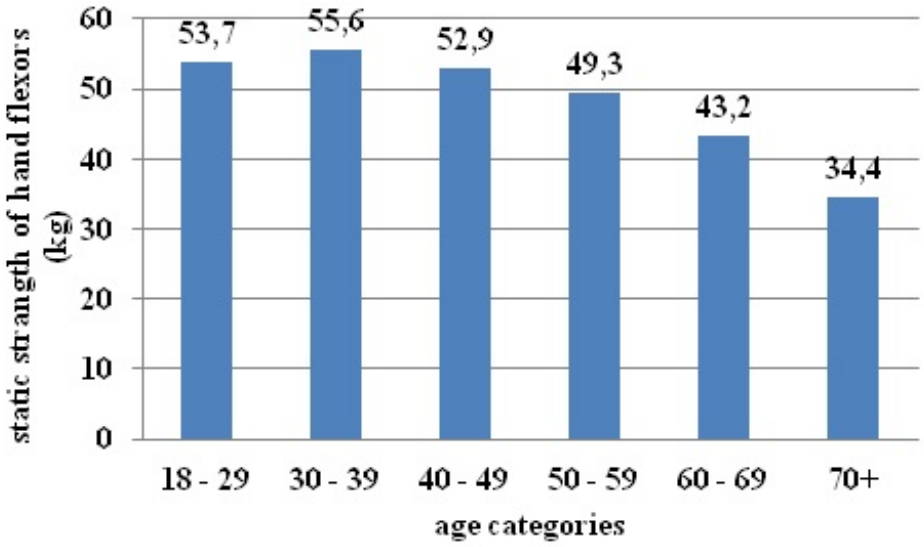

Figure 4. *Development of strength in the dominant upper limb in Czech men aged 18 years and older*

Table 5. *Basic statistical characteristics*

age	average	median	minimum	maximum	range	SD
18 - 29	53.7	53.4	26.5	76.8	70.4	8.4
30 - 39	55.6	55.5	31.6	83.3	82.5	9.1
40 - 49	52.9	52.9	31.2	76.9	72.1	8.5
50 - 59	49.3	49.2	16.7	65	87.2	9.3
60 - 69	43.2	45.3	20.4	65.1	94.2	9.7
70+	34.4	35.1	25.7	44.9	28.1	5.3

Spirduso (1995), Shepherd (1997) and Williams (2001) state that maximum isometric force increases up to the age 29 years. After this age it remains constant until ca. 40 years. In our research, we found somewhat different results. Isometric strength of the dominant upper limb in Czech men increased up to the age 39 years. The increase between categories 18-29 years and 30-39 years was +1,9 kg. The highest average value (55.6 kg) was found in the age group 30-39 years. The lowest values (34,4 kg) were measured in the category 70+ years. The largest decline in isometric strength (-8.8 kg) was observed between the age groups 60-69 years and 70+ years.

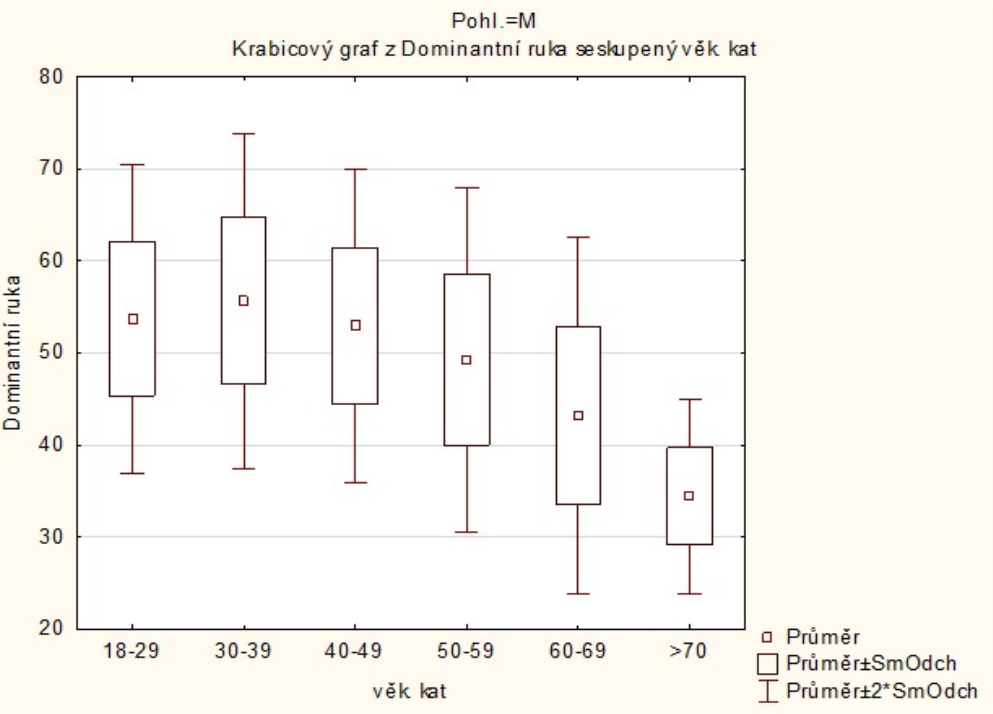

Figure 5. *A box plot of isometric strength of the dominant upper limb in Czech men aged 18 years and older*

CONCLUSION

The aim of this paper was to compare isometric strength of the upper extremities in the adult population of Czech men. We focused on the values of the dominant upper extremity.

According to some authors (e.g. Spirduso, 1995; Shephard, 1997; Williams, 2001), isometric strength increases up to the age 29 years. In our research, we came to different results. Isometric strength in Czech men increases until the age 39 years. One of the causes of this phenomenon can be weight gain and associated muscle gain between categories 18-29 and 30-39 years. Since the 40th year of life, the amount of muscle (expressed as % body weight) decreases due to hormonal changes, which is in accordance with the decrease of strength in the age category 40-49 years. The most significant loss of isometric strength (about -8.8 kg) was found between the age groups 60-69 and 70+ years.

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