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The isometric strength comparison of the upper limbs of women from the Czech Republic with a group of sportswomen from various branches

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ABSTRACT

Juránková, M, Vilím, M., & Janíčková, P. (2015). The isometric strength comparison of the upper limbs of women from the Czech Republic with a group of sportswomen from various branches. *J. Hum. Sport Exerc.*, 9(Proc1), pp.S354-S359. The aim of this work was to find out the strength difference of the static flexors of the hand between the dominant and non-dominant upper limbs of sportsmen from chosen branches and general population. A group of 20 sportswomen (10 tennis players and 10 javelin throwers) and a group of general population (252 probands from the whole Czech Republic area) took part in the measuring. All tested people were aged 18 – 29. The measured values (in kg) were obtained by means of a test of handheld dynamometry (digital handheld dynamometer). The measuring showed that sportswomen have higher values of dominant upper limb isometric strength than general population (58.2 kg and 53.8 kg). With the non-dominant upper limb, the situation is reverse: higher values were discovered with general population (51.2 kg) whereas with sportsmen it was only 50.1 kg. A substantially higher difference of isometric strength between the dominant and non-dominant hand was discovered with sportsmen (8.1 kg); this difference is much smaller (2.1 kg) with general population. **Key words:** HANDHELD DYNAMOMETRY, DOMINANT HAND, NON-DOMINANT HAND, WOMEN.



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INTRODUCTION

Measurement of isometric grip strength is generally considered as one of the most important indicators for assessing the functional status of muscle tissue followed by evaluation of the overall clinical condition of the individual.

Montalcini, Migliaccio, Yvelise, Rotundo, Mazza, Liberato, & Pujia, (2013) reported, that handgrip strength does not function only to assess the function of hands but also to evaluate the right-left symmetry of strength and general maximum upper limb strength during a common daily activity. To assess it, we use an easy test of the strength of the finger flexors, the value of which we can easily diagnose by means of a handheld dynamometer.

Luna-Heredia, Martín-Peña & Ruiz-Galiana (2005) carried out a research with 517 healthy volunteers (267 women and 229 men) aged 17 - 97 years. The strength of grip was measured by two hand dynamometers. Three consecutive measurements were performed in both dominant and non-dominant hand.

The results show that strength of hand grip is depending on sex (non-dominant hand: 22.8 ± 7.2 kg by women and 35.1 ± 12.4 kg by men (average \pm standard deviation), "t" test $P < 0.0001$) and have negative relation to age (women $r = -0.60$, men $r = -0.67$, $p < 0.01$). In both groups (men and women) is strength of hand grip descending with increasing age, it is same for dominant and non-dominant hand. For better illustration, these results are listed below only for women.

Dominant vs. non-dominant by women 25.72 vs. 22.8 ($P < 0.0001$). Isometric strength descent from first to third measurement. This effect was observed in both sexes by dominant and non-dominant hand, but values tend to be more stable in case of dominant hand. (Values for 1, 2. a 3. measure: dominant: 24.9, 24.4, 23.4, non-dominant: 22.2, 20.8, 19.8). Results are presented in Table 1.

Table 1. The measured values for the dominant and non-dominant arm (Luna-Heredia, Martín-Peña, & Ruiz-Galiana, 2005).

Strength of handgrip (kg)	Dominant	Non-dominant
N = 267	25.7	35.1

Hrnčiariková, Jurašková, Klemra & Zádák (2007) carried out a research called "Anthropometrical Examinations and Measurement of Muscle Strength in Geriatric Patients". The test sample included employees of the University Hospital in Hradec Králové. There were 62 women and 38 men. We present only the results of the male part of the control group which correspond to our research. The average age of the men was 29.1 years, ranging from 20 to 45 years. The average values of handgrip strength measured with a handheld dynamometer are shown in Table 2.

Table 2. Static strength of flexor hand in women (Hrnčiariková, Jurašková, Klemra & Zádák, 2007)

Strength of handgrip (kg)	Right hand	Left hand
N = 62	24	21.7

Another study dealing with this issue was carried out in the Malayan University of Malaya Medical Centre. Between January and April 2003, 412 subjects aged 18 – 65 were measured (200 women and 212 men). Secondary information necessary for measuring was gathered by anthropometrical measurement and a questionnaire. There were 93% test subjects with dominant right hand and only 7% left hand. The handgrip strength of the dynamometer handle significantly corresponded with hand preference, further on with gender, job, height and weight but not with body mass index.

In all age groups, men were stronger than women, with the 1.75:1 ratio. When both groups were compared on the basis of their preferred hand, the dominant hand was still stronger than the non-dominant one, with the 1.12:1 ratio of the right-handed group and 1.05:1 of the left-handed group. The highest measured maximum handgrip strength with the right hand dominant group was recorded in the group aged 25 - 34; with the second group it was in the age group aged 8 -24 years (Kamarul, Ahmad & Loh, 2006).

AIM

The aim of this work is to find out the difference of the static strength of the flexors of the hand between the dominant and non-dominant upper limb of sportswomen from chosen branches. The results will be compared with general population of the Czech Republic.

MATERIAL AND METHODS

The characteristics of the groups

Sportswomen

There were 17 sportswomen (10 tennis players and 7 javelin throwers) from the region of Brno who took part in the measuring of isometric strength of upper limbs. The results were obtained between May - August 2014.

General population

General population is represented by a sample of 217 women from the whole Czech Republic area. The results were obtained between August 2011 - June 2013 within a project investigating the physical activity level of Czech population (CZ.1.07/2.3.00/20.0044).

The age of all the tested people (sportsmen as well as general population) ranged from 18 to 29 years. All subjects were female.

Methods of data collection, data processing and evaluation

We obtained the values of isometric strength of upper limbs by means of a handheld dynamometry test. The aim of the test was to measure the static strength of flexors of the hand by means of handgrip. A handheld dynamometer (mechanical or digital) is used for testing. The tested person grips the dynamometer so that from one side there can be the pressure of the bent fingers and from the other side the dynamometer can lean on the thenar. Under the direction of an examiner, the tested person clenches his fist isometrically with maximum strength. It is handgrip intensity which is important, not the length. During the grip, a fist should be clenched from three-fourths. The person is not allowed to lean the hand with the dynamometer on a different part of the body or on an extrinsic object. The tested person has two attempts for the left as well as the right hand. The more successful attempt is recorded. The measured data are presented in kilograms or newtons.

We carried out the measuring by means of a digital handheld dynamometer MIE Medical Research and the measured values are presented in kilograms.

We processed the obtained results by means of mathematical-statistical and graphical methods. To process the measured values, we used Microsoft Office Excel 2007 and statistical program STATISTICA, version 9.0, by StatSoft (Tulsa, USA). By way of illustration and orderliness, the results were made into Tables and Figures.

The statistical significance was defined $p < 0.05$.

RESULTS

We tested the isometric strength of the flexors of the upper limbs with sportsmen of the chosen sports branches and general population by means of a digital handheld dynamometer. All tested people were aged 18 - 29. The measured values are presented in kilograms. The results are shown in Fig. 1, basic statistical characteristics in Table. 3, box plots in Fig. 2.

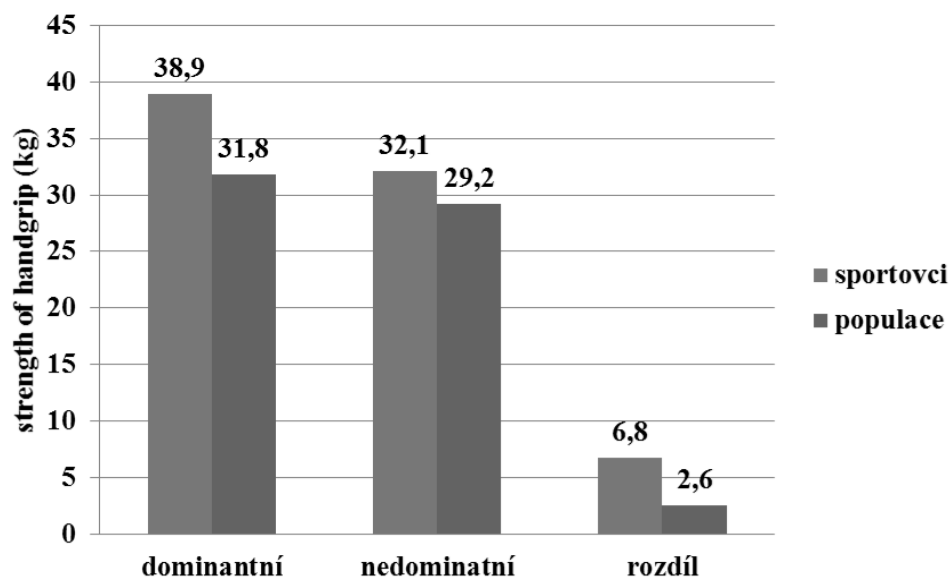


Figure 1. Isometric strength of the upper limbs of sportswomen and general population aged 18 - 29 in the Czech Republic (women)

Table 3. Basic statistical characteristics

Variable	Athletes (Average \pm SD)	Population (Average \pm SD)	<i>p</i>
Dominant	38.92 \pm 4.17	31.79 \pm 5.99	0
Non-dominant	32.13 \pm 3.68	29.18 \pm 5.80	0.03
Index of dominance	0.54 \pm 0.02	0.52 \pm 0.03	0

Legend: *p* = significance level of the test, SD = standard deviation

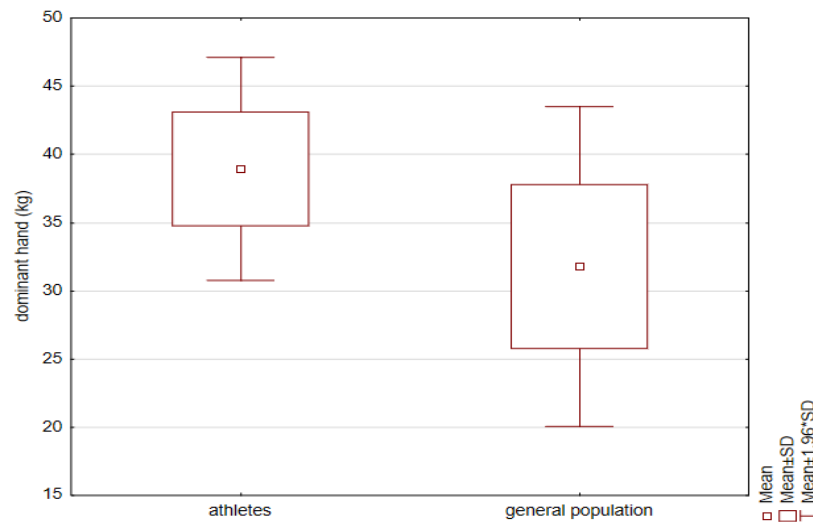


Figure 2. A box plot of the isometric strength of the dominant hand.

The results clearly show that in the case of the dominant upper limb sportswomen on average reach higher values of isometric handgrip strength (38.92 ± 4.17 kg) than women belonging to general population (31.79 ± 5.99 kg, with $p = 0.00$). The differences between the groups reach statistically significant difference.

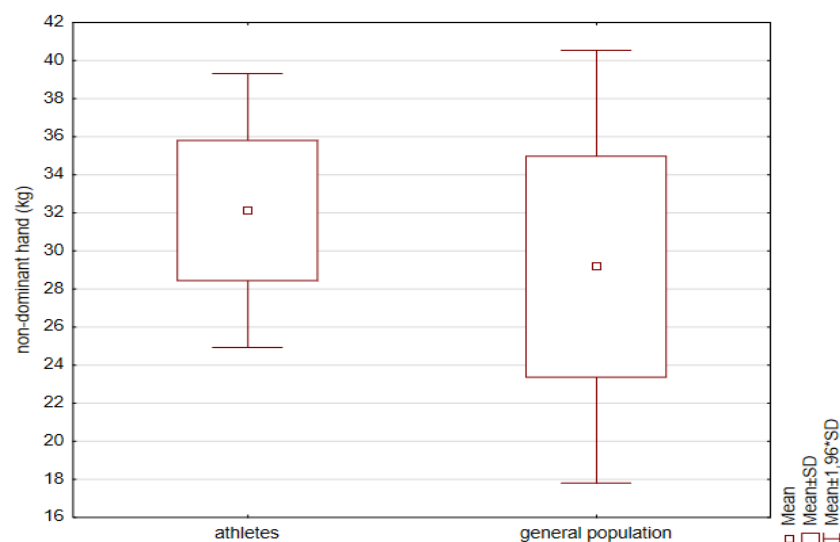


Figure 3. A box plot of the isometric strength of the non-dominant hand.

As a non-dominant limb were results similar as dominant arm. The higher values were measured with sportswomen (32.13 ± 3.68 kg); at general population were average measured value lower (29.18 ± 5.80 kg; with $p = 0.00$). In this case, the differences reach statistically significant difference.

The difference of the average isometric handgrip strength between the dominant and non-dominant limb of sportswomen (6.8 kg) is substantially higher than with men who do not do unilaterally straining physical activities (2.6 kg).

DISCUSSION

The measured results indicate that the chosen sportswomen have stronger dominant and non-dominant upper limb than general population. The difference between the women athlete and the general population was dominant in the upper limbs 7.1 kg, in the non-dominant hand, it was only 2.9 kg.

The big difference we see when comparing dominant and non-dominant upper limb. For women who are engaged in sports with unilateral load, it is 6.8 kg. The general population has this difference substantially lower, only 2.6 kg.

It is obvious that in sports which are focused on unilateral strain of upper limbs (tennis and javelin throwing), there will be higher deviations in the handgrip strength of the preferred and non-preferred arm. We believe that significant differences between the dominant and non-dominant upper limb could have negative impact on the sportswomen's state of health. Thus, sportswomen should do compensatory exercises which would be appropriate to be applied during the sports preparation.

CONCLUSIONS

The aim of this contribution was to compare the difference of the static strength of the flexors of the hand concerning the dominant and non-dominant upper limbs of a group of sportswomen (tennis and javelin throwing) and general population of the Czech Republic aged 18 - 29. We focused solely on female population.

The measured values of the dominant and non-dominant hand were higher in women who are engaged in sports with unilateral load. In the dominant hand, the difference 7.1 kg for the non-dominant hand only 2.9 kg.

A substantial difference of isometric strength between the dominant and non-dominant hand was discovered with sportswomen (8.1 kg); the difference with general population is much smaller (2.1 kg).

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