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## FORMATION OF POWER IN FINGER MUSCLE FLEXORS IN PROFESSIONALLY ACTIVE MEN

### INTRODUCTION

There are different types of handgrip from the mechanical point of view. They are mainly associated with the type of professional work. A multipoint finger-palm grip, also called power grip, is used in physical work (Fiutko, 1989; Dunnet et al., 1995). The increase in electrical activity of the finger flexor muscles with an increase in the grip force is observed to be most significant in static as well as dynamic loading conditions (Gurram et al., 1995). Finger motion is a balance of flexor muscles and intrinsic extensor muscles and provides a great versatility of fingers and hands (von Schroeder, Botte, 1997).

The aim of the following work was to analyze grip force differences in the breakdown of power in finger muscle flexors (PFMF) between the right and left hand, and to compare them between physical and office workers in consecutive categories of their professionally active age.

### METHODS

The group of physical workers consisted of 48 subjects; and the group of office workers of 52 subjects. The subjects' age ranged from 21 to 52 years for physical workers (mean 39.2, SD=9.00), and from 21 to 54 years for office workers (mean=40.1, SD=9.09). The duration of professional experience of the physical workers was 18.6 years and of the office workers 20.2 years. The mean body height of physical workers amounted to 178.5 cm (SD=4.97 cm) and of office workers – 173.9 cm (SD=6.21 cm). The study was carried out in 1999.

The PFMF of the right and left hand was determined using the JAMAR hydraulic hand dynamo-

meter (Sammons Preston, Inc.). To obtain additional quantities the following measurements were carried out: width of elbow epiphysis, width of distal forearm epiphysis, upper extremity length, and forearm length. All the principles of measurement methods were preserved (Drozdowski, 1998).

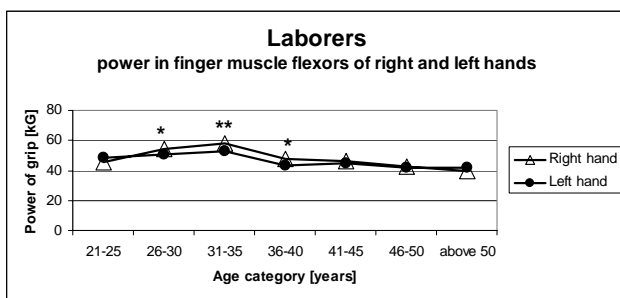
### RESULTS

All subjects were right-handed. They also showed asymmetry in features of the upper extremities (right and left). The skeletal mass in the upper extremity was greater in physical workers (width of elbow epiphysis and width of distal right forearm epiphysis between both groups:  $p<0.01$ ; width of distal left forearm epiphysis between both groups:  $p<0.05$ ). The length of upper extremity was comparable in both examined groups (non-significant for both extremities). The forearm length was longer in physical workers (non-significant for both extremities). The PFMF mean value of the right hand, in the entire age range, was higher in physical workers (non-significant); and the PFMF mean value of the left hand was higher in the office workers ( $p<0.025$ ) (Tab. 1).

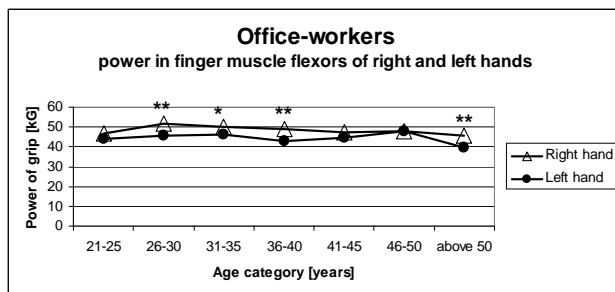
Figure 1 presents a the PFMF values of the right and left hand in physical workers according to age categories. In the age brackets of 26-30, 31-35, and 36-40 years there were significant differences in PFMF between the right and the left hand. Similar correlations were noticed in the office workers, also in the breakdown of PFMF values of the right and left hand according to age categories (Fig. 2). In this examined group differences between the PFMF of the right and the left hand over 50 years of age were observed as well.

**Table 1.** PFMF mean values of right and left hand in physical workers and office workers

	Physical workers		Office workers		p
	MEAN	SD	MEAN	SD	
PFMF of right hand [kG]	48.3	2.12	47.8	6.31	ns
PFMF of left hand [kG]	44.4	2.64	46.3	4.38	<0.025



**Figure 1.** Physical workers – PFMF of the right and the left hand

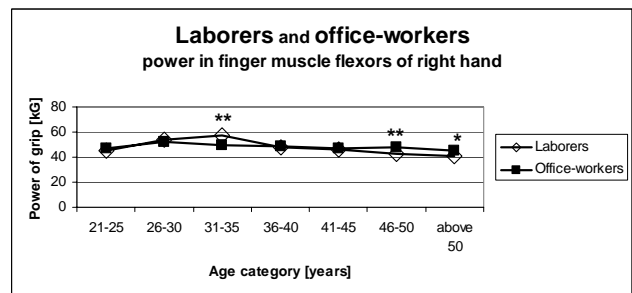


**Figure 2.** Office workers – PFMF of the right and the left hand

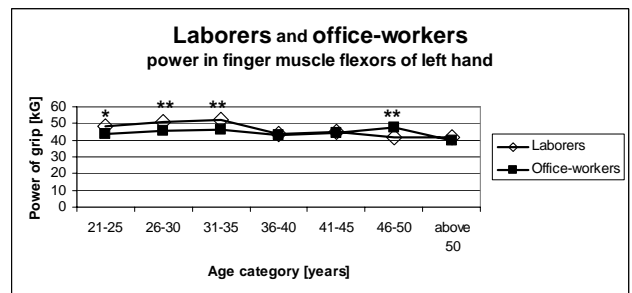
The highest PFMF in physical workers was between 31-35 years of age (Fig. 1), and in office workers between 26-30 years of age (Fig. 2). In physical workers there was a rapid PFMF increase below 35 years of age (Fig. 1). In office workers this increase was more moderate (Fig. 2).

Figure 3, in turn, shows a breakdown of PFMF values of the right hand in both examined groups. Comparing PFMF of the right hand between physical workers and office workers it is clear that physical workers have more strength in the right hand between 31 and 35 years of age ( $p < 0.01$ ) (Fig. 3). The PFMF of the right hand in office workers predominated between 45 and 55 years of age ( $p < 0.01$ ) and above 50 years of age ( $p < 0.05$ ).

Figure 4 presents a breakdown of PFMF values of the left hand in both examined groups. There was a greater significant differentiation in the left hand ( $p < 0.05$ ,  $p < 0.01$ ) in the entire period between 21 and 35 years of age (Fig. 4) in physical workers. Surprisingly, in the period between 46 and 50 years of age the office workers were shown to have more strength in the left hand than physical workers ( $p < 0.01$ ) (Fig. 4).

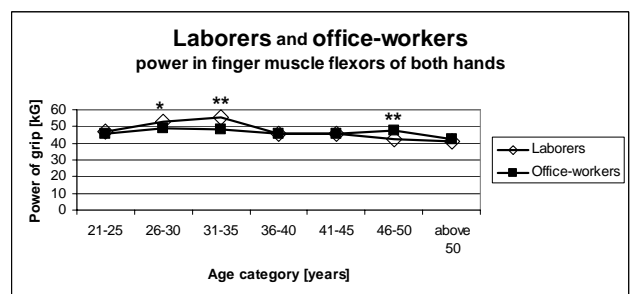


**Figure 3.** Physical workers and office workers – PFMF of the right hand



**Figure 4.** Physical workers and office workers – PFMF of the left hand

Figure 5 shows a breakdown of PFMF values of both hands in the studied groups. The results calculated for both hands demonstrated differences between physical workers and office workers between 26 and 35 years of age in favor of physical workers, and between 46 and 50 years of age in favor of office workers.



**Figure 5.** Physical workers and office workers – PFMF of both hands

After the age of 46 in physical workers, there was a regression of PFMF in both hands as compared to office workers (Fig. 5). At the age between 36 and 45 years the PFMF value of both hands was equal in both examined groups (Fig. 3, 4, 5).

## DISCUSSION

The body height in the examined groups was irrelevant in all the age categories as all the subjects were adult men. The length of upper extremity and particular parts of it (length of forearm) in physical workers is much differentiated. This differentiation does not occur in office workers. This phenomenon can be explained by the individual differentiation of body sizes in physical workers, higher frequency of using the right upper extremity by physical workers, and high long-term workloads, lasting in this professional group (Fig. 3, 4). It is associated also with a higher mass (over 46 years of age) of upper extremities in physical workers. However, a decrease in PFMF observed in physical workers (Fig. 3, 4, 5) can be caused by a higher physical exploitation of this work organ in this professional group as compared with office workers (Quaine et al., 2003).

Comparing the PFMF values in the examined groups (physical workers and office workers) with other professional groups within a similar age bracket one can notice that the highest value of PFMF in both hands characterizes subjects examined by Drozdowski (1975) and Zdanowska (1975), i.e. hang gliders and parachutists (Tab. 2). The PFMF values obtained by these groups were results of adaptation to the specificity of their professions.

office workers, this decrease is significantly lower. It can be caused by the higher long-term physical exploitation of this work organ in physical workers.

## REFERENCES

- [1] Drozdowski Z., *Antropometria w wychowaniu fizycznym (Anthropometry in physical education)*, AWF, Poznań 1998, nr 24.
- [2] Drozdowski Z., *Doniesienie z badań asymetrii siły mięśni zginaczy palców ręki, Materiały konferencyjne „Morfofunkcjonalna asymetria człowieka” (Reports on the asymmetry of power of finger muscle flexors. Conference proceedings.)*, AWF, Poznań 1975, 68.
- [3] Dunnet W.J., Housden P.L., Birch R., *Flexor to extensor tendon transfers in the hand, J. Hand Surgery*, 1995, 20 (1): 26-28.
- [4] Fiutko R., *Ocena siły mięśni zginaczy ręki u pracowników Huty Katowice na tle uwarunkowań społecznych i zdrowotnych (Assessment of power of finger flexors in workers of Huta Katowice in consideration of social and health conditions)*, AM, Warszawa 1989.
- [5] Gurram R., Rakheja S., Gouw G.J., Ma S., *Influence of power tool-related parameters on the response of finger flexor muscles, Int Arch Occup Environ Health*, 1995, 66 (6): 393-398.
- [6] Quaine F., Vigouroux L., Martin L., *Finger flexors fatigue in trained rock climbers and untrained sedentary subjects, Int J Sports Med*, 2003, 24 (6): 424-427.
- [7] Von Schroeder H.P., Botte M.J., *Functional anatomy of the extensor tendons of the digits, Hand Clin.*, 1997, 13 (1): 51-62.

**Table 2.** The comparison of the obtained PFMF values in different studies

	Physical workers	Office workers	Drozdowski (1975)	Zdanowska (1975)	Zdanowska (1975)
PFMF of the right hand [kG]	47.77	48.33	55.49	63.26	68.80
PFMF of the left hand [kG]	46.20	44.38	49.63	62.82	65.80

### Conclusions:

1. The highest PFMF value in physical workers was observed between 31 and 35 years of age, and in office workers between 26 and 30 years of age.
2. Similar PFMF values of the right and the left hand appear in both groups between 36 and 45 years of age.
3. After 45 years of age a decrease in the PFMF value of both hands in physical workers is observed. In

- [8] Zdanowska B., *Asymetria siły mięśni zginaczy palców ręki spadochroniarzy i szybowników, Materiały konferencyjne „Morfofunkcjonalna asymetria człowieka” (Asymmetry of power of finger flexors in parachutists and hang gliders. Conference proceedings)*, AWF, Poznań 1975, 68.