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EFFORT-INDUCED CHANGES IN THE MAXIMUM FREQUENCY OF TAPPING IN WOMEN AGED BETWEEN 65 AND 70

INTRODUCTION

The maximum frequency of movements depends mainly on the capabilities of human neural centres controlling antagonistic muscle groups. These capabilities are greatly affected by the process of aging. Christianson [3] observed significant differences ($p \leq 0.001$) in the frequency of finger tapping using the dominant hand between groups of 25-39 year olds and 55-70 year olds. The test using the non-dominant hand showed a significant difference between the 55-70 year olds and all three younger groups.

Cousins et al. [4] compared 10 seconds-long finger tapping between 75 and 18 year olds. Response initiation time and duration time were much longer in the older group.

Early symptoms of fatigue in elderly people follow the decrease in neuro-muscular coordination. The rate of fatigue could be associated with weakening of muscles; with atrophy of muscles and more intensive engagement of muscles in physical activity. It is due to age-related dysfunction in the neural system [2].

The main aim of this study was to examine effort-induced changes in the maximum frequency of tapping performed by women between 65 and 70 years of age.

METHODS

This study involved 34 women, aged between 65 and 70 ($\bar{x}$ =68.03±2.62 years). The mean body height was 156.38±6.45 cm, and the mean body weight was 70.85±12.57 kg.

The Ethical Committee at the Medical University in Poznan issued permission to carry out this study. All the participants signed a written consent to perform the exercises and had a full right to finish the experiment at any time without giving a reason. All the tests were carried under the supervision of a qualified doctor.

Maximum frequency of movements was measured with the MLS machine (Motorische Leisstung Serie) series 020669/01, included in the Vienna Test System (Dr. G. Schuhfried, Austria).

Each participant was prepared for the main task by taking part in pre-tests that allowed them to get familiar with the apparatus and the nature of the task.

The first stage measured the speed of the wrist and finger tapping initially. A participant was to tap a 40 mm x 40 mm square with a stylus as fast as possible for 32 seconds. Then the number of taps was calculated.

Before the first effort inducing exercise, participants took part in a warm-up led by a fitness instructor, based on an eight-minute long stretching routine developed by Rikli and Jones [6].

Then the participants carried out a physical exercise for 30 s. Sitting on a chair, with feet flat on the ground, the subjects lifted a 2.27 kg load, bending only at the elbow [6]. Immediately after the exercise the tapping test was carried out.

Each participant performed the routine (30 s load exercise and the tapping test) five times. Both tests were performed with the dominant hand.

To confirm the significance of differences between the groups we used the ANOVA, analysis of variances. The differences within the groups were measured with post-hoc Tukey’s test (HSD).

RESULTS

The analysis showed significant effort-induced changes in the maximum frequency tapping performed by the participants (Table 1).

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Table 1. Mean results of the tapping tests before and after subsequent exercises

group	before effort $\bar{x}_S$±SD	Tapping (number of taps) effort 1 $\bar{x}_1$±SD	effort 2 $\bar{x}_2$±SD	effort 3 $\bar{x}_3$±SD	effort 4 $\bar{x}_4$±SD	effort 5 $\bar{x}_5$±SD	F
elderly women n=34	165.38±34.09	156.32±30.39	156.29±36.12	156.88±36.30	157.85±32.41	154.32±32.32	55.7*

*p ≤ 0.001

The post-hoc analysis shows significant differences between the results obtained initially and after the very first effort, when the results dropped on average by 9.059 taps (p≤0.01). The following tapping tests did not continue to change in a significant manner. The results after the 3rd and the 4th efforts even increased in comparison with the earlier measurements (Table 2 and Fig. 1).

Table 2. Changes in tapping after subsequent efforts

group	change after effort 1 $d_{1\text{-}S}$	Tapping (number of taps) change after effort 2 $d_{2\text{-}1}$	change after effort 3 $d_{3\text{-}2}$	change after effort 4 $d_{4\text{-}3}$	change after effort 5 $d_{5\text{-}4}$
elderly women n=34	–9.06*	–0.03	+ 0.59	+ 0.97	–3.53

*p ≤ 0.001

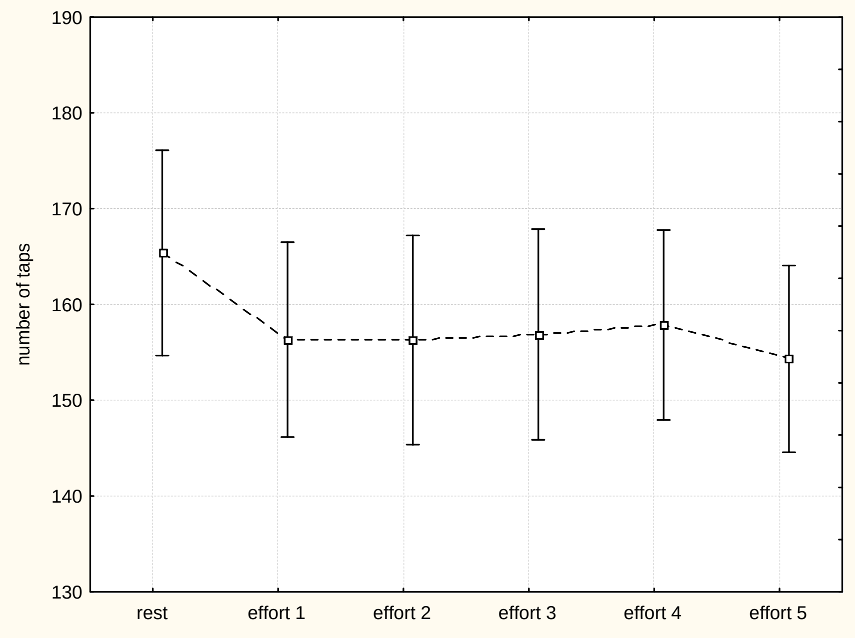

Figure 1. Tapping results during rest and after subsequent exercises

DISCUSSION

It is widely accepted that a tapping test is a good way of examining the ability of the central nervous system and its effectors. The analysis of our results shows that the load-lifting exercise significantly decreased the results of the tapping test in the group of elderly women. The decrease was actually distinct after the first load exercise. Along with the increased fatigue the results became more regular and stable.

In the report by Waskiewicz [7], anaerobic effort (3-fold Wingate test) resulted in worse and worse results of the bimanual tapping test performed by young men (22.4±1.3 years). The differences were significant except the penultimate and the last exercise, where changes in the frequency of movements were smaller and statistically insignificant.

Vanneste et al. [8] observed the tapping results over five days of an experiment carried out amongst young (from 20 to 30 years of age) and elderly people (from 60 to 76 years of age). The tapping was performed at the participants' own preferred rate, and the elderly group had significantly and consistently lower results than young people, whereby the elderly people seemed to keep a more steady rate of tapping over the five days of the experiment.

In the second task of the aforementioned test (synchronized-tapping and continuation task) the participants performed tapping synchronously to a given tempo (interresponse times: 300, 400, 500, 600 and 700 m/s) and continued the task for some time. In both groups the variance increased along with the rate of the given tempo. There were no significant differences between both groups.

The aforementioned reports and our study suggest that the character of the effort-induced changes within a group results from well-known biological processes of aging, such as a decrease in the mass and strength of muscles, lower nerve responsiveness, reduction in contractions of muscles, and numerous changes at cellular and enzymatic levels [1]. Lexell [5] argues that the most important factor leading to sarcopenia is degeneration of the neural system. The disappearance of alpha-mononeurons leads to the atrophy of muscle components, indicating the start of the process of degeneration after 60 years of age.

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