



## AGE AND SEX VARIATION IN THE RESULTS OF THE 2HAND TEST IN AN ADULT POPULATION

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ANNA SEBASTJAN<sup>1</sup>, KATARZYNA SIWEK<sup>1</sup>, SŁAWOMIR KOZIEŁ<sup>2\*</sup>,  
ZOFIA IGNASIAK<sup>1</sup>, ANNA SKRZEK<sup>1</sup>

<sup>1</sup> University School of Physical Education, Wrocław, Poland

<sup>2</sup> Polish Academy of Sciences, Unit of Anthropology in Wrocław, Poland

### ABSTRACT

**Purpose.** The aim of the present pilot study was to assess sex and age differences in sensory-motor coordination by examining eye–hand coordination in an elderly population. **Methods.** The sample consisted of 529 participants (158 men and 371 women) aged over 50 years from Poland. Participants performed the 2HAND test, with the results analyzed by two-way ANOVA. The three test parameters (total mean duration, total mean error duration, and coordination difficulty) of the test were treated as dependent variables while sex and age (separated into 5-year age groups) were the independent variables. **Results.** In each 5-year age group, differences between the analyzed parameters were higher in females. Significant age differences were found in the means of total mean duration and total mean error duration. Neither of the above parameters showed significant differences for sex. **Conclusions.** The values of all the parameters measuring eye–hand coordination showed a gradual deterioration with age. The pilot study warrants additional data collection, where large-scale quantitative research may help in the development of suitable prevention strategies to slow the impact of aging on eye–hand coordination abilities in the elderly.

**Key words:** 2HAND test, eye–hand coordination, aging, human motor skills

### Introduction

Aging is a multistage process that gradually impairs body function. The advance of musculoskeletal disorders is associated with a progressive functional degeneration of the central nervous system. This process commonly begins after 50–60 years of age and affects both men and women in similar ways. However, the onset and magnitude of these age-related musculoskeletal changes (sarcopenia) may be very different [1–3].

Sarcopenia is marked by a deterioration in complex movement performance and overall physical mobility (coupled with an increased fall risk) [4–6]. These changes also affect the performance of smaller manipulative movements such as eye–hand coordination, where eye movement is directly connected with hand movement. This mechanism is exceedingly important as it allows individuals to perform almost all activities of daily living and is, therefore, a prerequisite for self-care tasks, independent living, and active participation in social life. Impairments to eye–hand coordination can severely limit social interaction or lead to total exclusion from community activities [7–10].

A number of factors determine whether eye–hand coordination function is maintained at an appropriate level, including age and sex [11–14]. Although the effects of aging on eye–hand coordination are irreversible, methods aimed at slowing this process down can in-

crease the quality of life and maintain greater levels of independence in the elderly. For this purpose, it is important to diagnose the level and variability of eye–hand coordination with age by research on various elderly populations. Gaining knowledge about coordination issues and their relationships with other factors may help form suitable prevention strategies, thereby improving quality of life and allowing individuals to better cope with aging.

The goal of this study was to perform a preliminary assessment of the sex differences in sensory-motor coordination associated with aging by examining eye–hand coordination.

### Material and methods

The study sample comprised 529 participants (158 men and 371 women) aged above 50 years recruited by various means from Lower Silesia, a province located in Poland (see Tab. 1). All participants provided their written informed consent to participate in the study and then completed a questionnaire regarding current health, physical fitness levels, and prior illness. The inclusion criteria for the study and research group are described in greater detail in Ignasiak et al. [15] and a research project performed under the auspices of the Ministry of Science and Higher Education (No. N N404 075337). Research was performed at the Biokinetics Research Laboratory of the Department of Biostructure at the University of Physical Education in Wrocław, Poland and was led by a group of faculty members. This study

\* Corresponding author.

received approval from the University's Senate Committee on Research Ethics.

Participants' sensory-motor coordination was tested by the 2HAND test, which is part of the Vienna Test System (Schuhfried GmbH, Austria) developed by Schoppe and Hamster based on a factor analysis of specific motor skills. The 2HAND test examines the speed, accuracy, and coordination of small and precise hand movements. Participants use two knobs to move a red dot from point A to point B along a designated route (track) shown on a monitor. The right knob moves the dot vertically whereas the left knob moves the dot horizontally. Participants performed 10 trials, where test form S4 of the Vienna Test System was administered and used to examine the following variables:

- Total mean duration [s] – the mean time required to complete the track,
- Total mean error duration [s] – the time of error, summed over all runs, when the point was outside the tolerance limit of the track area,
- Coordination difficulty [s] – a measure of the respondent's coordination ability, expressed as a factor by the time required to complete the route increases when a track of the same length is travelled once with sensorimotor coordination (circular arc or V-shape) and once without sensorimotor coordination (inverted L) [16].

The results of the test were analyzed by a two-way ANOVA, where the three test parameters were treated as dependent variables while sex and age (grouped into 5-year-age groups) were the independent variables. All analyses were performed using Statistica ver. 10.0 software (Statsoft, USA) [17].

## Results

Tables 1–3 present descriptive statistics of the parameters of the 2HAND test in the age groups for each sex. In each age group, the total mean duration for females was higher than for males except in the oldest age group. Additionally, in each age group variations for this parameter were higher in females (Tab. 1). The same pattern was present in the second (total mean error) and the third (coordination difficulty) test parameter.

Table 4 shows the results of two-way ANOVA for the three test parameters. Significant differences in age were found for the means of total mean duration and total mean error duration. Neither parameter showed significant differences for sex. Only for total mean duration was the second-order interaction significant, indicating that the observed differences between ages were dependent on sex.

Figure 1 presents the age and sex differences in the means of the total mean duration. The means of this parameter gradually increased with age in both sexes. Interestingly, the mean of the females in the oldest age group (> 75 years) was below the mean recorded for the previous younger age group. In contrast, the mean of this parameter steeply increased in men.

## Discussion

Upper limb coordination, especially eye–hand coordination, plays a key role in proper human motor function. A temporary or permanent impairment can be particularly debilitating for an individual, as the

Table 1. Means, medians, and standard deviations of total mean duration [s] in the 2HAND test per 5-year age groups

Age	Males				Females			
	<i>n</i>	Mean	Median	<i>SD</i>	<i>n</i>	Mean	Median	<i>SD</i>
50–54	15	29.67	29.96	9.36	34	40.48	37.89	13.99
55–59	30	41.96	38.76	12.83	86	45.41	45.55	13.20
60–64	39	39.34	35.19	14.34	141	47.90	44.30	14.98
65–69	34	50.36	47.50	15.36	63	52.33	49.05	21.28
70–74	22	52.93	51.36	15.49	27	59.03	56.66	20.83
> 75	18	66.03	69.25	24.12	20	53.91	54.64	18.00

Table 2. Means, medians, and standard deviations of total mean error duration [s] in the 2HAND test per 5-year age groups

Age	Males				Females			
	<i>n</i>	Mean	Median	<i>SD</i>	<i>n</i>	Mean	Median	<i>SD</i>
50–54	15	2.12	1.99	1.13	34	2.97	2.09	2.65
55–59	30	1.92	1.53	1.26	86	2.65	1.90	2.33
60–64	39	2.62	2.40	2.22	141	4.02	2.87	3.40
65–69	34	2.16	1.65	1.64	63	3.28	2.60	2.64
70–74	22	3.31	3.41	2.08	27	3.15	2.30	2.44
> 75	18	4.68	3.84	3.60	20	3.92	3.38	3.05

Table 3. Means, medians, and standard deviations of coordination difficulty [s] in the 2HAND test per 5-year age groups

Age	Males				Females			
	<i>n</i>	Mean	Median	<i>SD</i>	<i>n</i>	Mean	Median	<i>SD</i>
50–54	15	2.74	2.80	0.76	34	3.11	2.80	1.09
55–59	30	3.47	3.12	1.09	86	3.23	2.94	1.08
60–64	39	3.07	2.81	0.97	141	3.30	3.17	1.00
65–69	34	3.41	3.20	0.90	63	3.30	3.10	1.18
70–74	22	3.06	2.87	0.87	27	3.70	3.32	1.53
> 75	18	3.34	3.21	1.10	20	3.02	2.65	1.17

Table 4. Results of two-way ANOVA for the three test parameters and age and sex

Parameters	Age		Sex		Interaction	
	<i>F</i>	<i>p</i>	<i>F</i>	<i>p</i>	<i>F</i>	<i>p</i>
Total mean duration [s]	15.52	< 0.001	3.32	> 0.05	2.86	< 0.05
Total mean error duration [s]	3.89	< 0.01	3.45	> 0.05	1.34	> 0.05
Coordination difficulty [s]	1.35	> 0.05	0.73	> 0.05	1.71	> 0.05

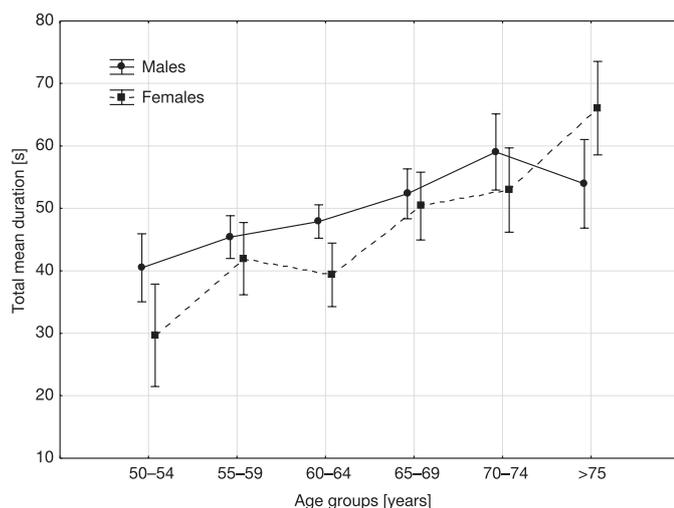


Figure 1. Means and standard error of means for total mean duration of the 2HAND test by age and sex in 5-year age groups

ability to perform manual tasks required for learning or working and basic activities of daily living (self-care tasks) can be limited and thus may infringe both independence and active participation in social life, factors which determine subjective quality of life [18].

Measurement of sensory-motor coordination ability should be approached with caution. Even if objective testing methods are applied, the results are affected by a number of factors both internal and external. The dynamics of maturation and aging are highly variable depending on the type of coordination ability that is being studied. Although the impact of sex on sensory-motor coordination abilities cannot be precisely determined, based on the results of the present study and in the literature, the levels of coordination ability can be extrapolated to a large extent in older age groups [11, 19–21].

The present study found a decrease in coordination ability with age. This was demonstrated in almost all age groups, where a statistically significant decrease was observed in each of the three parameters measuring coordination ability. In some cases this decrease was dependent on sex; in others, no dependencies were found. This may be associated with the fact that the rate of loss of muscle strength is similar in both sexes although strength values are overall much higher in men than in women.

Decreases in muscle mass are strongly correlated with a decline in the proper functioning of the upper limbs, especially in the ability to perform precise movements. Reductions in muscle mass have been observed as early as 30 years of age and significantly accelerate after 50 or 60 years of age [21, 22]. The most critical period associated with precise movement function appears to be 50 years of age, although some researchers suggest this to be around 60 years [12]. Around this point in time, all of the mechanisms that constitute coordination ability begin to slow down and are increasingly deregulated, causing movements to be less accurate and smooth [23–25].

Our results indicated a progressive decline in coordination ability as evidenced by the deterioration of scores in the 2HAND test. It is interesting that the changes in the average values of mean total duration between the 70–74 and > 75 age groups are different in both sexes. In men, this parameter improved, whereas in women a further deterioration of coordination functions of the upper limbs was observed. This may be due to the phenomenon of selective mortality, where higher mortality rates are observed among men. Those living longer may have lead much healthier lives, as evidenced by the fact that the > 75 men in the present study all reported relatively good health and overall high levels

of physical fitness in the questionnaire regarding current health status.

### Conclusions

The presented research is part of a larger currently active longitudinal study collecting information on motor skills and abilities. It is expected that the collected data will allow for more in-depth analysis and expand knowledge on the effects of aging on fine motor skills, eye-hand coordination, and other coordination abilities. This is especially important, as the above subject matter determines the types of activities of daily living the elderly can perform and thus affect their quality of life.

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#### Correspondence address

Sławomir Kozieł  
 Polska Akademia Nauk  
 Zakład Antropologii we Wrocławiu  
 ul. Podwale 75  
 50-449 Wrocław, Poland  
 e-mail: skoziel@antropologia.pan.pl