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**Title: Executive functions and handwriting process skills among adults – differences and correlations among different age groups.**

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### **Abstract**

The percentage of the elderly population in the general population has been increasing through the years. Though most people experience healthy aging without significant deficits, there might be a decrease in sensory, cognitive, meta-cognitive functions that constitute a danger to the independency of this population, in the areas of ADL (activity daily living) and IADL (instrumental activity daily living).

Writing is an example of a functional activity that is composed of cognitive, kinesthetic and perceptual motor components, used throughout a lifespan. Results of previous studies indicated that writing activities are sensitive to deficits in different executive functions that change with the increasing age, and therefore it might be an effective clinical evaluation tool for examining decrease in meta cognitive functions. Despite the importance of writing in everyday life, literature that dealing with the influence of aging process and possible decrease in executive functions in general, and handwriting process skills in particular, is scarce. Only a few studies based on clear criteria for evaluating the decreasing of executive functions and handwriting with aging have been done to this day.

**The main thesis objective:** Examining the differences appearing of normal aging in executive functions and in the handwriting process skills and to examine the correlations between the executive functions and the handwriting process skills with aging.

### Three main hypothesis were formulated for testing:

1. Significant differences exists between the various age groups in:
  - a. Performance on the BADS test that evaluates executive functions.
  - b. Temporal, spatial and pressure measures of the handwriting process as evaluated by the computerized ComPET system.
2. Negative correlations will be found between the BADS profile score and temporal, spatial and pressure measures of the handwriting process, and positive correlations between the BADS profile score and the measure of velocity of the handwriting process.
3. Correlations will be found between the profile score of the sub test: "action Programme" "search key" "zoo map" "Temporal Judgment" from the BADS and between the temporal measures of the handwriting paragraph copying task (total writing time, ground time and air time).

**The subjects** were divided into four groups according to their age, all aged 31 years and up. Each group included 20 subjects (N=80), with equal number of males and females. All subjects had proper cognitive abilities, without depression. People who were diagnosed as suffering from neurological diseases, arthritis, hypothyroidism and /or people who take medication that influences the neurological system were not included in the study, and in any case they did not take the drug on the day of the test nor on the previous day.

**Materials and Tools:** A demographical questionnaire, GDS, MMSE and a memory questionnaire were used in order to determine who is appropriate to participate in the study. The BADS (Behavioral Assessment of Dysexecutive) test and a computerized penmanship evaluation tool, ComPET were used in order to evaluate executive functions and handwriting process skills.

**Procedure:** After receiving the approval from the Ethics Committee of the Haifa University, subjects were chosen by the convenient sample. Potential participants were asked five questions about their general health. Then for those who met the criteria, they were screened with the MMSE

and GDS tests as well as the memory questionnaire. The 80 people that found suitable, evaluated by the tools mentioned above.

**Analyses:** The differences between the groups' executive functions and handwriting were analyzed by MANOVA test. Correlation between variables was then analyzed with the Spearman correlation analysis.

**Results:** The results showed significant differences between age group.

Significant differences were found between age groups in executive functions, meaning there is a decrease in executive functions with the increasing age as evaluated by the BADS test.

Parallel, significant differences were found between age group in the handwriting process skills, there were differences in temporal measures of the handwriting process (total writing time, ground time and air time) and decrease in the handwriting velocity. In addition, it found an increase in the size of letter (wide, height and length) with the increasing age. For the pressure variable it found no difference between different groups.

Significant correlations found between the BADS profile score and the temporal and spatial measures of the handwriting process. More specifically , significant correlations were found between the profile score of the sub test :”action programme” “search key” “zoo map” “Temporal Judgment” from the BADS test and between temporal measures of the handwriting process (total writing time, ground time and air time).

**Conclusions:** The result of this study shows changes with the increasing age in executive function and handwriting process and expands the professional knowledge in these fields. Also, finding correlations between the executive function and handwriting process skills, indicate that handwriting can become an affective instrument for examine decreasing in executive functions in elderly. In addition, this study strengthens the importance of using computerized system that supplied quantities objective valid measures which may contribute in diagnosis process among the elderly population.