



## THE IMPACT OF THE SUPPORT SERVICE “PROGRAMME OF MENTAL ARITHMETIC” ON THE QUALITY OF LIFE OF THE ELDERLY IN INSTITUTIONAL ACCOMMODATION

*Original scientific paper*

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### ABSTRACT

*The aim of the research was to determine whether the innovative support service “ Programme of mental arithmetic ” has positive effects on the cognitive abilities and the satisfaction of life of the elderly in institutional accommodation. New support services for the elderly are rarely developed, so it is expected that in addition to the direct positive effects on cognitive abilities, there are also indirect effects on the perception of life satisfaction. The study involved 60 elderly people, divided into control and experimental groups. Cognitive abilities were tested using the Montreal Cognitive Assessment (MoCA) test and life satisfaction by using the Satisfaction with Life Scale (SWLS). An increase in scores was found on both instruments after the program was conducted in the experimental group. The scores of the control group did not change significantly.*

**Keywords:** *mental arithmetic, support service, elderly, abacus, cognitive abilities*

### INTRODUCTION

Aging, as a part of human life, deserves its equal place in society especially today when human life has lengthened and the quality of life has enabled the elderly people to follow the changes and maintain the freshness of the spirit until old age or the end of life (Span, 2013).

Gerontology centers take care mainly and primarily for the physical health and social care of the elderly. This takes place mainly through services that are similar in all institutions of this type. Physical and cognitive limitations, but also inadequate offer of content intended for elder people in institutional accommodation, lead to a situation of lack of choice and creating a sense of objectification (Milosavljevic, 2011). Rarely are new services and innovative content and therapies developed that would enable older people to have a better quality of life.

Since physical deterioration in older people is more noticeable than cognitive decline, new programs are developed much more often, which strive to prevent physical deterioration (Dragojlovic-Ruzicic et al, 2015), as opposed to cognitive decline.

Also, most rehabilitation programs available to the elderly are focused exclusively on health goals, and no account is taken of whether the person likes to participate in such activities. Given that rehabilitation procedures in old age are an integral part of life, care should be taken to ensure that the activities within these procedures are attractive to the elderly.

Therefore, there is a need to create programs that have a dual character. A program for the elderly should simultaneously provide a therapeutic effect while improving satisfaction and quality of life.

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At the College of Social Work, a support service has been developed that includes a program of training cognitive abilities through the use of mental arithmetic. When developing this program, we considered that the program should be efficient in preserving the cognitive abilities of the elderly and at the same time to contribute to their satisfaction and quality of life.

Mental arithmetic is a traditional discipline developed as a result of many years of work by psychologists, pedagogues, and other experts in the field of education. This discipline uses the ancient Japanese abacus as a tool with the help of which the arithmetic operations of addition, subtraction, multiplication, and division are performed. The idea is to develop the ability to imagine or visualize an abacus and achieve remarkably fast computation abilities. This method of work is currently very popular in children's educational process. However elderly people are not expected to fully develop mental arithmetic skills, but the whole process is expected to improve or maintain cognitive abilities and quality of life. The aim of this research is to determine whether the support service "Program of mental arithmetic" improves the cognitive abilities and quality of life of the elderly. We expect that the elderly will enjoy the program and that the program will contribute to the socialization of users of the institution's services.

## METHODS

The research was conducted at the Gerontology Center "Novi Sad", Serbia. The institution gave approval for the research, and each of the participants included in the research gave consent for participation. Conducting the research involved several steps. The examiner (special educator rehabilitator – occupational therapist) filled out a specially designed questionnaire for all clients of the institution based on data contained in the institutional databases. Based on the inclusive criteria, participants agreement, and the need to balance the sample, 60 participants were selected. The Montreal Cognitive Assessment and The Satisfaction with Life Scale were conducted on the selected sample before including an experimental group in the "Programme of mental arithmetic". After an initial assessment, participants of the experimental group were included in the "Programme of mental arithmetic" for a period of six weeks, while both control and experimental groups continued with other regular activities (occupational therapy, physical exercises, workshops, etc.) within the institution. After a period of six weeks, the same examiner conducted a reassessment on all instruments, followed by statistical analysis and results interpretation.

### Sample

The inclusive criterion for the sample was that the person resides permanently in the institution (Gerontology Center "Novi Sad") and that they do not have associated diseases that may affect the results of the research (eg mental health diseases, sensory impairments that prevent participation in assessment or assessment, dementia, etc.).

The sample consisted of 60 participants, average age of 74.53 (SD = 7.30). The minimum number of years of participants was 65, and the maximal number of years was 90. Nearly half (45%) of the sample were men. 36 participants had lower and primary education (60%), 14 participants had secondary education (23.3%), and higher education 10 participants (16.7%).

The sample was divided into two groups, equal by the number of participants. The control and experimental group were balanced by gender, age, and level of education.

### Assessment tools

General data were obtained by a Specially designed questionnaire. The questionnaire included information on gender, age, education level, and health status.

The Montreal Cognitive Assessment (MoCA) is a test for the quickly assessment of cognitive skills. The test includes the domains: attention and concentration, executive functions, memory, language visuo-constructive skills, conceptualization, and orientation. The total score ranges from 0 to 30 points, and a cut score of 26. The Montreal Cognitive Assessment has adequate psychometric properties as a screening instrument for the detection of mild cognitive impairment. The MoCA shows an overall stable hierarchical factorial structure and a satisfactory general factor saturation (Sala et al., 2020).

The Satisfaction with Life Scale (SWLS) was used to assess general satisfaction with the participant's life as a whole. The SWLS is shown to be a valid and reliable measure of life satisfaction, suited for use with a different age groups (Pavot & Diener, 1993). It consists of 5-items. Participants indicate how much they agree or disagree with each of the 5 items using a 7-point scale that ranges from 7 strongly agree to 1 strongly disagree. Scoring should be kept continuous (summing up scores on each item).

### Description of "Programme of mental arithmetic"

The support service "Programme of mental arithmetic" consists of 3 parts. The first part is learning to use abacus and to solve simple mathematical operations like addition and subtraction with one or multiple digit numbers. The participants sat in a semicircle and always in the same place. The instructor, who led the session, was positioned in front of the participants. Each of the participants had his own abacus, and in addition to the abacus, the trainer used paper and pencil, which served him for additional explanations. The rules used to perform arithmetic operations were written on the board next to the instructor. As the new rule was introduced, it would be added to the board. The duration intended for these activities is 45 minutes. Mental arithmetic is also part of the program and is intended to last 10 minutes. It is organized in the same manner as the direct work with an abacus. The participants had the task to imagine an abacus in their head and add or subtract numbers with the help of the rules that were mastered in the previous and given session.

At the end of the program, the participants did physical dynamic and relaxation exercises in a sitting position for 10 minutes. The goal is to stimulate blood circulation and promote relaxation after a period in which participants did not move much because they had to be concentrated on the task ahead. The sessions were conducted twice a week during the period of six weeks and always took place in the occupational therapy room at the same time of a day.

**Data analysis**

SPSS (Statistical Package for the Social Sciences), version 22. was used for statistical data processing. Descriptive statistics and the t-test of repeated measurements were used as statistical methods. Data are presented in tabular form.

**RESULTS**

The average values of the scores on the Montreal Cognitive Assessment (MoCA) and the Satisfaction with Life Scale (SWLS) are presented in Table 1. The average values of the scores on individual tasks of the Montreal Cognitive Assessment (MoCA) are presented in Table 2. A paired samples t-test was conducted to evaluate the impact of the intervention on experimental group participants' scores on the Montreal Cognitive Assessment (MoCA).

There was a statistically significant increase in MoCA scores from before the training application (M = 16.83, SD = 2.89) to after training application (M = 18.40, SD = 2.98),  $t(29) = -3.47, p < .0005$  (two-tailed) in experimental group. The mean increase in MoCA scores was -1.57 with a 95% confidence interval ranging from -2.49 to -.64. The eta squared statistic (.29) indicated a large effect size (Table 1).

There was not a statistically significant changes in MoCA scores from time of test (M = 14.33, SD = 5.33) to time of re-test (M = 13.80, SD = 5.60),  $t(29) = 1.43, p = .16$  (two-tailed) in the control group (Table 1).

A paired samples t-test was conducted to evaluate the impact of the intervention on experimental and control participants' scores on the Satisfaction with Life Scale (SWLS). There was a statistically significant increase in SWLC scores from before the training application (M = 22.47, SD = 2.22) to after training application (M = 23.63, SD = 2.34),  $t(29) = -4.59, p < .0005$  (two-tailed) in experimental group. The mean increase in SWLC scores was -1.17 with a 95% confidence interval ranging from -1.69 to -.65. The eta squared statistic (.72) indicated a large effect size (Table 1).

There was not a statistically significant changes in SWLC scores from time of test (M = 22.53, SD = 3.25) to time of re-test (M = 22.43, SD = 2.54),  $t(29) = .22, p = .83$  (two-tailed) in control group (Table 1).

*Table 1. Differences in the scores of the control and experimental groups on the assessment instruments*

Instrument	Control	Experimental
The Montreal Cognitive Assessment (MoCA)	14.33 (5.33)	16.83 (2.89)
The Montreal Cognitive Assessment (MoCA) Retest	13.80 (5.60)	18.40 (2.98) *
The Satisfaction with Life Scale (SWLS)	22.53 (3.25)	22.46 (2.22)
The Satisfaction with Life Scale (SWLS) Retest	22.43 (2.54)	23.63 (2.34) *

\*p < .05

A paired samples t-test was conducted to evaluate the impact of the intervention on experimental group participants' scores on individual tasks of the Montreal Cognitive Assessment (MoCA). Table 2 shows significant results according to statistical analysis of the t-test.

Significant differences were found in the scores on the following tasks: Visuoconstructional Skills (Clock), Memory: Immediate recall I, Memory: Immediate recall II, Delayed recall.

*Table 2. Differences in the scores of the experimental group on the MoCA tasks before and after the intervention*

MoCA tasks	Before intervention	After intervention
Alternating Trail Making	.07 (.25)	1.33 (.35)
Visuoconstructional Skills (Cube)	.13 (.35)	.17 (.38)
Visuoconstructional Skills (Clock) *	1.30 (.84)	1.83 (.65)
Naming	2.80 (.48)	2.90 (.40)
Memory: Immediate recall I*	3.90 (1.27)	4.40 (.93)
Memory: Immediate recall II*	4.20 (1.21)	4.60 (.86)
Attention	5.50 (.78)	5.37 (.72)
Sentence repetition	.93 (.82)	.93 (.82)
Verbal fluency	.67 (.25)	.67 (.25)
Abstraction	1.10 (.80)	1.03 (.85)
Delayed recall*	.80 (1.32)	1.53 (1.76)

\*p < .05

## DISCUSSION

The analysis of the obtained results showed that there is a statistically significant difference in the scores of participants in the control and experimental groups on the instruments used, which indicates a possible positive impact of service on cognitive abilities and quality of life of the elderly.

### Programme of mental arithmetic and cognitive skills

The results of our research confirmed that there is an improvement in cognitive performance in the elderly after the implementation of the support service "Program of mental arithmetic" in institutionalized accommodation. Comparing the scores on individual tasks before and after the implementation of the program, we found a significant increase in scores on visuo-constructional, memory, and delayed recall tasks. On most other tasks, we find higher scores after the program, but without a statistical indication of significance. Since the scores of the control group did not differ significantly on the MoCA test at the time when the experimental group was not yet involved in training and the time after the experimental group ended training participation speaks in favor of the importance of mental arithmetic training for improvement of cognitive skills in elderly.

Although the program of mental arithmetic we developed is unique in its adaptation to the elderly, there are programs of other authors who have shown a positive impact of abacus training on cognitive abilities. Matias-Guiu, Perez-Martinez, and Matias-Guiu (2016) developed the BrainFactory program, which is based on programs designed to adopt mental arithmetic in children, and applied it to people aged 60 and over. Improvements were found in scores on the Mini-Mental State Examination (MMSE) test that assesses cognitive status, after the training process. This test, although it has less ability to detect finer changes in cognitive status than the MoCA, also confirmed the effectiveness of mental arithmetic programs on the cognitive status of the elderly. The same authors emphasize in the interpretation of their results that their intervention involved stimulation of cognitive functions such as visuospatial skills, working memory, executive function, and episodic and semantic memory. Within our research, a significant increase in MoCA scores after training was observed in the field of visuospatial skills and memory.

In a larger study conducted by Hu et al. (2017), 198 participants aged between 52 and 92 years who participated in mental arithmetic training over a period of 3 months showed improvements in cognitive abilities measured on the MoCA instrument. Most participants, even those with cognitive impairment, improved their cognitive function, particularly in attention, visuoconstructional functions, and delayed recall. In our study, we did not find significantly better performance on the attention tasks.

The reason for this can be found in the shorter time of implementation of the program in our study. The other results of Hu et al. (2017) are in agreement with the ones we got.

A review paper published in 2021 (Lima-Silva et al., 2021) states that data from 29 studies of which 8 aimed to identify the effect of abacus-based mental calculation (AMC) for different age groups and to determine its applicability as a method of cognitive stimulation for older adults showed that programs of mental arithmetic are promising in terms of the rehabilitation of cognitive abilities. Within these studies, AMCs are mainly designed in such a manner that allows participants to learn to use the physical abacus and after achieving proficiency they try to perform calculations using a mental image of the device, manipulating the beads of the so-called mental abacus. Our training is the only one that takes into account the satisfaction of the elderly as well as other aspects of health. Our program is the only one that in the final segment contains dynamic and relaxation exercises adapted to the elderly. This makes our programme innovative because it prevents the process of dehumanization during the rehabilitation process. In addition to the assessment of cognitive abilities at the end of the program, we are equally interested in the impact of the program on the quality of life of users of the institution.

### Programme of mental arithmetic and quality of life

The authors of the mental arithmetic programs generally did not examine the effects of the program outside the domain of cognitive abilities. The only research that examined user satisfaction with mental arithmetic training was conducted by Matias-Guiu, Perez-Martinez, and Matias-Guiu, (2016). After completing the cognitive stimulation program, usability and satisfaction were measured with an analog scale ranging from 1 to 1. Usability was evaluated with the question "Did you find it easy to complete the stimulation program?". Satisfaction was assessed with the question "What is your level of satisfaction with the BrainFactory method?".

We believe that this approach is justified, but we believe that the quality of support services must be analyzed through a much broader framework. The quality of life largely depends on the health condition, as well as the preservation of cognitive functions (Cankovic et al., 2016; Ivanovic & Trgovcevic, 2018). Deteriorating health often leads to depression in the elderly (Urosevic et al., 2016; Radevic et al., 2019). Institutionalized accommodation provides various services in order to maintain the health of the elderly, however, the innovation of these services is slow, so the routine and unsuitability of services to individuals can reduce a person's motivation to participate (Nedovic et al., 2019). We hypothesized that in such conditions, our mental arithmetic program, which was developed in accordance with the needs of the elderly, could have a very motivating effect that could be reflected in the scores of the Satisfaction with Life Scale.



Increasing scores on SLWS after an intervention may indicate that an approach to foster innovation of support services could be important for the quality of life of users. It is necessary to conduct research on the adaptation of services to the individual needs of users, but also on the impact of the dynamics of new services on the quality of life of the elderly.

## CONCLUSIONS

The mental arithmetic program developed at the College of Social Work, Belgrade has shown positive effects on the cognitive status of the elderly in institutional accommodation. We believe that the innovativeness of the program has contributed to the degree of life satisfaction among the users of the institution. As the perception of quality of life as a secondary effect of support service or treatment is insufficiently researched concept, further research is needed. We believe that it should be emphasized that this study had certain limitations in the size of the sample and the duration of the intervention, so these limitations should be taken into account when interpreting the results.

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