NICOLAUS COPERNICUS
UNIVERSITY
IN TORUŃ

“How learning to play the game of Bridge affects well-being and cognitive skills of the elderly”.

(PILOT STUDY)

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Bridge in Welfare Houses- summary

Following our unexpected experimental research results in Warsaw Alzheimer Center where we gave bridge lessons to Mild Cognitively Impaired (MCI) patients (more about here: http://www.world-bridge.org/2020/06/18/bridge-and-dementia-prevention/) and following the advice of our friend, the world-famous academic specialist we decided to make our pilot research on possible positive cognitive and well-being aspects of playing bridge in Welfare Houses (called DPS). Residents spending all their late-life there are not happy people. It also turned out, that the selected group for our studies is cognitively impaired and in depression. The education level of the group was very low.

Researchers team from Nicolas Copernicus University represented geriatrics and gerontology, education, physiology of sport, methodology, physiotherapists and bridge teachers.

After initial tests and checks (described below) bridge lessons started (called later in this text intervention). For twenty successive weeks, we applied 3 hours of playing bridge a week starting from teaching rules of the game we started regular play.

From the initial group of 36 residents in two Welfare Houses, there were only two dropouts.

Medical research indicates a low level of health of project participants. Despite this, they were able to participate in the 20 weeks cycle of bridge lessons. Changes in psychological parameters are unknown or none, but there is a noticeable change in the parameters of positive mental health - PERMA (M. Seligman) in people who entered the classes with lower PERMA parameters. This may indicate the effectiveness of bridge lessons in preventing the ageing process.

Substantiation.

Participants in the bridge learning experiment were elderly of generally low health. Such people suffer from homeostasis disorders - they are associated with age and various diseases. As a result, regularity is the systematic lowering of the parameters of physical and mental health. Due to the pandemic, it was impossible to make post-intervention medical tests to check the physical condition of the patients. Only mental health measurements were made by the Welfare Houses staff at the end of the intervention. The results of the research indicate that there was no decrease in mental health parameters during the experiment, and in those who obtained lower results in the initial tests, there was a slight improvement. This may indicate that learning to play bridge effects slowing down the mental ageing process. Learning to play and playing bridge stimulates mental activity and provides participants with pleasant emotions and satisfaction in overcoming challenges. The positive impact of

team activity on mental processes can also be significant. Such a direction of changes in the participants of the Welfare Houses inmates' shows that experiment is consistent with the assumptions of M. Seligman's concept of positive mental health PERMA and the concept of PIWKO P. Błajet's pro-health activity strategy for seniors.

MEDICAL EVALUATION

The medical evaluation was performed before the intervention and was associated with the identification of the ability of individual patients to participate safely in the project. As part of this assessment a physical examination was performed, which included individual parameters:

1. Measurement of blood pressure and pulse,

2. BMI calculation,

3. Assessment of general condition, including auto- and allopsychic orientation,

4. Physical examination of the head and neck area,

5. Physical examination of the chest and abdomen,

6. Medical assessment of the functioning of the muscular and skeletal systems.

The model according to which the physical examination was conducted is provided in the Annex No. 1.

Due to the epidemiological situation at that time, no medical evaluation was performed after the intervention. However, in the case of many of the assessed parameters, it can be considered high the probability that the period elapsed between the first and second surveys it was too short for significant changes.

Blood pressure and heart rate

In-office measurements (the conditions under which the measurement was carried out should be considered as similar to the office) criteria for the diagnosis of arterial hypertension (or hypertension wrong treated) is blood pressure equal to or greater than 140 mmHg for the pressure systolic and/or 90 mm Hg for diastolic at two different visits. Out of 28 the measurements performed as part of the medical evaluation had to be repeated in 13 people examination at the next visit. However, none of the measurements was eligible for a diagnosis of hypertension in one measurement, because then the values should be 180 mmHg for systolic pressure and/or 110 mmHg for diastolic pressure. All heart rate measurements with normal values within 60-100 beats per minute, showed no abnormalities.

BMI

In 25 participants of the project, it was possible to calculate the BMI (Body Mass Index) based on the measured weight and height (for organizational reasons, it was not conducted measurements of weight and height in people in a wheelchair, so their BMI could not be calculated). Values above the norm (25) were found in as many as 21 subjects, while obesity (values over 30) was diagnosed in 8 patients. Confirmed results indicate a significant problem of overweight and obese respondents.

General condition assessment

During the assessment of general condition, difficult contact was found in 5 patients (A10, A12, A18, A19 and A31), one person (A18) was diagnosed with impaired auto – and allopsychic disorders, 5 people (A5, A8, A10, A14 and A19) had dry skin, and 6 patients had (A7, A19, A21, A23, A25 and A28) lower limb oedema was diagnosed.

Physical examinations of the head and neck

When assessing the head and neck, changes were found in 5 patients (A5 - post-cataract, A12 and A29 - drooping eyelids, A28 - poor vision on the left side, and A31 – strabismus convergent). At least one tooth was missing in all subjects (7 were missing teeth at all). Hearing impairment was noted in 17 people, and in 3 (A21, A25 and A28) it was impossible there was a feel for the thyroid gland during an examination.

Physical examination of the chest and abdomen

On examination of the chest and abdomen, scars were found within the chest in 6 patients (A21, A23, A25, A28, A30 and A31), two patients were diagnosed with disturbances in flow through arterial vessels (A6 and A27), and through venous vessels in 5 people (A21, A23, A25, A27 and A28). As many as 21 people had abdominal wall above the level caused by being overweight or obese. Postoperative scars found in 13 people.

Medical assessment of the muscular and skeletal system

During the evaluation of the muscular and skeletal systems, as many as 15 people were found muscle weakness, and 10 patients were diagnosed with muscle weakness. Gait disturbances were described in 19 participants of the project, 6 of whom were in a wheelchair (A1, A8, A10, A23, A24 and A27). Limited mobility of the spine was diagnosed in as many as 20 patients, in turn, 11 people had deviations within the upper limbs. More project participants, because as many as 19 had deviations in the lower limbs, two of which did not have one of the limbs (A24 - left lower limb and A27 - right lower limb). Variations in 5 patients (in A6, A7, A12 and A24 these were changes degenerative disease, and patient A15 reported joint pain).

FUNCTIONAL (PHYSIOTHERAPEUTIC) EVALUATION

All participants had a functional assessment performed before the intervention. Due to the specificity of the tools, people in a wheelchair did not participate in the parts tests. The following tools were used as part of the functional assessment:

1. Tinetti test,

2. Short Physical Performance (SPPB),

3. Dynamometric test,

4. "Get up and go" test.

Physiotherapeutic evaluation after the intervention, due to the situation at the time the epidemiological report was performed by the staff working at the facility. For the test, stand up and go and the dynamometric test results were not obtained.

1. Tinetti test

It is a widely used tool in overall geriatric evaluation, often it is also used in neurological and orthopaedic departments. It is used for risk assessment of falls. It consists of two parts: the static equilibrium test once-dynamic (while walking). In the first stage, the test taker may receive a maximum of 16 points, in the part concerning gait - 12 points. This gives a total of 28 points. A score below 26 points, there is a problem. However, getting less than 19 points means that the patient has a 5 times higher risk of falling than someone who scored 28. The form is presented in Appendix 2.

Results are presented in figures 4 and 5.

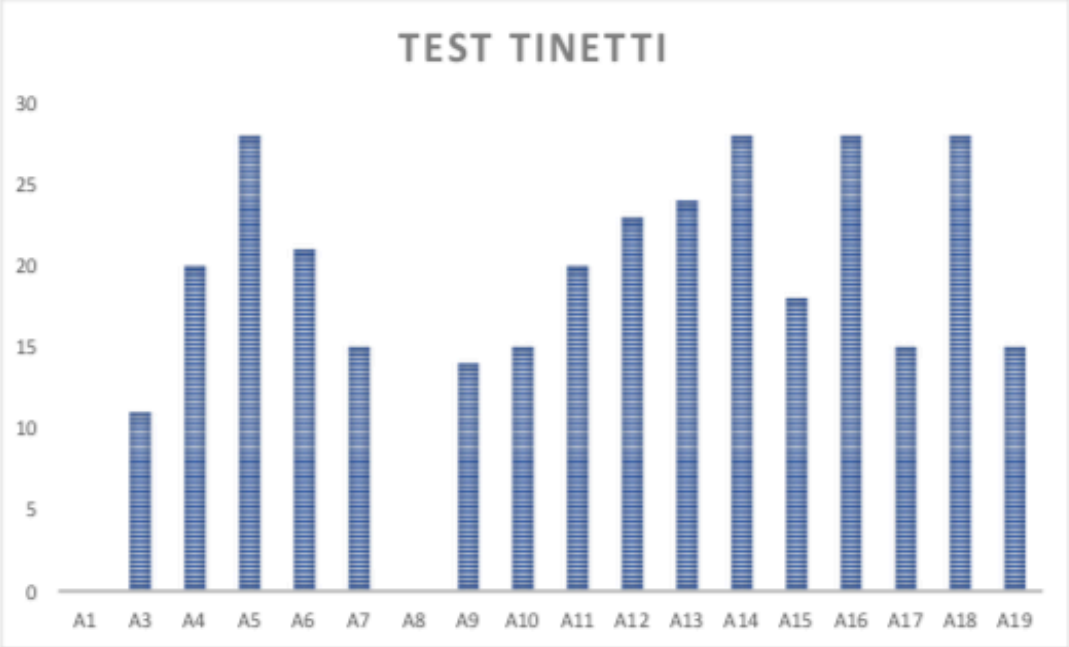


Fig. 4 DPS nr 1 - Results before the intervention, Tinetti Test

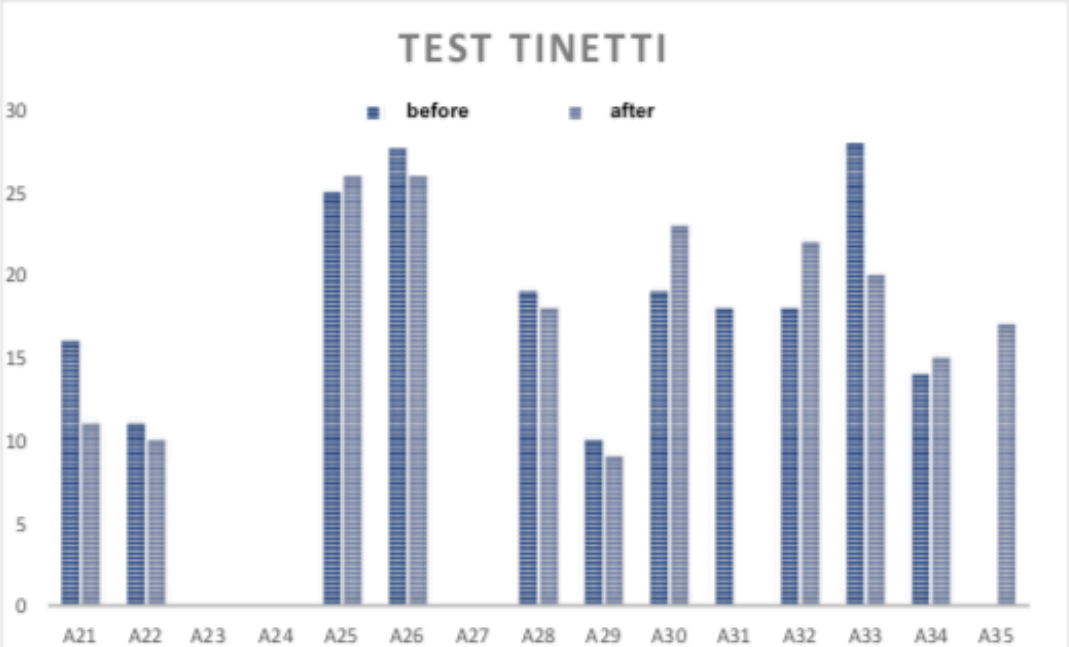


Fig. 5 DPS nr 2 - Results before and after the intervention, Tinetti Test

2. Short Physical Performance Battery (SPPB)

The Short Physical Performance Battery (SPPB) rates physical fitness in three aspects:

1. Getting up from the chair - The first step in the test is getting up from the chair. Initially, the therapist was obliged to check whether the patient was able to perform this task. Senior he was asked to stand up with his arms crossed over his chest standard chair without the help of hands. When one sit-down attempt is passed and getting up from the chair, asked to repeat this activity five times in how the fastest time. The therapist measured the time obtained.

2. Balance test - For the assessment of static balance, the subject was asked to behave balance in three different positions for 10 seconds. The next position is adopted only if the previous one is okay.

● the first position is the position with the feet next to each other

● second - with the selected leg in front so that the side of the heel of the front foot touches the big one toe of the other foot

● third - with the foot behind the foot (so that the heel of the front foot stands in front of and was touching the toes of the other foot)

3. To assess the walking speed, the subject was asked to walk 3 and 4 meters fast pace; if he moved with orthopaedic equipment, he still uses it.

● Walking speed - 3 meters

● Walking speed - 4 meters

For each of the stages, the respondent may receive a score following Appendix 3.

Results are below in figures 6 and 7.

Fig. 6 DPS nr 2 - Results before the intervention, SPPB

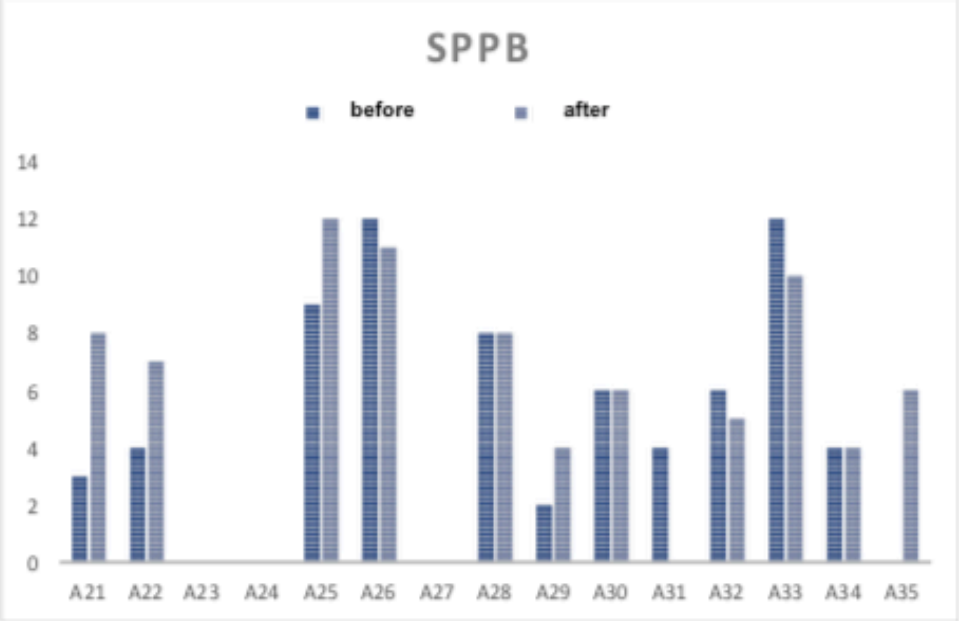


Fig. 7 DPS nr 2 - Results before and after the intervention, SPPB

3. Dynamometer test performed only before the intervention

Only done before the intervention. The test method was as follows: both right and right force was measured 3 times in each patient left hand. Dynamometric testing is essential for patient evaluation for detection sarcopenia, weakness syndrome or other progressive change disorders involution/disease. The cut-off values for individual groups have remained presented in Annex 4. The results are presented in Figures 8 and 9 below.

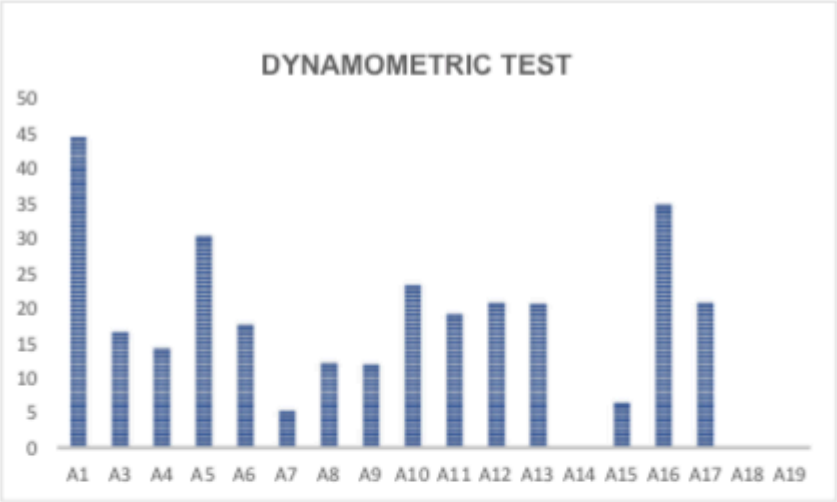


Fig. 8 DPS nr 1 - Results before the intervention, Dynamometric Test

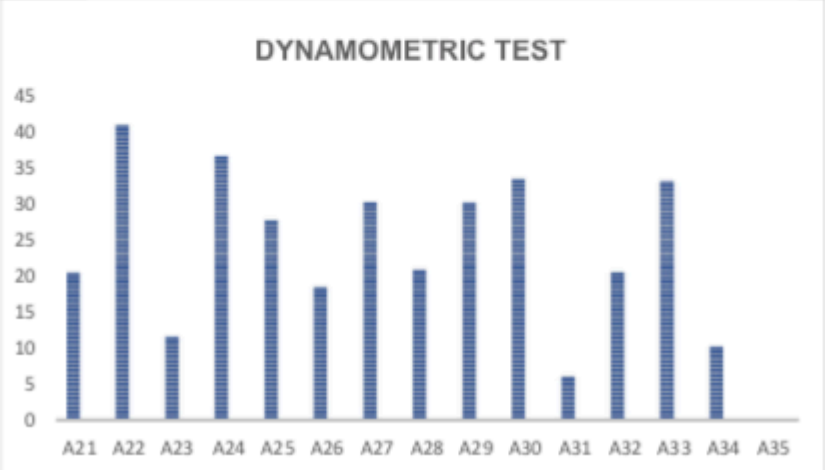


Fig. 9 DPS nr 2 - Results before the intervention, Dynamometric Test

4. "Get up and go" test performed only before the intervention

During the test, get up and walk the subject was sitting on a standard chair with the seat on 45 cm high, hands were on the thighs, feet were resting on the floor at any time setting. A bollard has been placed 3 meters in front of the chair. On fixed of the command, the participant got up from the chair and walked towards the cone, then walked around him from any one side, then returned to its original position and sat down in the chair. Time counted in the trial - the attempt should be made as soon as possible. The tester stood nearby and when necessary he helped - by securing. The test has been previously demonstrated. The result is the best time of two trials, recorded with an accuracy of 0.1 s. Interpretation of results was included in Annex 5. The obtained results are presented graphically in the following figures.

Fig. 10 DPS nr 1 - Before the intervention, Get up and go Test

Fig. 11 DPS nr 2 - Before the intervention, Get up and go Test

ASSESSMENT OF INDEPENDENCE

The assessment of independence and the ability to perform daily activities was examined using tools:

1. Scale VES-13,
2. ADL scale,
3. IADL scale.

Due to the epidemiological situation at that time, it was carried out by the personnel working in the facility

4. VES 13

* performed only before the intervention

A VES-13 scale is a tool where the risk of malfunction is determined as well as the risk of death both among outpatients and hospitalized patients (est. 6). The results obtained by the group are shown below.

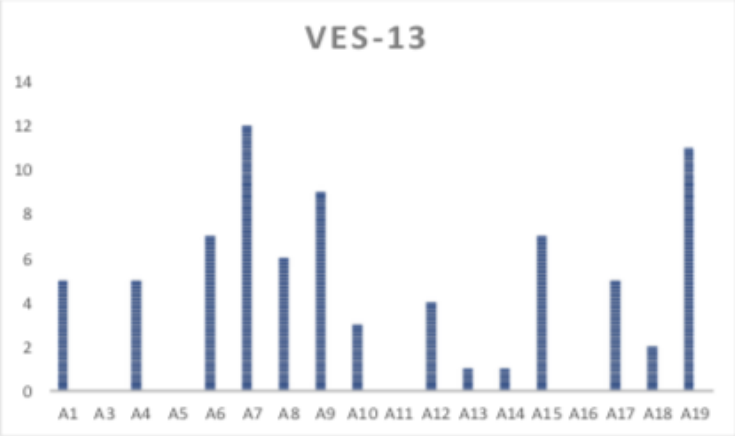


Fig. 12 DPS nr 1 - Results before the intervention, VES Scale

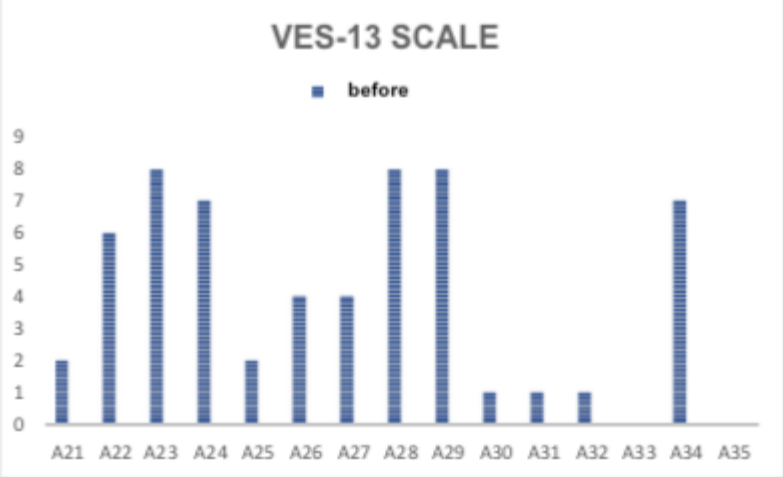


Fig. 13 DPS nr 2 - Results before the intervention, VES Scale

ADL

Katz Scale (ADL is the primary tool for assessing physical condition an elderly (functional) patient. It describes basic life activities patient (Annex 7). The obtained results are presented graphically in the figures below.

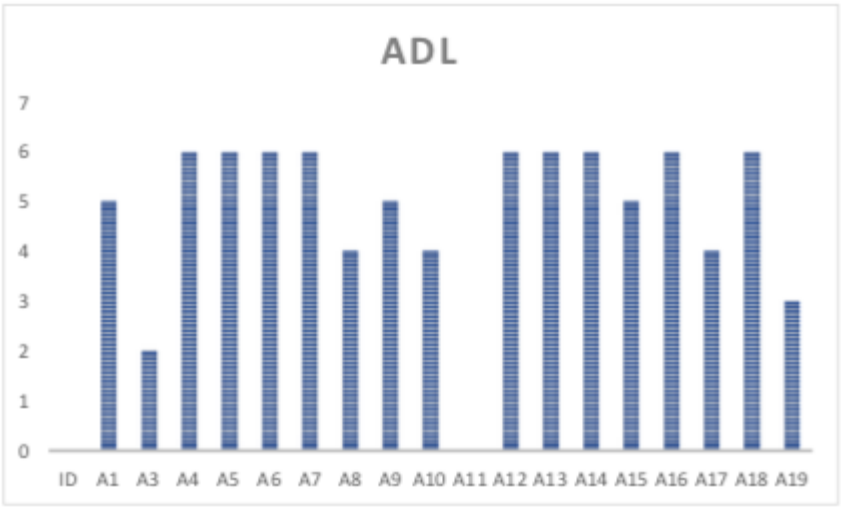


Fig. 14 DPS nr 1 Before the intervention, ADL

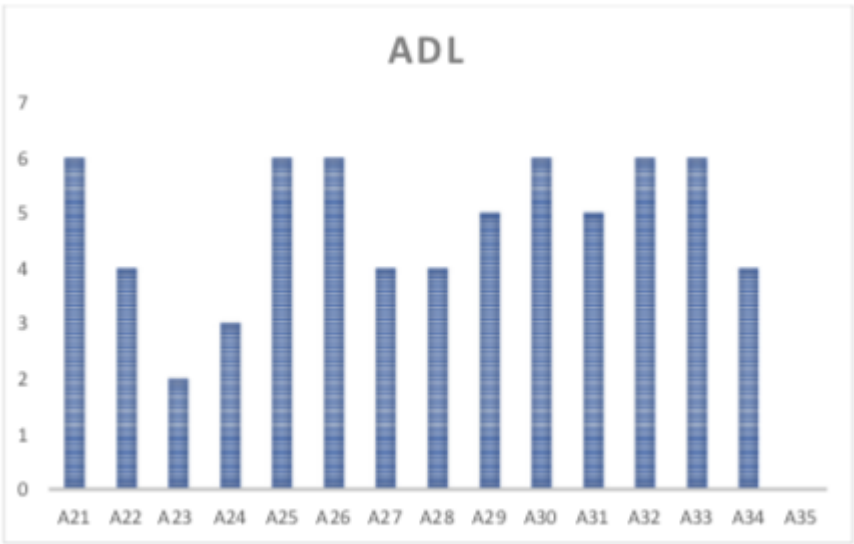


Fig. 15 DPS nr 2 - Before the intervention, ADL

IADL

Lawton's Scale (IADL), measures complex daily activities, based on the subject's ability to cope with the external environment or with a complex activity which is e.g. using a telephone (Annex 7). The results obtained by the group are presented in the figures below.

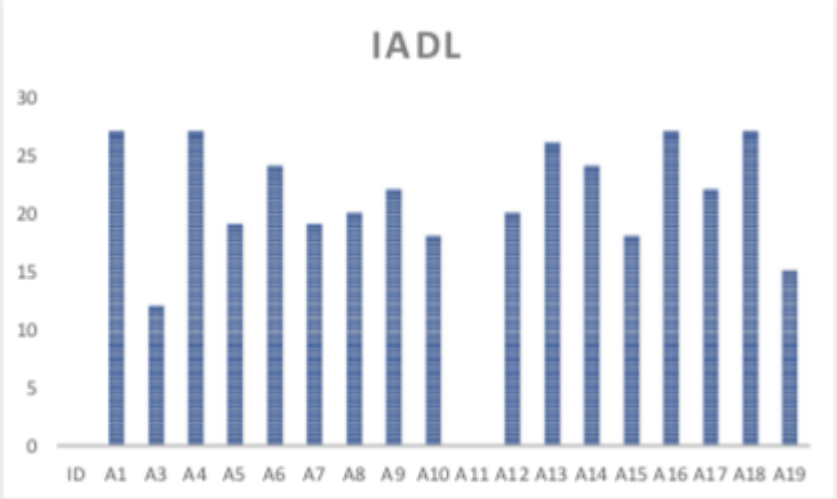


Fig. 16 DPS nr 1 - Before the intervention, IADL

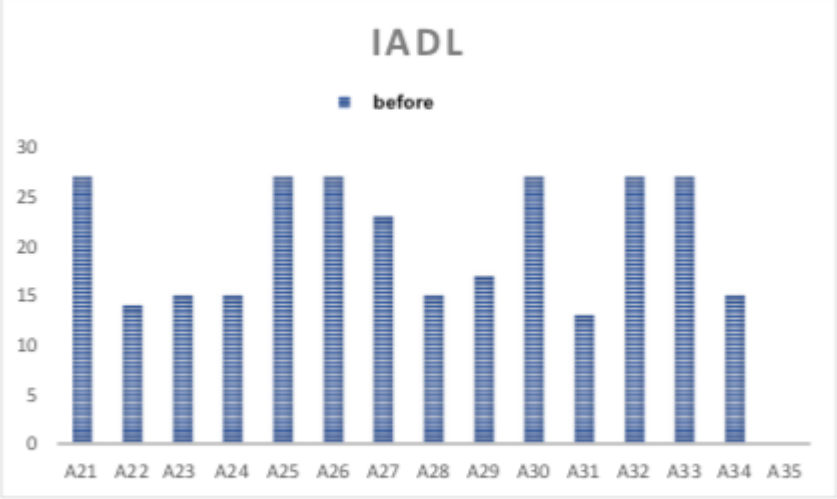


Fig. 17 DPS nr 2 - Before the intervention, IADL

COMMENTS

● Due to the individual nature of each of the nursing homes, further analysis should be made, take into account the participation of the respondents in other classes and activities taking place in the centres during the entire "Bridge to well-being" project.

● Due to the epidemiological situation at that time, a post-intervention evaluation was performed by staff working at the facility, which could have influenced the obtained test results. For this reason, the above-mentioned the test results document independence after the intervention.

● Some tools did not get results due to refusal to participate in final studies or delayed joining the program.

Appendixes

Appendix 1. Physical examination template

Physical examination

Name: Patient ID: Date of birth: PESEL: Address:

Blood Pressure: Hg; Pulse: Temp: C; Ms kg; Increase: BMI:

SUBJECT RESEARCH General condition: Assessment of consciousness: Contact: Orientation about the place, time, self: Structure: Skin: Pressure ulcers: Lymph nodes: Edema:

HEAD AND NECK Head: Mobility of the neck: Eyeballs: [P] [L]; Pupils: Reaction to light: Nose: Cavity oral: Mucosa: Language: Teeth: Ears (leak): [L] [P]; Hearing in a whisper: Throat: Thyroid

CHEST General appearance: Scars: Breathing: Respiratory mobility: Percussion sound: Glands thoracic (pathological resistance): Auscultation of the lungs (alveolar murmur): Heart action: Tony: Pathological murmurs: Circulation:

VASCULAR SYSTEM Arteries: Veins

ABDOMINAL CAVITY

General appearance: Postoperative scars: Hernias: Compression soreness: Abdomen: Peritoneal symptoms: Peristalsis: Pathological resistance in the abdominal cavity: The area kidney: [P] [L]; External Genitalia: studied

THE NERVOUS SYSTEM

Muscle strength: [L] [P]; Muscle tension: normal [P]; Meningeal symptoms: Walk:

MOTION ORGAN Spine: Upper limbs: [P] [L]; Lower limbs: [P] [L]; Joints:

Appendix 2. Tinetti scale

SCALE FOR BALANCE AND WALKING (Tinetti M. et al. 1986)

Patient ID .... BALANCE (The subject sits on a hard chair without a handrail)

1. Balance while sitting: 0 = leans in or slides off the chair 1 = balanced, secured

2. Getting up from your seat: 0 = unable to stand up independently 1 = stands up but helps himself with his hands 2 = stands up without hands

3. Attempts to get up from the seat: 0 = unable to stand up without assistance 1 = stands up but needs a few tries 2 = gets up in the first try

4. Balance immediately after getting up (first 5 sec.): 0 = stands shaky (staggers, moves feet, sways torso clearly) 1 = stands firm but supports himself with a walker, cane, or grabs other objects 2 = stands firmly without any support

5. Balance while standing: 0 = standing uncertainly 1 = standing firmly but with a wide base (both heels> 10 cm apart) or using a cane, walker, etc. 2 = standing with feet together, unsupported

6. Rubbing test: (the subject stands with his feet as close as possible, the subject pushes him slightly, touching the chest three times at the level of the sternum) 0 = starts to fall over 1 = staggers, grabs on objects but holds position by itself 2 = stands firm

7. Rubbing test with the eyes closed: 0 = standing uncertainly 1 = stands firm

8. Turning 360 º: 0 = intermittent movement 1 = continuous movement 2 = uncertain (staggering and grasping objects)

9. Sitting down: 0 = uncertain (misjudges distance, falls into a chair) 1 = Helps with his hands or movement is erratic 2 = confident, smooth movement

BALANCE - Final Score ……. /16

WALK (The subject stands next to the examiner; walks along a corridor or across a room - first with a simple step and back with a quick but safe step while enjoying a handkerchief or a walker, if used normally)

10. Start of gait: (immediately upon command) 0 = any indecision (hesitation) or repeated attempts to move away 1 = start without hesitation

11. Stride length and height: A. Right foot movement range when lunging: 0 = does not cross over the standing area of the left foot 1 = crosses left foot position 0 = right foot is not completely clear of the floor 1 = right foot is fully clear of the floor B. Left Foot Movement Range on Lunge: 0 = does not go beyond the standing area of the right foot 1 = crosses right foot position 0 = left foot not completely clear of the ground 1 = left foot lifts completely off the floor

12. Symmetry of the step:

0 = the stride length of the right and left feet are not equal 1 = stride length of both feet seems equal

13. Continuity of gait: 0 = pause between steps or other gait discontinuity 1 = gait seems continuous

14. Walking path: (evaluate about 3 meters, record a 30cm deviation) 0 = clear track deviation 1 = slight to moderate deviation or patient is using instruments auxiliaries (cane, etc.) 2 = straight path without using help

15. Torso: 0 = marked rocking or patient is using auxiliary devices 1 = there is no rocking, but patient bends knees, back or extends arms while walking 2 = patient does not swing the torso, does not bend the knees or back, does not involve the upper limbs nor use auxiliary devices

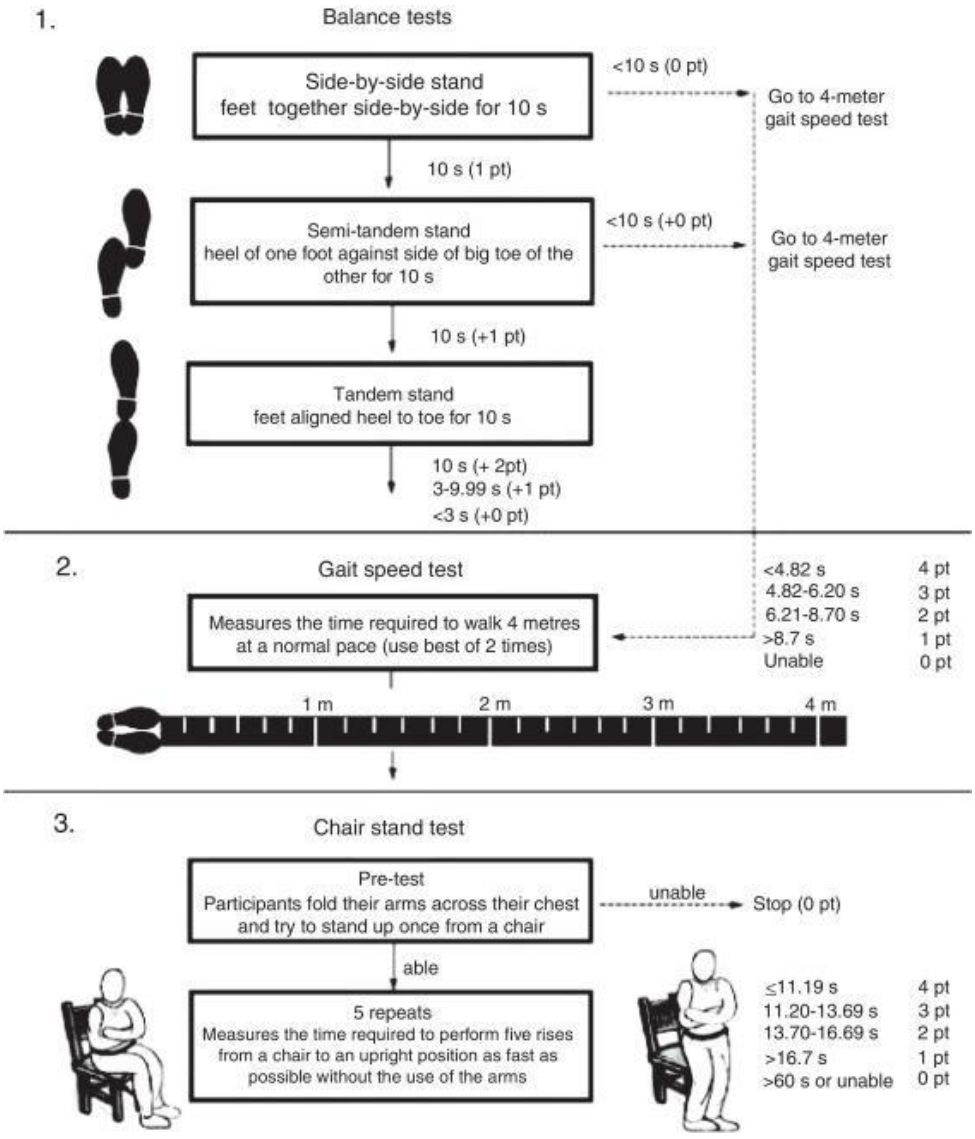
16. Walking position: 0 = heels apart 1 = Heels are almost touching when walking

WALK - Final Score …… / 12

TOTAL NUMBER OF POINTS …… / 28

Appendix 3. Short Physical Performance Battery (SPPB)

Załącznik 3. Short Physical Performance Battery (SPPB)



źródło: https://www.sciencedirect.com/science/article/pii/S2013251419301415

Appendix 4

Dynamometric test

http://gerontologia.org.pl/wp-content/uploads/2018/06/Gerontologia-Polska_1_2018-9.pdf

Appendix 5

Get up and go

http://dpssopot.pl/wp-content/uploads/2014/06/PROCEDURA-TESTU-WSTAN-I-IDZ.pdf

Appendix 6

VES-13 Scale

http://www.wolski.med.pl/vdata/pliki/inne/ht[3145]karta_do_przejecia_do_oddzialu_geriatrycznego.pdf

Appendix 7

ADL and IADL Scales

http://www.emc-sa.pl/phavi/at/upl/2016/0615/0633-skala-oceny-podstawowych-czynnosci-zycia-codziennego-adl-skala-katza-original.pdf

M. Podhorecka, PhD

J. Husejko, MD

Psychological tests

Report

Test persons 34 people, 16 women and 18 men took part in the study, which constitutes 47% and 52.9% of the entire research group, respectively. The respondents were between 49 and 92 years old, and their average age was 69. The most numerous group of respondents were residents with elementary education - 13 people and secondary education - 11 people. The rest - 7 people with primary education and 3 people with higher education. The respondents were recruited from social welfare homes located in the Kuyavian-Pomeranian Voivodeship. The period of living in a nursing home ranged from 1 month to 22 years (M = 3 years; SD = 5 years).

Tools

Geriatric Depression Scale (GDS)

The scale was constructed as a screening tool to assess the intensity of depression symptoms in elderly people. It consists of 30 short questions with two answer options (yes/no). The questions included in the GDS are used to assess the various manifestations of mental life related to depression (mood, motivation, somatic symptoms, self-image, etc.). The research also uses the shortened version of the GDS scale, consisting of 15 questions (the so-called GDS-SF (short form), GDS - 15). The standard use of the GDS-SF is a score where 0-5 points indicate no depression, 6-15 points indicate depression. In this study, a shortened version of the tool was used.

Mental State Examination (MMSE)

Short Scale MMSE is a clinical scale used to test a patient's cognitive dysfunction. The scale is used both for initial assessment and for tracking the dynamics of changes over time and for assessing the potential effects of therapy. It consists of 30 questions/tasks allowing the quantitative assessment of various aspects of cognitive functioning. The areas to be assessed include Time Orientation, Place Orientation, Memorization, Attention and Counting, Reminding, Naming, Repetition, Understanding, Reading, Writing and Drawing. The maximum result that a participant can obtain is 30 points. A score below 24 points (the so-called cut-off point) suggests the presence of a dementia process. The result of the scale depends on the age, education, environment, emotional state and efficiency of the senses (sight, hearing) of the examined person. Some limitations can be overcome making calculations based on the formula: MMSE score — [0.471 × (years of education - 12) + 0.31 × (70 - age)]. This produces a corrected result that has been calculated for the analysis performed in this study.

Clock Drawing Test (CDT)

The clock drawing test is used to assess visual-spatial, constructional, executive functions, and abstract-conceptual thinking abilities. A score below 6 points indicates disorders.

Well-Being Index (WHO-5)

WHO-5 is a subjective well-being tool. A scale is a short tool consisting of 5 questions for which the respondent is to indicate on a scale from 0 to 5 with which frequency during the last two weeks he experienced the described well-being. The raw score ranges from 0 to 25, with 0 being the worst possible quality of life and 25 being the best possible quality of life.

RESULTS

The statistical package Statistica was used to process the results. First, descriptive statistics were calculated for each variable under study - mean and standard deviation and their results are presented in Table 1.

Variable	Statistics						
	Number	Average	Minimum	Maximum	Std.Dev.	Angle	Kurtosis
GDS_1	31	12,67742	1,00000	25,0000	7,05874	-0,04279	-1,36982
GDS_2	32	9,90625	2,00000	23,0000	5,37233	0,82211	0,16435
MMSE_1corr.	25	23,76688	8,17700	31,5180	5,65393	-1,02489	0,79636
MMSE_2corr.	23	19,76378	2,94100	28,7800	7,27928	-0,73373	-0,32743
CDT _1	31	3,70968	0,00000	7,0000	2,05254	-0,09957	-1,45104
CDT _2	32	4,15625	0,00000	7,0000	2,43773	-0,53556	-1,30592
WHO-5_1	32	12,40625	0,00000	23,0000	5,59873	-0,47240	-0,30143
WHO-5_2	18	15,22222	2,00000	25,0000	7,94507	-0,48658	-1,12998
age	30	69,40000	49,00000	92,0000	12,13885	0,16074	-1,10967
Education years	31	11,12903	8,00000	16,0000	2,21723	0,45387	0,66080
Years in Welf.House	27	36,74074	1,00000	264,0000	60,83369	2,79442	7,88518

The results revealed that in the studied group, the average severity of depressive symptoms was at the pathological level, both in the first measurement: GDS M = 12.7 (the norm is below 6 points) and in the second one: GDS M = 9.9. The subjective feeling of mood (WHO-5) in the first measurement was at the level: M = 12.4, while in the second: M = 15.2, which indicates an average quality of life rating.

Average corrected result of MMSE, M = 23.8 the first measurement, while in the second measurement it was at the level of M = 19.8. The results of both measurements (below 24 points) indicate a dementia process taking place in the subjects. In terms of the variable - visual-spatial abilities, the obtained average results in both measurements were respectively: M = 3.7 and M = 4.2, normality of the distribution of the studied variables was also checked with the Shapiro-Wilk test. The distribution of results for all variables differed significantly from the normal distribution, which is the result of the specificity of the studied group. The influence of learning to play bridge on visual-spatial abilities, executive functions and emotional processes.

To test the prediction that systematic learning to play bridge has a beneficial effect on visual-spatial abilities, executive functions and emotional processes in elderly demented people, an ANOVA with repeated measurement was performed.

The results of the analyzes revealed no significant statistical differences in the levels of all examined variables in both measurements.

Summary

The obtained results did not confirm the assumptions about the beneficial effect of learning to play bridge on the analyzed psychological variables. Systematic exercises did not change the level of well-being of the residents of the nursing home, nor did it change the visual-spatial abilities. This may be due to both low mood in the respondents (mean score indicating depression), as well as the fact that the second measurement is postponed. The inability to perform the measurement immediately after the intervention (which was learning to play bridge) was a consequence of the necessity to close the nursing home due to the COVID-19 epidemic. This fact could have had an impact on the obtained results, because, on the one hand, the residents could not consolidate the skills they had already acquired, and on the other hand, they felt anxiety about caring for their health and life.

A. Wołowska, PhD

Partial report on the measurement of well-being with the PERMA questionnaire

The study was performed in two dependent samples in the form of a pre-test and a post-test. The pretest is a measurement of well-being (self-esteem of mental sense) before starting bridge training, and a post-test after a finished series of training. The report compares the general result of the PERMA questionnaire, calculated as an ordinal variable and an interval variable. The procedure of increasing the measurement level was performed using the mean and standard deviation for a small sample N = 33. For this reason, the interval measurement was treated only as indicative and as an external criterion for the actual measurement.

The overall test score is a score that indicates long-term well-being or malaise. Ultimately, the PERMA tool is to measure several more detailed dimensions of well-being:

I. Positive emotions

II. Engagement

III. Relations

IV. Meaning

V. Accomplishments.

Such a variable structure is hypothetical and requires verification with confirmatory factor analysis - CFA. Research on the standardization of the questionnaire in question is ongoing, and we are currently using its experimental version.

The statistical analyzes presented below were to answer the question about the differences between the two dependent measures (on the same sample) of well-being. In this design of the natural experimental study, differences or lack thereof can be attributed to the manipulation between measurements that was bridge training. A control sample was not introduced into the model yet, therefore the analyzes were performed as dependent samples. In both variants of the measurement, small but statistically significant differences were obtained between the pre-test and post-test results. **Statistical significance of 0.05 means that we can say with 95% probability that the recorded differences between the measurements can be attributed to the procedure used, not** to measurement errors. Thus, the bridge training changed the results of the well-being test. How? People who felt well in the pretest did not change it in the post-test, but people who felt unwell in the pre-test - generally - achieved better mental well-being. These results are preliminary, based on non-standardized measurement, but show that the hypothesis about the increase in positive thinking about oneself under the influence of bridge training makes empirical sense, and the study of this phenomenon should be continued on larger samples and using standardized measurement tools.

Statistics

Interval measurement – comparison of averages

	N Statistics	Minimum Statistics	Maximum Statistics	Average Statistics	Standard Deviation Statistics	Variance Statistics	Slant Statistics	Slant Standard error
Pretest PERMA	33	29.00	96.00	56.8485	19.14439	366.508	.547	.409
Posttest PERMA	33	37.00	96.00	61.0000	17.06422	291.187	.391	.409
N Valid	33							

Statistics for dependent samples

		Average	N	Standard deviation	Standard average error
Pair	Pretest PERMA	56.8485	33	19.14439	3.33261
	Posttest PERMA	61.0000	33	17.06422	2.97050

Conclusion: the hypothesis about the occurrence of differences in measurements was confirmed.

Nominal-ordinal measurement - dependent samples

1. Marked Wilcoxon rank test for paired samples

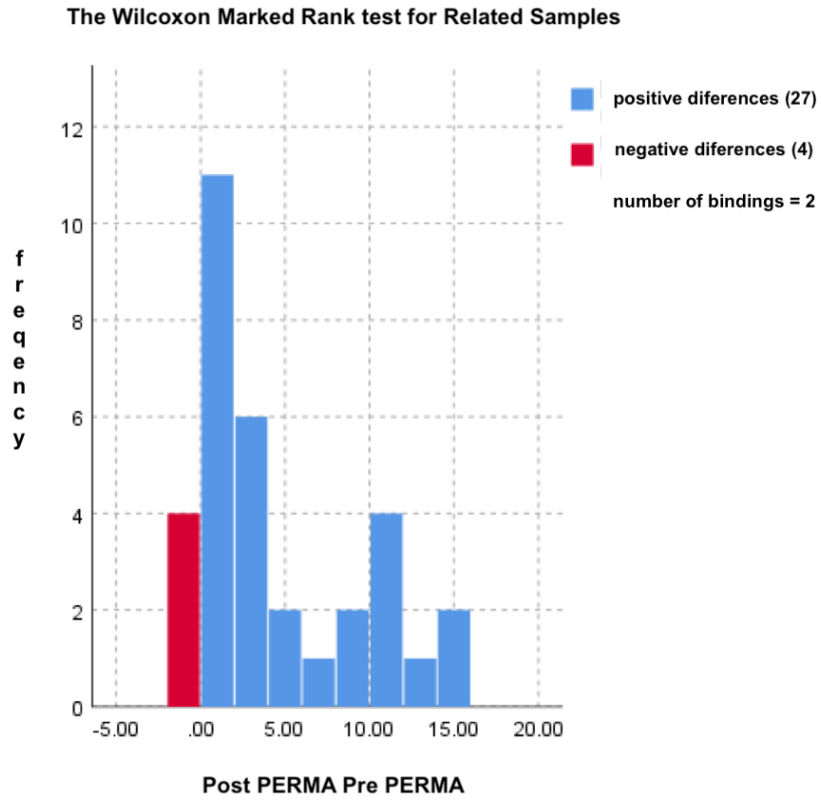
Summary of the hypothesis test

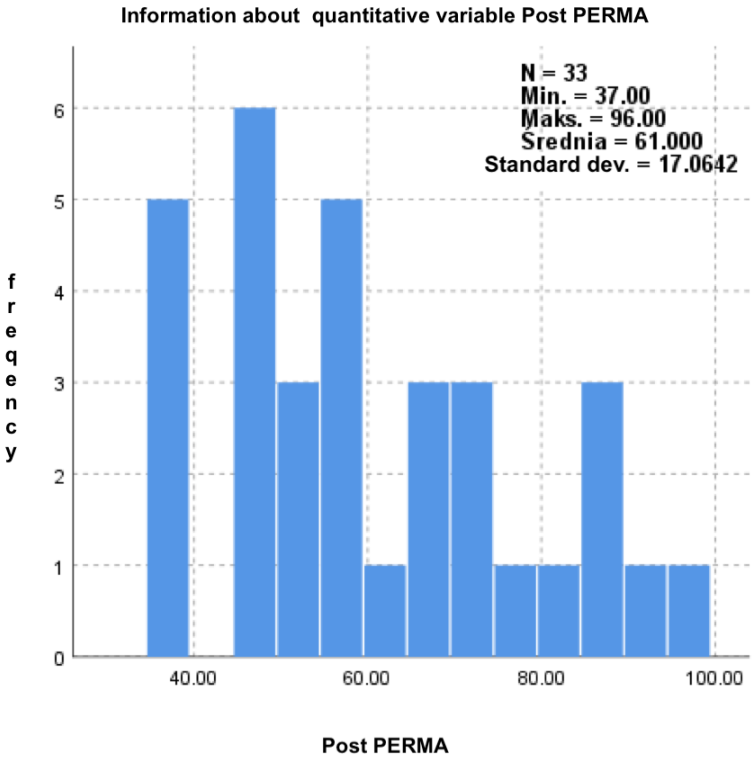
	Null hypothesis	Test	Relevance	Decision
1	Median of differences between pretest PERMA and posttestPERMA equals zero	Marked Wilcoxon rank test for paired samples	.000	Reject the zero hypothesis

Asymptotic significance is presented. The significance level is .050

Summary of the Wilcoxon Marked Rank Test for Related Samples

Total N	33
Test statistics	462.000
Standard error	50.654
Standardized test statistic	4.225
Asymptotic significance (two-tailed test)	.000


The Wilcoxon Marked Rank test for Related Samples
positive diferences (27)
negative diferences (4)
number of bindings = 2
freqency
12
10
8
6
4
2
0
-5.00
.00
5.00
10.00
15.00
20.00
Post PERMA Pre PERMA


Information about quantitative variable Post PERMA
N = 33
Min. = 37.00
Maks. = 96.00
Średnia = 61.000
Standard dev. = 17.0642
freqency
6
5
4
3
2
1
0
40.00
60.00
80.00
100.00
Post PERMA

2. Friedman's test

Rank

	Average rank
Pretest PERMA	1.15
Posttest PERMA	1.85

Test value

N	33
Chi-square	17.065
df	1
Asymptotic significance	.000

Conclusion: Tests 1 and 2 confirm the hypothesis that there are differences in both measurements

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