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ASSESSMENT OF SUPERFICIAL SENSITIVITY IN SENIOR POPULATION AFTER PARTICIPATION IN THE TAILORED PROGRAM OF BIOPSYCHOSOCIAL REHABILITATION IN THE LIGHT OF GERONTO-PROPHYLAXIS

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Background:

SUMMARY

Positive attitudes to old age and successful ageing are the trends in contemporary gerontology. Promotion of an active period of old age, the maintenance of cognitive and physical abilities in seniors as well as active participation in various activities and social roles are challenges and tasks for geronto-prophylaxis and psychosocial rehabilitation. The process of ageing, apart from its effect on the body systems and functions has also a marked effect on the perception of sensory stimuli. Sensitivity to touch decreases with age. The aim of the presented study was to show the effect of a tailored program of sensorimotor activation in seniors with different fitness levels on changes in touch sensation in the area of the arms. The main cognitive goal of the presented research project was an assessment of sensory stimuli perception on the completion of the biopsychosocial rehabilitation program using an esthesiometer.

Material/ Methods:

The sample included 51 seniors from two care units, aged 77.52 ± 9.51 years. The assessment of superficial sensitivity perception involved the two-point discrimination approach using a wheel esthesiometer (Touch Test-Two Point Discriminator). The study was conducted immediately before and after the application of the rehabilitation program.

Results:

A significant improvement in sensory perception was noted on the finger bulbs of both hands within the studied senior population, regardless of the levels of psychophysical fitness and the social support center where they stayed. The following average values, corresponding to the changes in both hands, were obtained from: 6.6mm to 4.45 in the seniors from the Social Care Unit and from 6.35 to 4.2 in the seniors from the Senior Support ($p < 0.05$). According to the norms for touch sensation (2-point discrimination) for the hand, before the start the level of sensation was satisfactory, below the norm limit, while after rehabilitation this level turned out to be good.

Conclusions:

The proposed program of biopsychosocial rehabilitation (activation of seniors undergoing hand treatment) fulfilled the settled cognitive and practical goals and was welcomed with great satisfaction and engagement by the beneficiaries. In the case of senior rehabilitation the area of geronto-prophylaxis is oriented to the stimulation and improvement of sensory stimuli perception in the hands, using various manual forms of movement.

Key words: superficial sensation (touch), esthesiometry, bio-psycho-social rehabilitation, seniors, gerontoprophyllaxis

BACKGROUND

During recent years a significant increase in the number of studies on active old age has been observed. Gerontology and neuropsychology are increasingly complementary sciences and this potential is used in bio-psychosocial rehabilitation. Positive experience related to old age as well as positive attitudes to growing old are the trends in the new gerontology (Błachnio 2011, Makuła et al. 2014, Pačalska 2019). The development of opportunities allowing to avoid diseases or falls as well as maintaining the cognitive and physical abilities in older people, and active participation in various activities and playing social roles are the objectives of health prophylaxis in the aspect of gerontoprophyllaxis. The development of this domain in Poland has its already substantial history connected with the widely understood physical culture (Makuła et al. 2014). Undoubtedly, in gerontoprophyllaxis, physical activity is essential (Makuła 2014). According to the newest WHO recommendations from 2020 (WHO.inf), it comprises various forms of movement and everyday activities apart from the sole sport-related activities and motor recreation, including special recommendations for older people and people with disabilities. Promotion and propagation of the increasingly new forms of physical activity dedicated to older people with different degrees of disability and self-sufficiency, should be focused on the encouragement to participate in these activities regardless of their health state and wellbeing. The applied motor activities should be pleasurable, relaxing and satisfactory (utilitarian -vital) despite the disability levels in older population. The main goal of gerontoprophyllaxis is maintaining a possible self-sufficiency of older people facing the changes related to ageing process. This process, apart from the obvious effect on the main systems and functions of the human body, has also a marked effect on perception of sensory stimuli. With age, the sensitivity to touch decreases. This is manifested by the difficulty to discriminate two identical mechanical stimuli acting on a finger bulb, as compared with younger people. The ability to maintain precision and control grip strength as well as arm and finger muscle strength, also decreases. In older people, arm strength is 30% weaker. (Ranganathan VK. Et al., 2001). Identification of the external and internal stimuli will depend on fitness of the nervous system. Sensation/sensibility is divided into different categories, namely: exteroceptive (superficial, originating from the skin, e.g. touch, temperature or pain, teleceptive category (acting at the distance, e.g. hearing), interoceptive, proprioceptive (deep, originating from muscles and sinews) and interoceptive, (visceral, originating from organs). There is also a division into a precise and not very precise discrimination of stimuli. The decrease in sensation of even stronger stimuli such as: touch and heat, loss of sensation or decreased sensation of pain or no pain sensation are indicative of disability (Rubinowicz-Zasada M. et al., 2014). The measurements of sensory sensitivity require proper specialist tools, enabling reliable interpretation of data. In research, such tools as Weber's compass and different esthesiometers are used.

The presented study was aimed at presentation of the effect of sensorimotor activation in the sample of seniors. This study was focused on the presentation

of the effect of sensorimotor activation in seniors with different levels of fitness, on changes in superficial sensation on finger bulbs. The program was primarily focused on the palms of both hands and forced in a planned and spontaneous manner using the palms with different strength, pressure, friction, rolling within a defined time limit, (mimicking different movements used in classic massage the seniors were taught earlier). (Cabak 2020). The seniors, through playing different roles in the activation program „let us massage one another” (both the massaging and massaged person) were also emotionally and socially helping one another. The maneuvers used in classic massage were also focused on support of the manual functions, being the forms of hand rehabilitation procedures as well as memory training and memorization. The main theoretical goal of the research project was assessment of changes in touch sensation (2-point discrimination) in seniors using an esthesiometer. The practical goal was to verify the possibility of program implementation in selected senior centers, in residents with different levels of psychomotor fitness.

MATERIAL AND METHODS

The study group included the total of 51 participants with 35 persons from the Daily Support Center for Seniors and 16 persons from a (round-the-clock) residential home. The participants' age ranged from 60 to 97 years (the mean value = 77.52 ± 9.51). 43 women and 8 men participated in the study. In each participant, the right hand was a dominant hand. The inclusion criterion was full communication with the participant and no contraindications for participation in the tailored activation program based on massage (Cabak 2020). The assessment included different elements such as back pain (VAS pain scale), mini-mental state examination of the participant (MMSE scale) and Positive and Negative Affect Schedule (PANAS), already described in the previous paper (Cabak 2020) and the presented assessment of touch sensation, the so called two-point discrimination.

Touch-Test 2-point Discriminator by North Coast Medical was applied for the assessment of two-point discrimination (Figure 1). The test is used to assess sensation sensitivity within 2 ranges (from 1 to 8mm and from 9 to 15 mm) depending on the assessed part of the body. It can be applied in the palms, feet and other parts of the human body (https://www.ncmedical.com/products/touch-test-two-point-discriminator_705.html). It has been proven an effective approach in the assessment of superficial skin sensation in patients after nerve injuries, diagnosing injuries and defining perception before and after various procedures. It can be used in specialist units or by a caregiver at home, for verification of treatment progress. A study conducted using this tool indicates the degree of sensitivity to touch, which can be related to the performance of precise procedures. The smaller the perceived distance, the higher is the ability to perform more precise tasks. Interpretation of the results was defined by the American Society for Surgery of the Hand (Bożek M, Gaździk TS. 2001). The value of a two-point discrimination depends on the part of the body. According to the guidelines, the value lower



Figure 1. Touch Test-Two Point Discriminator Esthesiometer

than 6 mm measured on the hand is defined as anormal value. The values between 6 and 10 mm are satisfactory. The values between 11 and 15 correspond to poor results (the information based on the instruction attached to the pool) (www.praxisdienst.pl/pl/Diagnostyka).

Research procedure

The duration of the aforementioned program was 2 weeks. The subjects participated in 3-4 therapeutic sessions. Each time they performed about 10-15 min various massaging movements in back areas of the partner's body, also using special sensory balls for this purpose (earlier they underwent training in such procedures). The treatment stations were adequately adapted so that the people with disabilities confined to their wheelchairs or unable to stand by themselves could participate in these procedures. The entire assessment was supervised by the occupational therapists (one therapist for one pair of the participants).

The study conducted using an esthesiometer involved assessment of the finger bulbs, both of the right and the left hand. The participant's task was to answer the question: how many points he/she sensed with his/her eyes closed, so as not to see the measurement taken and be influenced by the readout. The subject's hand was in external rotation. The pressure was lightly exerted so as not to cause discomfort related to pain. The initial distance was 5 mm. Pressure was exerted with equal strength. The finger bulb was pressed seven times at the same strength value. At least four repeated answers were required, concerning the number of the sensed points. If after seven trials the subject still felt only one point, the distance was increased by 1 mm and the pressure was repeated until the settled answer was given. Adequately, if the subject during the first attempt correctly sensed two pressures, the distance was gradually reduced (the methodology presented in the esthesiometer user manual). The entire measurement procedure was performed twice, prior to the first session and after the last session, on finishing the program.

Statistical analysis was conducted using Statistica 13.0 PL software. The significance level was set at $\alpha=0.05$. The Mann-Whitney U-test, Wilcoxon and Spearman rank correlation tests were applied.

RESULTS

The results of two-point discrimination assessment, corresponding to the perception of superficial dermal sensation using esthesiometer, showed significant changes in the reception of sensory stimuli in the studied seniors after their participation in the rehabilitation and activation program. The changes were found both in 24 hour residential homes (fewer functionally fit residents) (Table 1) and in seniors living by themselves and attending a daily care center (Table 2). Improvement was noted both in the right and left finger bulb. The presented data are statistically significant ($p<0.05$). The total mean value (for the left and right finger bulbs) was 6.6 mm prior to the application of the rehabilitation program for seniors from the residential home while after the program it was 4.45. The change is significant at the level $p=0.003$. Analogically, for the group of seniors from the Support Center, the mean value was 6.35 mm/ 4.2 mm, at the level $p=0.001$. The presented values indicate that the two point sensory discrimination in the studied sample was satisfactory before implementation of the program while, according to the American Society for Surgery of the Hand (ASSH), on completion of the program it reached a so called normal value. No significant between group differences were noted prior to and after the application of the program. It was also found that, before the program, sensory perception on the right finger bulb was on the border of the normal level: 6.0 mm for seniors from the residential home and 5.9 mm for those from the support center while for the left bulb it was higher and exceeded the limit for normal values. All the studied

Table 1. The results of sensory discrimination test in care home resident; significance level (p)

	Residential home			
	LEFT bulb		RIGHT bulb	
	Before	After	Before	After
Mean value	7.2	4.4	6.0	4.5
SD	2.6	1.8	3.3	2.1
min	3	2	3	3
max	11	8	14	9
p	0.003		0.003	

Table 2. The results of sensory discrimination test in residents from the Support Center for Seniors; significance level (p)

	Support Center for Seniors			
	LEFT bulb		RIGHT bulb	
	Before	After	Before	After
Mean value	6.8	4.3	5.9	4.1
SD	2.4	1.9	2.6	2.1
min	3	1	1	1
max	14	9	12	10
p	0.001		0.001	

seniors were right handed. After the program, significantly bigger changes were found in dermal sensation perception: 7.2 mm/ 4.4 mm and 6.8 mm/ 4.3 for the left bulb in seniors from the residential home and for those from the support center for seniors respectively.

DISCUSSION

The cognitive goal of the presented study was an attempt to assess the changes in superficial sensation on finger bulbs in seniors from different residential centers (with different degrees of ability and self-sufficiency) following the applied program of biopsychosocial rehabilitation.

Prior to implementation of the rehabilitation program, the mean value corresponding to sensory discrimination on both hands' fingers was at the so called satisfactory level. Some of the participants obtained even the values of 11 and 14 mm. There were participants who obtained the scores of even 11 and 14 mm which, according to the norms settled by the ASSH, indicates impairment of sensory stimuli perception which, in turn, may be related to the impairment of sensory stimuli perception, which was possibly due to different limitations of hand function.

The program has brought about a significant improvement of sensory perception in the entire studied sample and the mean values obtained on finishing the rehabilitation program in both groups were 4.3 and 4.2 mm, which, according to the settled norms, is a good level. This means that the skin on the finger bulbs of the studied seniors has become more sensitive to touch and compression. The obtained values were due to the more frequent than before use and stimulation of hands by the studied seniors, through touch and massage (friction on different surfaces and structures) and the used massage tools (sensory balls, massagers). Both fingers and any part of the hand were used by seniors who performed different movements resembling basic techniques of classic massage, however, they were also able to perform any movements. Some of them discovered their own manual abilities, frequently stimulated by their imagination and the comparison of the movements performed during everyday useful or creative art activities, namely: kneading, cake rolling, surface washing or even painting or drawing. The entire back, nape of the neck and arms were subjected to treatment. The participants who were massaged wore light clothes (most often thin blouses or T-shirts), which additionally provided adequate conditions for hand stimulation using the surfaces with different hardness and softness (Cabak et al.2017).

Interestingly, the result indicating that all the seniors, regardless of their physical and mental fitness levels measured using MMES (Cabak 2020) obtained a significant improvement in superficial sensation perception and, even these with most serious disabilities (confined to wheelchairs or using walking frames and walkers) were really engaged in the program. In such cases they could perform their tasks in a seated position.

Apart from the measurable effects pertaining to skin sensation improvement, all the participants noted and assessed the benefits of the applied program, con-

cerning their integration, activation to exercise performance, aiding their peers and the opportunity of developing new skills (using simple massage and touching techniques, memory training, and integration with peers). Other important effects of the applied program, namely the improvement of the well-being in patients with pain symptoms and mood (positive emotions) improvement, were presented in the earlier report (Cabak 2020). Massage was intentionally chosen as a form of therapeutic intervention. Chochowska et al. have shown that, with age, the number of pain symptoms increases, resulting in deterioration in wellbeing. Classic massage is an effective approach to mood improvement in the older population. It reduces pain and makes contact with other people easier (Chochowska et al., 2011).

According to other authors' reports, the workouts were focussed on the improvement of sensory performance in everyday practice (Engel-Yeger, Rosenblum, 2017). The better perception of sensory stimuli, the higher is the involvement in various task among the elderly population. Płażewska-Żywko et al. have shown that the majority of older people from residential homes cope with their everyday duties on their own, however, with age, the functional fitness is likely to deteriorate. In older people, self-sufficiency depends not only on the state of mind, but also on self-esteem and wellbeing (Płażewska-Żywko et al., 2008).

The presented study also fulfilled an essential practical/implementation goal. The seniors turned out to be very creative in terms of taking advantage of their hands during application of massage, based on the earlier presented and learned movements, besides, they were able to (were encouraged to) present their own performance and solutions. The suggested tailored program of activation, dedicated to senior population, turned out effective in practice; it brought the expected effects and is an innovative form of biopsychosocial senior rehabilitation, considering hand treatment which is part of the domain and goals of gerontoprophylaxis, since the primary goal of the applied program involved the development of fitness through movement and various opportunities of taking advantage of the outcome. This program focused on rehabilitation of senior population should be applied during further studies in a wider group of beneficiaries, in order to confirm its favorable pro-health effect and activation of older people who are often lonely and threatened with social exclusion, even in the smallest local group, near their place of residence.

CONCLUSIONS

1. A significant improvement in superficial sensibility was noted on finger bulbs of both hands in the studied sample of seniors, regardless of the level of psychophysical fitness and the support center which was their day care center .
2. The proposed biopsychosocial rehabilitation program (considering hand activation and treatment) fulfilled the settled cognitive and practical goals and was accepted by the beneficiaries with great satisfaction and commitment.
3. During rehabilitation procedures performed in older people, the area of gerontoprophylaxis oriented to stimulation of sensory stimuli and the improvement

of sensory perception in the hands, using various manual forms of movement, should be taken into consideration.

4. In the case of psychomotor health prophylaxis, the acquired abilities including motor abilities should be used and developed. More creative and satisfying forms of treatment and body fitness development are needed. Such therapeutic interventions would allow a higher engagement in task performance and participant's motivation, as well as the readiness to participate in the task and getting satisfaction from the effect. This is a big challenge, especially for occupational therapists who can set an example and support other therapists, and above all, the seniors themselves.

REFERENCES

- Błachnio, A.(2011). Impact of older adults social status and their life satisfaction on Health Care Resources. *Acta Neuropsychologica*, 9 (4):335-349.
- Bożek, M., Gaździk, TS.(2001). Wartość badania klinicznego w diagnostyce zespołu kanału nadgarstka. *Ortop. Traumatol. Reh*, 3(3): 357-360.
- Cabak, A. (2020). The evaluation of changes in the level of positive and negative emotions in seniors after the activation program. *Acta Neuropsychologica*, 18 (2):195-206.
- Cabak, A., Rudnicka, A., Kulej, L., Tomaszewski, W.(2017). Biopsychosocial Rehabilitation Programme for Patients with Chronic Back Pain. Preliminary Report *Ortopedia TraumatolReh*, 2 (6):165-174.
- Chochowska, M., Marcinkowski, J., Rąglewska, P., Babiak J. (2011). Masaż klasyczny i masaż wibracyjny punktów spustowych bólu w leczeniu zespołu bólowego kręgosłupa z towarzyszącym mu obniżeniem nastroju – u osób starszych. *Probl Hig Epidemiol*, 92(3): 428-435.
- Engel-Yeger B., Rosenblum S. (2017). The relationship between sensoryprocessing patterns and occupational engagement among older persons. *Canadian Journal of Occupational Therapy*, 84(1): 10-21.
- Makula, W., Gawęda-Staszczak, I., Szumiec, A., Nowakowska, K., Żak, M.(2014). Gerontoprofilaktyka jako ważny element kultury fizycznej seniorów. *Gerontologia Polska*, 4:179-184.
- Pąchalska, M. (2019). Integrated Self-System Microgenetic Approach. *Acta Neuropsychologica*, 17, 4, 349-392.
- Płaszewska-Żywko L., Brzuzan P., Malinowska-Lipień I., Gabrys T. (2008). Sprawność funkcjonalna u osób w wieku podeszłym w domach pomocy społecznej. *Probl HigEpidemiol*, 89(1): 62-66.
- Ranganathan, VK., Siemionow, V., Sahgal, V., Yue GH. (2001). Effects of aging on hand function, *J Am Geriatr Soc.*, 1478-1484.
- Rubinowicz-Zasada M., Czepczor D., Orczyk M., Wierzbiński K., Orczyk A., Suszyński K., Kwiek S. (2014). Zaburzenia czucia dyskryminacyjnego u pacjentów po przebytych udarach niedokrwienym i krwotocznym mózgu, na przykładzie obszaru unerwienia nerwu pośrodkowego i promieniowego. *Ann. Acad. Med. Siles*, 68;5:350-360.
- (WHO.inf):<https://ncez.pzh.gov.pl/aktywnosc-fizyczna/nowe-zalecenia-who-dotyczace-aktywnosci-fizycznej/>
- (https://www.ncmedical.com/products/touch-test-two-point-discriminator_705.html)
- <https://www.praxisdienst.pl/pl/Diagnostyka/Diagnostyka+ogolna/Mlotki+neurologiczne+i+stroiki/Touch+Test.html>

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