

Application of two structured rehabilitation regimens in the frail octogenarians (over 85) with disturbances of daily-life functioning

Ocena wyników rehabilitacji osób po 85 roku życia z zaburzeniami sprawności funkcjonalnej

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Key words

geriatrics, falls, multi-sensory training, rising from a fall, frailty syndrome

Abstract

Background. Disturbances in functioning associated with performing simple tasks of daily living, especially in conjunction with a constant hazard of incidental falls, constitute major challenges any elderly population has to face.

Aim. To assess the effects of two specifically structured physical rehabilitation regimens on enhancing individual functional capabilities and minimising the risk of incidental falls among the frail octogenarians (over 85).

Material and methods. Duration of the study was 3 months (comprising two exercise sessions a week). Fifty subjects (mean age: 87 years) randomised into two groups: Group I – 25, Group II (controls) – 18. Group I was assigned an intensive rehabilitation regimen combining active exercises, multi-sensory training, instruction on performing safe postural shifts and rising effectively from falls, walking short distances; Group II – active exercises and multi-sensory training. Twenty five subjects in Group I and 18 subjects in Group II completed the study. The Timed UP & GO and Tinetti (POMA) tests were applied respectively to assess individual mobility before and upon completion of the study. The results were subsequently processed, *inter alia*, with a non-parametric Wilcoxon test.

Results. Statistically significant improvement was observed in Group I ($p < 0.05$) in the Timed UP & GO test score (mean time 26.1 sec. vs. 20.9 sec.), as well as in the Tinetti (POMA) test (balance assessed before: 11.2 ± 1.8 after 13.1 ± 1.8 , gait assessed before: 8.9 ± 1.5 ; after 10.4 ± 1.7), whereas the changes observed in Group II were not statistically significant.

Conclusions. Structured rehabilitation regimen combining diverse active exercises, walking training, multi-sensory training, instruction on safe postural shifts and rising effectively from incidental falls is believed to significantly enhance individual functional capabilities in the frail octogenarians.

Słowa kluczowe

geriatria, upadki, ćwiczenia sensomotoryczne, podnoszenie się po upadku, zespół wątlności

Streszczenie

Wstęp. Istotnymi problemami starości są rozmaite zaburzenia występujące podczas wykonywania czynności życia codziennego oraz upadki.

Cel. Ocena wpływu dwóch programów rehabilitacji na wykonanie prostych czynności ruchowych i ryzyko upadków u osób po 85 roku życia z zaburzeniami czynności życia codziennego.

Material i metody. Badaniami objęto 50 osób (32 K, 18 M., śr. wieku 87 lat), podzielonych losowo na dwie grupy. Grupa I realizowała program rehabilitacji, obejmujący ćwiczenia czynne wolne, ćwiczenia sensomotoryczne, ćwiczenia zmiany pozycji i marsz na krótkim dystansie oraz naukę podnoszenia się po upadku. Grupa II wykonywała ćwiczenia czynne wolne, ćwiczenia sensomotoryczne. Oba programy rehabilitacji trwały 3 miesiące i były realizowane 2 razy w tygodniu. W grupie I ukończyło program 25 badanych, a w grupie II – 18. Na początku i końcu badań wykonywano test Timed UP & GO oraz test Tinetti (POMA). Przed rozpoczęciem badań nie odnotowano istotnych statystycznie różnic pomiędzy badanymi grupami. Do opisu materiału badawczego wykorzystano podstawowe parametry statystyczne, a w celu porównania uzyskanych wyników zastosowano test t-Studenta oraz nieparametryczny test Wilcoxon.

Wyniki. Rezultaty wykonywania testów poprawiły się w sposób istotny statystycznie ($p < 0,05$) tylko w grupie I. Średni czas wykonania testu UP & GO przed programem wynosił 26,1 s, a po jego zakończeniu 20,9 s. Wyniki testu Tinetti, zarówno wynik sumaryczny, jak i ocena równowagi (przed programem $11,2 \pm 1,8$ po $13,1 \pm 1,8$) oraz chodu (przed programem $8,9 \pm 1,5$ po $10,4 \pm 1,7$) były lepsze. W grupie II różnice przed i po programie rehabilitacji nie były istotne statystycznie.

Wnioski. Ćwiczenia sensomotoryczne połączone z nauką podnoszenia się po upadku i nauką zmiany pozycji oraz marszem na krótkim odcinku, stosowane u osób starszych z zaburzeniami czynności życia codziennego, wpływają na poprawę wykonywania tych czynności i zmniejszenie ryzyka upadków

Introduction

The population of the elderly is very diverse. Among persons who are older than 65 years, there is a majority of relatively healthy persons; however, with increasing age, chronic diseases are more frequent, and in very old people, frailty syndrome is commonly observed^{1,2}. The characteristic features of this syndrome include: difficulties in maintaining homeostasis in response to stress, reduced capability to perform activities of daily living, multi-organ failure, incapability to restore agility after an acute illness, body weight loss, and a low level of physical activity with low gait velocity and decreased handgrip force^{1,2}. All components of the syndrome result in a higher risk of falls and, in the majority of cases, are the cause of dependence of these persons on the assistance of other people. Apart from the appropriate treatment of concomitant diseases, proper nutrition and appropriate rehabilitation program are listed among the methods of frailty syndrome prevention.

In many studies, it was demonstrated that physical training, especially resistance training, improves physical agility and muscle strength in the elderly, ameliorates general agility, prevents sarcopenia^{3,4}. Beneficial effects of frailty syndrome prevention were observed especially in persons with a physical agility restricted to a lesser extent². Physiotherapy also constitutes an important element of multi-directional interventions aimed at preventing falls. It was shown that general agility exercises reduce the risk of falls by 10% and balance exercises – by 17%⁵.

A serious limitation of introduction of rehabilitation programs into the therapy of very old persons is associated with the fact that randomised clinical studies were performed mainly in patients up to the age of 75 years^{2,3,5}. The number of studies on the tolerance and effectiveness of physical training in persons at advanced senility (older than 85 years) is limited. The awareness of the lack of broader works presenting the results of rehabilitation programs in persons at late senility and the obtained encouraging results of several-year observation of the effects of rehabilitation programs on functioning abilities of elderly persons prompted the authors of this paper to further search for the methods of rehabilitation in persons at advanced senility^{6,7,8}. The above mentioned study results became an inspiration for conducting a study in a group of persons above 85 years of age, in whom disturbances in functioning abilities and a threat of a next fall occurred. The study was conducted using other methodology and other rehabilitation programs than those used in the studies described above.

Aim of the study

To evaluate the effects of two rehabilitation programs on performance of simple motor tasks and on the risk of falls in patients above 85 years of age and to answer the following research questions:

- Does a rehabilitation program comprising free active exercises, sensorimotor exercises, exercises in changing position and in walking on a short distance, and learning to rise from a fall by means of rear movements, improve performance of simple motor tasks and reduce the risk of falls?
- Does participation of elderly persons in the exercises twice a day affect their performance of simple motor tasks?

Material and methods

Of the group of 143 persons who were older than 85 years and were treated as outpatients in outpatient clinics in Cracow, 50 persons were enrolled into the study (32 females, 18 males, mean age: 87 years) based on the following inclusion criteria: 1) age above 85 years; 2) three or more falls reported during the year preceding the study; 3) limitations during performance of simple motor tasks and score in the Lowton scale ranging 9 to 18 points; 4) physical and mental status allowing to participate in the rehabilitation program; 5) capability of independent changing of body position from sitting to standing and from standing to sitting; 6) capability of independent walk on a distance of 6 metres; 7) rehabilitation at home recommended for the patient. Patients with past cerebral vascular incidents with hemiparesis, as requiring special rehabilitation treatment, were excluded from the study. During conduction of this study, patients were not allowed to participate in another rehabilitation program that could affect results of the present study.

After having completed inclusion criteria-based selection, qualification by the attending physician for the participation in the rehabilitation program and after having signed the informed consent to participate in the rehabilitation program, the participants were randomised into two groups by means of computer-assisted randomisation. The study was initiated in 25 persons in each group. The study was completed by: 25 persons in the group I (20 females, 5 males, mean age: 88 years) and 18 persons in the group II (13 females, 5 males, mean age: 86 years), as 7 participants from the group II withdrew from the study. Participants' characteristics are listed in the Table 1.

Table 1
Participants' clinical characteristics

Evaluated feature	Group I (n=25) X ± SD	Group II (n=18) x ± SD	Level of significance
Age (years)	88 ±4.9	86 ±6.8	Ns
Gender (F/M)*	20/5	13/5	Ns
Height (cm)	161 ±6.4	166 ±4.9	Ns
Body weight (kg)	74 ±8.2	73 ±12.6	Ns
Number of concomitant diseases	4.1 ±1.7	4.9 ±2.6	Ns
Number of medications used	6.6 ±4.1	6.9 ±4.2	Ns
Cardiovascular diseases (%)	60	61	Ns
Diseases of the locomotor system (%)	56	66	Ns
Respiratory system diseases	28	25	Ns
Diabetes (%)	32	33	Ns
Urinary tract diseases (%)	48	50	Ns
Gastrointestinal diseases	24	22	Ns
Neurological diseases (%)	32	33	Ns
Psychiatric diseases (%)	20	22	Ns
Ophthalmologic diseases (%)	28	33	Ns
BMI – Body Mass Index	28 ±3.1	26.4 ±4.3	Ns
ADL# - number of points	4.1 ±1.8	4.8 ±1.2	Ns
The timed UP & GO Test (s)	26.1 ±6.2	25.9 ±4.7	Ns
The Tinetti (POMA) Test	20.1 ±1.6	19.8 ±1.6	Ns
Total score			
A fall during the last 3 months %	56	61	Ns
Walking with a technical aid %	36	39	Ns

* (F/M.) F - Females. M – Males; # ADL - Activities of Daily Living Scale; ## Ns – Not significant

To answer the study questions, the participants were evaluated using The Timed UP & GO and the Tinetti (Performance Oriented Mobility Assessment)¹⁰ tests prior to and after termination of the rehabilitation program. The "up and go" test was performed twice by the participants, at their own rate, following oral instructions and a demonstration; the participants stood up from a chair, from a sitting position with their back on the back rest (seat height: 46 cm), covered a distance of 3 metres on a flat surface, performed subsequently a 180° turn, went back to the chair and returned

to the sitting position. Measurement of the performance time was performed using an electronic stopwatch with an accuracy of 1/10 second. The best achieved result was reported.

In the Tinetti (POMA) test, 16 items are assessed, where 9 items allow to assess maintenance of balance during performance of various activities, and 7 other items – to evaluate gait. These features are scored on a 0-2 point scale. In this test, a participant could score a maximum of 28 points. A result below 26 points indicated presence of a risk for falls, and a score below 19 points indicated that the risk for falls in a given person is five-fold greater than in a person, who scored 28 points¹⁰.

Prior to commencing the study, no statistically significant differences between the groups were noted.

To describe the study material, parameters of descriptive statistics were used (arithmetic mean and standard deviation). For the comparison of study results, Student t-test for dependent variables was applied, the level of statistical significance was set at $p < 0.05$. As a non-continuous, point scale ranging from 0 to 2 was used to evaluate particular items of the Tinetti (POMA) test, a non-parametric Wilcoxon signed rank test, involving comparison of point scores between pairs, was applied to obtain the information on changes in particular items of the test. The pairs included assessment results during the first and the second evaluation. The test allows assessing, whether the existing differences are statistically significant. The data were processed using the computer program Statgraphic for Windows¹¹.

Physiotherapy programs

Physiotherapy program for the group I

The physical therapy program was conducted by one physiotherapist at patient's home, twice a week, in two sessions, each lasting 70 minutes: 35 minutes during morning hours and 35 minutes during afternoon hours, for three months. During morning hours, the exercises were started by warm-up, when low-intensity active exercises of the upper and lower extremities and the trunk were performed initially in the supine position, and subsequently in the sitting position on a chair. During and after the above exercises, respiratory exercises were performed. The main part included sensorimotor exercises on a pneumatic pillow creating conditions of unstable ground and exerting a resistance. These exercises were performed both in the sitting and standing position.

Sensorimotor exercises in the sitting position on a chair:

- Exercise (Ex.) 1. Baseline position (Bp): sitting on the pneumatic pillow, the upper extremities (ue) in extension along the trunk (T), the feet resting on the ground. Ex. of bending T forward and backwards. Return to Bp.
- Ex. 2. Bp as above. Ex.: leaning T to the right, and then to the left. Return to Bp.
- Ex. 3. Bp sitting on the pneumatic pillow, ue in extension and elevated at an angle of 45 to 90° (dependently on participant's abilities), the hands of the exercising person close to the hands of the therapist (protection), the feet off the ground. Ex.: bending T forward. Return to Bp.
- Ex. 4. Bp as above. Ex.: leaning T to the right, and then to the left. Return to Bp.
- Ex. 5. Bp sitting on a chair, the pneumatic pillow on the floor under the exercising person's feet, ue along T, the hands of the participant resting on the edges of the chair. Ex.: bending T forward, an attempt to lift the buttocks from the seat (a trial of independent rising from the chair), the physiotherapist secures the exercising person from forward. Return to Bp. Sensorimotor exercises in the standing position:
- Ex. 6. Bp standing on the pneumatic pillow, ue in extension and elevated at an angle of 45 to 90° (dependently on participant's abilities), the hands of the exercising person held by the hands of the therapist (protection). Ex.: bending T forward and backward. return to Bp.
- Ex. 7. Bp as above. Ex.: leaning T to the right, then to the left. Return to Bp.
- Ex. 8. Bp as above. Ex.: the participant walks in place on the pneumatic pillow, secured by the physiotherapist.
- Ex. 9. Bp as above. Ex.: the exercising person flexes the lower extremities (le) in the hip, knee and ankle joints (a slight squat), and subsequently performs the extension movement in the above joints. The physiotherapist secures the participant.
- Ex. 10. Bp as above, a chair behind the participant. Ex.: the exercising person sits down on the chair secured by the physiotherapist while standing on the pneumatic pillow.

The above exercises are performed intermittently with respiratory exercises. Duration of the exercises was 20 minutes. Subsequently, safe performance of changing the position was practiced (from the sitting to standing and from the standing to sitting).

The final part of this session included relaxation exercises of the lower and upper extremities and respiratory exercises.

During the afternoon hours, the exercises were begun with warm-up, like in the previous session, then the participant – while sitting on a chair with the arms on the arm-rest – was, after having heard the word "go!" to safely stand up and walk at his own pace on a flat surface to a point located 2 metres away, turn around, come back to the chair and safely sit down. While the participant was performing these activities, the physiotherapist was correcting the improperly performed tasks. Duration of this part of the program was 10 minutes.

Subsequently, the patient was taught to rise after a possible fall using the method of rear movements, performing particular sequences of this method day after day during the period of the rehabilitation program¹⁷.

During the terminal phase of this session, similarly as previously, relaxation exercises of the lower and upper extremities and respiratory exercises were performed.

Physiotherapy program for the group II

The physiotherapy program was conducted by one physiotherapist at patient's home, twice a week, in one session lasting 60 minutes during morning hours, for three months. Exercises were started – similarly as in the group I – by warm-up. The main part comprised low-intensity active exercises of the upper and lower extremities in the sitting position on a chair and in the standing position. Duration of the exercises was 15 minutes. These exercises were performed intermittently with respiratory exercises. Subsequently, sensorimotor exercises, same as those in the group I, were performed for 30 minutes. During the terminal phase of the program, relaxation exercises of the lower and upper extremities and respiratory exercises were performed.

In the group II, no exercises of changing body position, walking on a short distance or learning to rise from a possible fall were performed.

During conduction of the rehabilitation program, pulse rate and blood pressure were monitored in all participants.

Following each session, the physiotherapist documented all changes and the course of the session in the clinical observation chart.

Prior to the commencement of the rehabilitation programs and after one month and two months of their conduction, the participants were provided with the information on the threat of falls and possibilities of modification of external factors in order to reduce the risk of falls.

Results

The conducted rehabilitation programs were accepted and tolerated by the patients; during performance of the exercises, excessive rises in pulse rate, or blood pressure, or respiratory system disturbances were not observed.

Analysis of the results after the rehabilitation programs demonstrated that the duration time of The Timed UP & GO test was significantly decreased ($p < 0.05$) in the group I from 26.1 s to 20.9 s. The results are illustrated in the Figure 1 and the Table 1. In the Group II, results of the Tinetti (POMA) test also significantly improved, both when considering the total effect (before the program: 20.1 ± 1.6 , after the program: 23.5 ± 1.7) and the assessment of balance (before the program: 11.2 ± 1.8 , after the program: 13.1 ± 1.8) and gait (before the program: 8.9 ± 1.5 , after the program: 10.4 ± 1.7). The results are presented in the Table 2. In the control Group II, results of the tests obtained after the rehabilitation program did not change significantly as compared to baseline results.

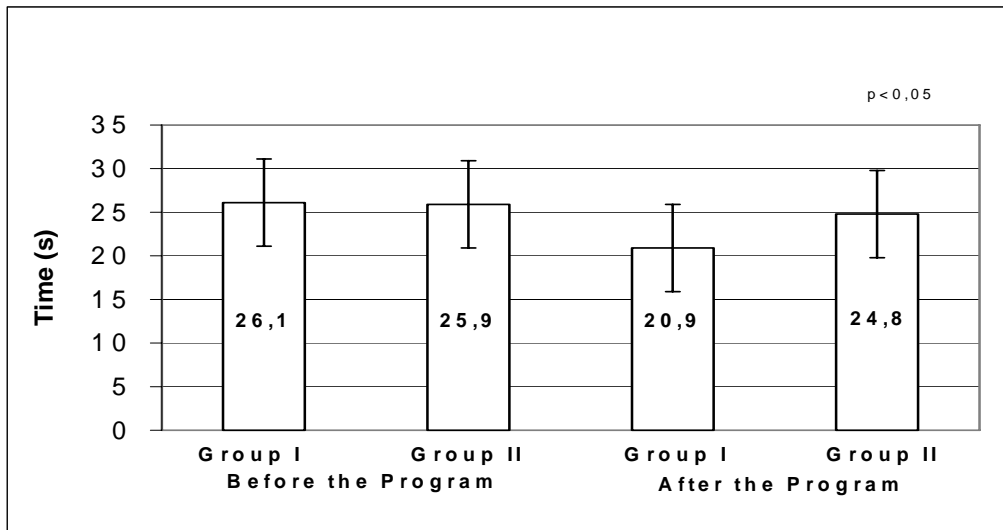


Figure 1
Results of The timed UP & GO test before and after physical rehabilitation regimens

Table 2
Results of the physical rehabilitation programs

	Group I (n=25) x ± SD		Group II (n=18) x ± SD	
	Before the Program	After the Program (p<0.05)	Before the Program	After the Program Ns
The timed UP & GO Test (s)*	26.1 ±5.2	20.9 ±4.2	25.9 ±4.7	24.8 ±5.1
The Tinetti (POMA) Test**	20.1 ± 1.6	23.5±1.7	19.8 ±1.6	20.8 ±1.6
Total score				
The Tinetti (POMA) Test**	11.2 ±1.8	13.1 ±1.8	10.9 ±1.8	11.5 ±1.8
Assessment of balance				
The Tinetti (POMA) Test**	8.9 ±1.5	10.4 ±1.7	8.9 ±1.5	9.3 ± 1.5
Assessment of gait				

* The Student-t test was used; ** The non-parametric Wilcoxon signed rank test was used; ## Ns – Not significant

Discussion

The presented physiotherapy programs were oriented towards an improvement of performance of simple motor tasks and a reduction of the risk of falls in persons older than 85 years with a limited ability of independent life at home or in a flat and with an inability to take part in physiotherapy other than the home-based. During the 3 months, the conducted broadened physiotherapy program including elements of sensorimotor training and teaching to rise from falls by means of rear movements and teaching how to change body position resulted in a substantial improvement of agility of patients at advanced senility, ameliorated the performance of simple motor tasks and resulted in a reduction of the risk of falls. It seems that the program of conducting exercises twice a day in a shorter time interval may be beneficial for consolidation of motor agility improvement and the tolerance of exercises.

Results of our own studies confirm the results of previous randomised clinical trials conducted in larger patient groups. Fiatarone and her team¹³, who applied an appropriate rehabilitation program in persons at the age of 90 or older, showed that it is possible to achieve an improvement in locomotor capabilities in this age group. In the FAST study (Fitness Arthritis and Seniors Trial) comprising the elderly treated as outpatients, rehabilitation of various intensity was

conducted in three groups for one and a half year and the obtained results were compared to the results of persons running a sitting style of life. It was demonstrated that each rehabilitation program significantly improved not only patients' agility but also their general feeling¹⁴.

A reduction in the risk of falls is an additional advantage of an appropriate physiotherapy program for persons from this age group. In the FICSIT study (Frailty and Injuries: Cooperative Studies of Intervention Techniques), physical training and balance exercises markedly reduced the incidence of falls both for the individual home-based exercise program and for group exercises⁵. Moreover, systematic physical training in the elderly allows to maintain their cognitive function, decreases the tendency to depression, ameliorates general feeling and self-esteem¹⁵. This is also confirmed by the studies by Źak and Gryglewska conducted in non-agile elderly persons with hypertension, who achieved better results in both the "up and go" and the 6-minute walk tests following participation in a 12-week rehabilitation programme⁸. It seems important in the conduction of rehabilitation programs in this age group to teach rising from a possible fall using the method of rear movements, which played an important role also in the current study. Beneficial effects of learning to rise from a fall in the elderly are also confirmed by the studies by Hoffmeyer et al.¹⁶ and by Źak and Grodzicki¹⁷, who found a reduction in post-fall complications in patients at this age, who participated in a rehabilitation program.

The obtained results as well as the results of other groups demonstrate that appropriately prepared and conducted physiotherapy program may be safely performed at home by persons at advanced senility and that such program is well tolerated and accepted by these persons.

Conclusions

In persons older than 85 years, who have disturbances in the performance of daily-life activities, performance of sensorimotor exercises concomitantly with exercises in changing body position, walking on a short distance, together with learning to rise from a fall result in improved performance of simple motor tasks and reduce the risk of falls. Such rehabilitation program is recommended for persons who were diagnosed with frailty syndrome.

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