



Original Article

## Effects of inpatient physical therapy on the functional status of elderly individuals

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**Abstract.** [Purpose] The aim of the study was to analyze the impact of inpatient rehabilitation on the functional status of the elderly. [Subjects and Methods] A total of 100 patients (>65 years of age) in a rehabilitation ward were enrolled in this study. Age, absence of depression and signs of dementia in screening tests constituted the inclusion criteria. A comprehensive geriatric assessment was performed of all of the subjects twice, at the beginning and end of hospitalization (Assessments I and II, respectively), and included fall risk assessment (Timed Up and Go Test, TUG), evaluation of physical function (Short Physical Performance Battery Test, SPPB), the handgrip strength test, as well as patients' self-reports of pain intensity, well-being and functional status. [Results] At the end of inpatient rehabilitation, significant improvement was observed in reduction the TUG time, physical function, and handgrip strength, as well as in subjective parameters such as self-reported pain intensity, well-being, and functional status. [Conclusion] Our results show the high efficacy of inpatient rehabilitation as a means of improving functional independence. Hospital rehabilitation should be recommended for elderly people, not only in cases of absolute indications for hospital admission, but also periodically for patients at risk of physical disability.

**Key words:** Physical therapy program, Functional status, Elderly

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### INTRODUCTION

A steadily increasing number of elderly people has stimulated a growing interest in the process of ageing, defined as a set of gradual changes leading to a decrease in existing reserves and limited ability to maintain homeostasis under stress. They are a natural progression of physiologic changes and, as such, constitute an unavoidable element of human life. Although these changes do not inevitably lead to disease or disability, they notably increase the risk of their occurrence.

Naturally, in practice it is not always possible to avoid diseases and the vast majority of elderly people suffer from at least one chronic condition. Also, diseases in the older population often lead to impaired performance of everyday activities. Recently, much attention has been given to the possibility of restoring the functional status by means of physical therapy, as well as compensating for the loss of functions resulting from various diseases. That, in turn, would allow a significant number of the elderly to maintain their independence. The results of PolSenior research revealed the percentage of person independent in activities of daily living (ADL) notably decreased from 99.9%, for age groups between 65–69, to 79.1% for people >85. With regard to IADL (Instrumental Activities of Daily Living), limitations in the corresponding age groups were 20% and 90% of the cases, respectively<sup>1)</sup>. Thus, it seems vital to design and implement physical therapy programs to prevent loss of independence and maintain high quality of life in old age. A systematic review and meta-analysis of inpatient

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rehabilitation specifically designed for geriatric patients done by Bachmann et al. showed beneficial effects over usual care for functional improvement, preventing admissions to nursing homes, and reducing mortality<sup>2</sup>.

The aim of our study was to evaluate the effects of physical therapy in hospital rehabilitation on the functional status of the elderly. We attempted to determine whether hospital rehabilitation influenced the investigated parameters, both subjective and objective, and improved functional status.

## SUBJECTS AND METHODS

A total of 100 patients, aged  $\geq 65$ , who were hospitalized in a rehabilitation ward in Poznań and met the inclusion criteria, were recruited for this study. Age, absence of depression and signs of dementia in screening tests constituted the inclusion criteria. The subjects demographic data were mean age  $72.3 \pm 6.1$  years: females  $n=79$  (79%), mean age  $72.8 \pm 6.0$  years; males  $n=21$  (21%), mean age  $70.3 \pm 6.3$  years.

The evaluation of the functional ability, based on selected elements of the Comprehensive Geriatric Assessment (CGA), was performed twice. The first examination was performed within 48 hours after admission to the ward (Assessment I), and the second one at the end of a 5-week (35 day) hospitalization period (Assessment II). During their hospital stay, each patient followed an individually tailored physical treatment program – consisting of kinesiotherapy aiming to increase strength, endurance, balance and range of motion (exercise using Thera-bands, balance platform, balance balls). The patients exercised every day in a gym (for 45 min) and received individual therapy (30 min) from a physiotherapist for five weeks. The therapy program was selected and individually tailored to the functional status of the patient.

Osteoarthritis (58%), followed by endoprosthesis (25%), and stroke (18%), were the most common reasons for hospitalization in the rehabilitation ward. There were isolated cases of hospitalization due to rheumatoid arthritis (2%), Parkinson's disease (1%), multiple sclerosis (1%), or fractures (2%). The vast majority of subjects (85%) suffered from one (40 patients) or at least two (45 patients) concomitant diseases, with hypertension (54%), osteoporosis (16%), and diabetes (14%) among the most common conditions. Forty-five subjects reported use of mobility aids (20 – one crutch, 23 – two crutches, and 2 – walking frame), and the remaining 55 patients moved without any mobility aid.

The Mini Mental State Examination (MMSE)<sup>3</sup>, was used as a screening test for cognitive impairment. The threshold score of 23 points signifies risk of dementia. Patients who scored  $\leq 23$  points were excluded from the study. The risk of depression was identified using the Geriatric Depression Scale (GDS)<sup>4</sup> shortened to 15 question in which the threshold score of 5 points indicates an increased risk of depression. Patients who scored  $\geq 5$  points were excluded from the study. The functional ability of each patient was assessed with regard to ADL, IADL, fall risk, physical ability, handgrip strength, pain intensity, as well as self-reported mobility and well-being. We used the Katz Index of Independence<sup>5</sup>, to measure ADL. The Lawton IADL scale<sup>6</sup> was used to assess independent performance of more complex activities. The Timed Up and Go (TUG) test<sup>7</sup> was used to determine the risk of falls. If the TUG time exceeds  $\geq 13.5$  seconds, it indicates an increased risk of falls<sup>8</sup>. The Short Physical Performance Battery (SPPB) test was used to assess physical performance. This test measures the lower extremity function of three items: standing balance, gait speed and rising from a chair and returning to the seated position<sup>9, 10</sup>. Handgrip strength was measured with a Jamar hand dynamometer (Sammons Preston Rolyan, the USA), in accordance with the guidelines of the American Society of Hand Therapists, with an accuracy of  $\pm 1$  kg<sup>11</sup>. The Numeric Rating Scale (NRS) was used to assess pain intensity, mobility and well-being<sup>12</sup>.

The experiment reported in this paper was undertaken in compliance with the current laws of Poland, and the Committee for Bioethics of the Karol Marcinkowski University of Medical Sciences in Poznań gave consent for the carrying out the examinations. All of the subjects provided their written informed consent prior to participation, in accordance with the ethical principles of the Declaration of Helsinki.

The results were statistically analyzed. Normal distribution of the data was checked with the Shapiro-Wilk test. Data lacking a normal distribution are presented, apart from to analyze the average and standard deviation, with the median (M) and range (R). In group comparisons the Mann-Whitney test was used independent variables and the Wilcoxon test to analyze dependent variables. The Spearman's rank correlation coefficient was calculated to measure the degree of relationship between two variables. A value of  $p < 0.05$  was considered statistically significant. Statistical analyses were performed using the statistical packages of STATISTICA v. 10.0 (StatSoft. Inc.) or StatXact v. 9.0 (CytelStudio).

## RESULTS

At the end of hospital rehabilitation, improvement was noted in objective (TUG, SPPB, handgrip strength) and subjective (NRS pain, mobility, well-being) parameters. The averages of the results are presented in Table 1.

As far as ADL was concerned, the level of functionality in the investigated group did not change during hospital rehabilitation. Similarly, the level of functionality in the analyzed group did not change with regard to IADL, either. During hospitalization, 90 subjects improved their TUG test result. The improvement was statistically significant ( $p < 0.001$ ). In Assessment I, only 2 participants obtained the maximum score (12 points) in the SPPB test, whereas after rehabilitation 6 subjects obtained the maximum in the SPPB test ( $p < 0.001$ ). In Assessment I, 19 participants obtained the maximum score in the SPPB *Gait speed* test. After one-month of hospital rehabilitation, 30 patients scored the maximum number of points,

a significant improvement ( $p<0.001$ ). Handgrip strength improved for as many as 80 patients. As for NRS *Pain*, 20 participants reported no pain in Assessment I. At the end of hospitalization, 23 patients reported no pain, significant improvement ( $p<0.001$ ). Moreover, 67 patients were found to experience less pain. As for NRS *Mobility*, 10 and 15 participants obtained the maximum number of points in Assessments I and II, respectively, a significant improvement ( $p<0.001$ ). As for NRS *Self-reported well-being*, 28 and 42 participants obtained the maximum number of points in Assessments I and II, respectively. In comparison with Assessment I, a statistically significant improvement was observed ( $p<0.001$ ). Correlations were found, between the time of TUG and the ADL and IADL scores and also between TUG time and self-reported well-being and mobility, [Table 2](#).

**Table 1.** Test results obtained before and after a 5-week hospital rehabilitation

Test	RESULTS	
	Assessment I	Assessment II
Geriatric assessment tools used in the study		
Activities of Daily Living (ADL) (score)	5.7±0.6 <sup>a</sup> 6.0; 4–6 <sup>b</sup>	5.8±0.4 6.0; 4.0–6.0
Instrumental Activities of Daily Living (IADL) (score)	7.0±1.3 7.5; 3–8	7.1±1.1 8.0; 4.0–8.0
Timed Up and Go (TUG) (sec)	16.9±7.4 15.2; 5.5 – 43.0	15.0±6.4 * 13.1; 5.5–36.6
Short Physical Performance Battery (SPPB) (score)	6.1±2.9 6.0; 1–12	6.9±3.0 * 7.0; 1–12
SPPB Repeated chair stand test (score)	1.1±1.2 1.0; 0–4	1.3±1.4 1.0; 0–4
SPPB Balance tests (score)	2.7±1.3 3.0; 0–14	2.9±1.2 3.5; 0–4
SPPB Gait speed (score)	2.2±1.2 2.0; 0–4	2.6±1.2 * 3.0; 0–4
Handgrip strength (kg)	15.1±9.2 14.0; 0–46	17.5±10.1* 16.0 ; 0–51
NRS pain (score)	4.6±3.1 5.0; 0 – 10	3.1±2.5 3.0; 0 – 10
NRS mobility (score)	6.1±2.0 6.0; 0–10	7.4±1.9 * 8.0; 0–10
NRS well being (score)	7.5±2.2 8.0; 1–10	8.6±1.6 * 9.0; 4–10

\* $p<0.001$  <sup>a</sup>Mean, SD. <sup>b</sup>Median; range

**Table 2.** The correlations among TUG, ADL, IADL, SPPB, and NRS

	R Spearman
TUG vs ADL	0.420 *
TUG vs IADL	0.574 *
TUG vs NRS mobility	0.233 *
TUG vs NRS well-being:	0.266 *
SPPB vs ADL	0.429 *
SPPB vs IADL	0.554 *
NRS mobility vs NRS well-being	0.308 *
NRS pain intensity vs NRS well-being	0.185 **
NRS pain intensity vs NRS mobility	0.152 **

\*  $p<0.001$ , \*\*  $p<0.01$

## DISCUSSION

As societies are ageing, a growing amount of attention is being paid to the problems of the elderly. It is vital for them to maintain independence in performing daily activities in order to live a good-quality life. A study by Von Heuvelen et al. demonstrated that engaging in physical activity leads to improved functional status<sup>13</sup>). Proper rehabilitation, taking into consideration polipathologies typical of advanced age, plays an important role as far as health problems are concerned. Co-existing diseases may limit possible applications of a physical therapy program, but rehabilitation always leads to improved physical performance. Brach et al.<sup>14</sup>), presented areas of physical function recognized as the most important components of functionality (gait speed, risk of falls, handgrip strength), that can prove useful to physiotherapists in their daily clinical practice to develop rehabilitation programs preventing disability in the performance of basic ADL tasks by the elderly.

The participants of our study were patients hospitalized in a rehabilitation ward. The group was heterogeneous with respect to the cause for rehabilitation and the concomitant diseases. A lack of homogeneity in terms of diseases and functional status is a typical feature of the older population. As it would have been challenging to gather 100 patients of a similar clinical and functional profile in a relatively short period of time, we decided to include consecutive patients who met the criteria, irrespectively of coexisting diseases, and to use functional assessment tests recommended for that age group. The majority of our patients suffered from at least two coexisting diseases. Longevity increases the incidence risk of chronic diseases in the elderly, inevitably leading to polipathologies. Thus, the number of people without any coexisting diseases is small among the oldest patients. Hypertension is found in about 80% of the Polish elderly, and the incidence of diabetes, frequently referred to as the epidemic of the 20th and 21st centuries, is 22%<sup>1</sup>). Our study participants were most often diagnosed with hypertension (54%) and diabetes (14%) and represented the typical elderly population with polipathologies but we did not analyze the influence of coexisting diseases as well as the reasons for hospitalization. During hospital physical therapy, improvement was noted in the case of both parameters.

Statistically significant ( $p < 0.001$ ) improvements in the TUG and SPBP measures were achieved as a result of hospital rehabilitation. The data collected by Chang et al.<sup>15</sup>), in their meta-analysis, show that physical activity is one of the possible interventions for reducing the risk of falls. Kim et al.<sup>16</sup>) reported balance training in a standing position as an exercise that is helpful for improving activities that mainly use the lower extremities, such as gait, and training in a sitting position as somewhat helpful for improving balance ability. A study by Park et al. confirmed that a community-centered muscle strengthening program using the elastic bands was effective at changing the physical functions and quality of life of the rural elderly<sup>17</sup>). Viccaro et al.<sup>18</sup>), during their one-year observation of 500 veterans, found that poor TUG times, in addition to increasing the risk of falls, predispose to health decline and ADL performance problems in formerly fit people. Huang et al.<sup>19</sup>) found that poor TUG times at enrollment in a study predisposed to ADL disability within 6 months, but not within 12 and 18 months. In our study, a correlation was found between both, the TUG result and the scores obtained for ADL and IADL, as well as between the TUG time and self-reported well-being and mobility. Physical activity was found to be an effective way of improving the scores obtained in the SPPB test in a multi-center blind randomized trial involving sedentary older adults (*The Lifestyle Interventions and Independence for Elders pilot study*)<sup>20</sup>). The authors of that study suggested that in the long run, physical activity should translate into health benefits, including disability and reduced mobility. Vasunilshorn et al.<sup>21</sup>), while analyzing the lives of the InCHIANTI study participants (a representative population-based study of the Chianti area in Italy) for 3 years, noted that low physical ability as measured by SPPB predisposes to disturbances of the lower extremity function, which in turn causes problems with walking the distance of 400 meters. The risk of inability to walk that distance after three years was at least 25 times higher for people whose initial score on the SPPB test was lower than 7 points than for those whose score was 12 points. Guralnik et al.<sup>22</sup>) found that low scores obtained in the SPPB test indicate not only future disability in terms of mobility, but also disability in performance of ADL and increased mortality. It should be emphasized that the authors cited above perceived gait speed as the most sensitive parameter in the SPPB test, and that their findings were consistent with our results. Changes in the overall SPPB test were accompanied by parallel changes in *gait speed* as the only sub-parameter. Huang et al.<sup>19</sup>) demonstrated that the assessment of physical ability with the use of the SPPB test at the beginning of the study is one of the best indications of disability in ADL performance after 6, 12 and 18 months. They found a relationship between the scores obtained in the SPPB test and on the Katz and the Lawton scales, indicating a positive correlation between physical ability and higher performance in terms of ADL and IADL. Self-reported well-being and mobility were also improved. Their observations are consistent with the findings of Sposito et al.<sup>23</sup>), who showed that better physical ability as measured by SPPB corresponds to improvement in selected domains of well-being.

In our study, better handgrip strength was demonstrated at the end of hospitalization ( $p < 0.001$ ). Improvement was found in as many as 80% of the participants. Taekema et al.<sup>24</sup>), in their prospective analysis of the population included in the Leiden 85+ study (the study of people aged  $\geq 85$ , inhabitants of Leiden, Holland), demonstrated that low handgrip strength predisposes to problems with performing ADL and IADL tasks. As it also translates into cognitive function impairment and risk of depression, they suggested that handgrip strength, considering its ease of measurement, should be applied in geriatrics to identify patients with an increased risk of functional disability. This is consistent with the earlier observations of Giampaoli et al., conducted over a four-year period<sup>25</sup>). Moreover, Rantanen et al.<sup>26</sup>), demonstrated during their 25 year-long observation period that poor handgrip strength in middle-age is a predisposing parameter to disability in old age. On the other

hand, Garcia et al.<sup>27)</sup> showed that owing to a link between handgrip strength and strength and range of lower extremities motion, measurement of the former could be used as a screening tool to assess the lower extremity function. In our study, no connection between handgrip strength and SPPB scores assessing the lower extremity function was found. Lower extremity function can also be indirectly assessed by means of the TUG test. There was no connection between handgrip strength and TUG times either, although a strong correlation was found between the TUG and SPPB scores. Gudlaugsson et al.<sup>28)</sup> demonstrated identical changes as far as these two tests were concerned, with no significant differences in handgrip strength after a six-month rehabilitation.

Inpatient physical therapy resulted in pain reduction ( $p < 0.001$ ). It is a well-known fact that pain hinders performance of activities of daily living. Zyczkowska et al.<sup>29)</sup>, in their study of all elderly inhabitants of the province of Ontario, Canada (almost 200,000 people), demonstrated that pain—regardless of its origin or location—increased the risk of disability in ADL performance. Di Lorio et al.<sup>30)</sup> stated in the InCHIANTI study that back pain caused problems with performing such activities as bathing, laundering, shopping, and carrying shopping bags. In our study, no relationship was observed between pain intensity and physical ability in performance of ADL and IADL. Reduced pain intensity was found to result in better self-reported well-being and mobility. Improvement in self-reported well-being ( $p < 0.001$ ) and mobility ( $p < 0.001$ ) were observed at the end of the one month of hospital physical therapy. Regular physical activity is believed to reduce fear and stress levels, thereby having a beneficial effect on well-being<sup>31)</sup>.

Distinct improvement achieved due to the hospital rehabilitation can be explained by the fact that the hospital physical therapy program is intensive and multidimensional. Our patients participated in individually tailored physical exercises twice a day. A meta-analysis done by Kwakkel et al.<sup>32)</sup> revealed that intensification of a therapeutic program may have a beneficial effect on the functional ability of patients after stroke. However, it is impossible to continue such intensive programs at home due to a lack of specialist equipment and supervision from a physiotherapist, who would support patients during exercises requiring help and safety measures (balance exercises), and motivate them to exercising on a daily basis. Our study demonstrates the high effectiveness of the hospital physical therapy program in terms of reducing the risk of falls, improving physical ability, increasing handgrip strength, and improving subjective parameters such as pain intensity, self-reported well-being and mobility. Inpatient rehabilitation should be recommended for elderly people, not only in cases of absolute indications for hospital admission, but also periodically for patients at risk of physical disability.

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