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FACTORS INFLUENCING USE OF ASSISTIVE TECHNOLOGY IN POST-STROKE PATIENTS – PRELIMINARY FINDINGS

CZYNNIKI WPŁYWAJĄCE NA WYKORZYSTANIE TECHNOLOGII WSPOMAGAJĄCEJ U PACJENTÓW PO UDARZE – WYNIKI WSTĘPNE

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S u m m a r y

B a c k g r o u n d . Assistive technology (AT) is regarded as one of the most important factors influencing functional recovery and independence in patients after stroke. There is still a need for research on predictors and early identification of AT requirements in order to shape and maximize its positive influence on the recovery process.

O b j e c t i v e . To identify and evaluate relationship between selected factors (age, sex, time after cerebrovascular accident) and AT use.

R e s u l t s . Among 140 patients involved in the study, the use of AT was as follows: the most common AT equipment were wheelchairs (used by 40.81% of patients), canes (15.71%) and husks (15%). Up to 5 % patients used more than one AT device. Sex, age, time after cerebrovascular accident, and post-stroke complications were important factors influencing AT use in stroke-survivors.

C o n c l u s i o n s . Study outcomes confirm important clinical information extending existing studies, especially co-occurrence of AT devices use.

S t r e s z c z e n i e

W p r o w a d z e n i e . Technologia wspomagająca jest uważana za jeden z najważniejszych czynników wpływających na funkcjonalny powrót do zdrowia i samodzielność pacjentów po udarze. Wciąż jednak potrzebne są badania w zakresie czynników predykcyjnych i wczesnej identyfikacji potrzeb w zakresie technologii wspomagającej, aby kształtować i maksymalizować pozytywny wpływ tej grupy rozwiązań technicznych na proces powrotu do zdrowia.

C e l . Identyfikacja i ocena związków pomiędzy wybranymi czynnikami (wiekiem, płcią, czasem po udarze) a wykorzystaniem technologii wspomagającej.

W y n i k i . Pośród 140 pacjentów biorących udział w badaniu najczęściej spotykanymi przedmiotem należącymi do technologii wspomagającej były wózki dla osób niepełnosprawnych (używane przez 40,81% badanych), laski (15,71%) i łuski (15%). Do 5% pacjentów wykorzystywało więcej niż jeden przedmiot należący do technologii wspomagających. Płeć, wiek, czas od udaru oraz zmiany wtórne po udarze stanowiły istotne czynniki wpływające na wykorzystanie technologii wspomagającej u pacjentów po udarze.

W n i o s k i . Badanie potwierdza ważne klinicznie dane rozszerzając dotychczasowe badania, szczególnie w obszarze jednoczesnego wykorzystywania różnych przedmiotów należących do technologii wspomagającej.

Key words: stroke, assistive technology, activities of daily living; quality of life

Słowa kluczowe: udar, technologia wspomagająca, czynności codziennego życia, jakość życia

INTRODUCTION

Stroke is perceived as the leading cause of disability, mortality, and medical cost in adult population. Despite few research where it is commonly believed that approximately 50% stroke survivors suffer from limited independence [1, 2]. Assistive technology (AT) is regarded as one of the most important factors influencing functional recovery and independence in patients after stroke. There is still a need for research on predictors and early identification of AT requirements in order to shape and maximize its positive influence to the recovery process [3, 4, 5, 6].

AT use can be shaped by AT-related policies and services. Experiences and motivation of potential users may shape future AT use [7, 8]. Results of studies by Philips & Zhao showed that even up to 29.3% of all AT devices can be abandoned, mainly due to selection of AT without taking into consideration opinion of the patient, poor performance of AT devices, and of course due to changes in patient' needs. Moreover, mobility aids were more frequently abandoned. Abandonment rates were highest during the first year and after 5 years of use [9]. The aforementioned causes of abandonment make rehabilitation planning (including common goal setting and AT selection) and its continuous reassessment the most important part influencing rehabilitation effectiveness.

Despite acceleration of research and development in the field of AT for individuals with severe motor impairments over the past 10 years there are a few of general studies on AT use [10]. The objective of this study was to identify and evaluate the relationship between selected factors (age, sex, time after cerebrovascular accident) and AT use.

METHODS

The study was of observational type. The research was conducted among 140 adult patients who had undergone stroke and was admitted to the Neurological Rehabilitation Ward (2013-2015).

Inclusion criteria consisted of: age above 18 years, diagnosis: stroke, patient during rehabilitation after cerebrovascular accident (CVA). Size and anatomical involvement of infarct varied depend on the patient. Inclusion of patients was each time confirmed by medical record. Clinical summary of the patients is presented in table 1.

Table 1. *Clinical summary of the patients*

	Patients n=140 (100%)
Sex:	
Females	61 (43.57%)
Males	79 (56.43%)
Age [years]:	
Min	26
Max	89
Mean	53.01
SD	18.66
Median	57
Time after cerebrovascular accident (CVA) [weeks]:	
Min.	1
Max	520
Mean	41.59
SD	11.61
Median	36
Number of patients with assistive technology	93 (66.43%)

Each patient was assessed once (at discharge, after last session of inpatient rehabilitation) by physical therapist experienced in neurorehabilitation (> 10 years of experience). Assessment were performed in each patient based on the real (not: reported or proposed) use of AT devices. It allows for replication of this study and makes its results more useful in everyday clinical practice.

Data were collected using MS Excel 2013 software. The results, where available, are expressed as mean, median, minimal value (min), maximal value (max) and standard deviation (SD). Statistical analysis of data was performed using the Statistica 10 software. A probability (p) value < 0.05 was considered as statistically significant. We do not observed missing or incomplete data.

The study was conducted in accordance with the Helsinki Declaration and the rules of Good Clinical Practice. Written informed consent was obtained from each patient before the study.

RESULTS

Among the 140 patients involved in the study, the results were as follows: the most common AT equipment were wheelchairs (used by 40.81% of patients), canes (15.71%) and husks (15%) (table 2).

Significant differences were observed in AT use in females and males (table 3), and younger and older (table 4). AT issues depends also on time after CVA (table 5). It was hard to observe the general tendency – use of AT in each group varied depending on subgroup of patients and AT device.

Table 2. *Percentage in the whole group of patients*

	wheelchair	prosthesis	parapodium	walker	husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
%	40.81	4.07	1.43	3.57	15	9.29	15.71	7.14	5	5.71	4.29	1.43

Table 3. *Percentage depending on sex*

	Wheelchair	prosthesis	parapodium	walker	husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
Female												
%	34.43	0	4.92	19.67	14.75	14.75	6.56	4.92	6.56	8.2	0	8.2
Male												
%	45.57	2.53	2.53	11.39	5.06	16.46	7.59	5.06	5.06	1.27	2.53	10.13

Table 4. *Percentage depending on age*

	wheelchair	prosthesis	parapodium	walker	Husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
Patients < 57 (median)												
%	44.29	2.86	2.86	18.57	11.43	12.86	5.71	5.71	8.57	4.29	2.86	14.29
Patients ≥ 57 (median)												
%	38.57	0	4.29	14.29	7.14	18.57	8.57	4.29	2.86	4.29	0	7.14

Table 5. *Percentage depending on time after CVA*

	wheelchair	prosthesis	parapodium	walker	husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
Patients ≤ 4 weeks after CVA												
%	42	0	2	14	10	8	6	6	10	4	0	16
Patients > 4 weeks till 3 months after CVA												
%	41.46	1.96	3.92	11.76	5.88	21.57	5.88	5.88	5.88	5.88	1.96	5.88
Patients 4 -12 months after CVA												
%	48	4	4	12	4	12	8	0	0	0	4	4
Patients > 12 months after CVA												
%	36	0	4	20	16	16	8	4	0	4	0	4

Table 6. *Percentage depending on complications observed in patients after stroke*

	wheelchair	prosthesis	parapodium	walker	husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
Patients with spasticity												
%	44.44	0	6.67	15.56	17.78	6.67	11.11	4.44	13.33	2.22	0	11.11
Patients with contracture												
%	43.1	1.72	6.9	17.24	17.24	5.17	8.62	5.17	8.62	3.45	0	6.9
Patients with pusher syndrome												
%	30.77	0	0	30.77	15.38	1.78	1.78	0	15.38	0	0	7.69
Patients with unilateral neglect												
%	16.67	0	0	33.33	16.67	0	16.67	0	0	0	0	0
Patients with heterotopic ossification												
%	50	0	0	10	10	10	0	0	0	0	0	0

Spasticity, contractures, pusher syndrome, unilateral neglect and heterotopic ossifications as the most common complications observed in patients after stroke influenced AT use. Use of wheelchairs is the lowest in patients with unilateral neglect (table 6).

Rates of co-incidence were relatively low: up to 5% (table 6).

Table 7. *Coincidence of AT use within the whole group of patients*

	wheelchair	prosthesis	parapodium	walker	husk	crutch	cane	tetrapod walking stick	foot up	sling	orthosis: upper limb	orthosis: lower limb
wheelchair	-	0	4.29	4.29	4.29	5	5	3.57	3.57	2.86	0	5.71
prosethesis		-	0	0	0	0.71	0	0	0	0	0	0
parapodium			-	0.71	0.71	0	0	0	0	0.71	0	0.71
walker				-	2.14	2.86	0	0	0	0	0	1.43
husk					-	0	0	0	0	0	0	1.43
crutch						-	0.71	0.71	0	0.71	0	0.71
cane							-	0	1.43	0	0	0
tetrapod walking stick								-	1.43	0.71	0	2.14
foot up									-	0.71	0	2.14
sling										-	0	0
orthosis: upper limb											-	0
orthosis: lower limb												-

DISCUSSION

Use of AT devices in post-stroke constitutes an important interdisciplinary (scientific, technical, clinical, and social) problem. It is hard to cover all possible issues and factors in a single study.

Low number of relevant studies makes the study a difficult compartmental one. Results of this study are partly similar to those published by other authors, but more detailed.

The need for AT as far as environmental modifications among stroke survivors changes over time. Early study by Sorensen et al. showed much bigger percentages of patients' provision in AT and environmental modifications:

- 75% at discharge,
-.81% six months after discharge,
- 74% at follow-up 3–5 years later [11].

Similar to the study's findings were results concerning the most frequently used AT: wheelchairs and aids for walking [11]. Results by Teasell et al. [12] and Preston et al. [13] show contrary increase in AT provision with time after CVA. But provision of expensive AT devices, such as scooters, power wheelchairs, and selected walking aids can be associated with costs [6]. Previous results by Mikołajewska concerning wheelchair use in patients after ischemic stroke show similar tendency to decrease wheelchair use with time after CVA:

- 71% three weeks to three months after CVA,
- 42% three months to six months after CVA,
- 20% six months to three years after CVA [14].

We do not know if such decrease is a result of recovery (improved functional state within area of mobility), abandonment or financial shortages of post-stroke patients and their families. This issue needs additional research, both in well-developed and developing countries.

Unfortunately, the study concerns only AT provided/prescribed at discharge. Results do not cover area of aids for bathing, cooking/eating and reading/hearing/writing. It seems that further home visits (e.g. by therapists during home rehabilitation) are required in order to investigate patients' needs for assistive devices and environmental modifications, including these changing with the functional status. Recent study by Dolbow & Figoni showed an important but not fully recognized relationship between accommodation (including access to exercise equipment and restrooms) and wheelchair use in people with mobility deficits [15]. The results of a study by Pettersson et al. indicates that powered wheelchairs mostly have a positive impact on the quality of life of patients with stroke [16]. But the role of AT in recovery from stroke seems be still underscored and is hard to validate, although walking/wheelchair use is regarded as significant sign of functional independence in post-stroke patients [17, 18, 19, 20].

Proper selection and trained use of AT may increase effectiveness of the post-stroke rehabilitation. Wheelchair skills training in powered wheelchairs users causes greater extent (30%) than in the control group (0%). What is more, presence of spatial neglect did not affect aforementioned results [21]. ADL performance is regarded as primary cause of falls

among post-stroke patients [22]. One the other hand, testing of AT devices influence the functional outcomes of the rehabilitation is still challenging both due to variety of AT equipment, and complexity of the possible therapeutic effect in particular patient after stroke [23, 24, 25]. Current result are incomplete or not consistent. Additional studies on a greater and more diverse population are needed.

Influence of complications after stroke to AT use may vary depending on present (set of) complications. Their presence may influence the way and effectivity of the therapy, an AT provision; thus, early diagnosis and proper qualification are key elements of treatment, rehabilitation and care. No doubt patients with complications are more severely compromised than those without, but there is still few evidences. Abnormal muscle tone such as spasticity may significantly affect AT use (e.g. due to problems in wheelchair positioning) [26]. Adversely increasing contracture (e.g. in the shoulder) after stroke [27]. Heterotopic ossifications may limit AT use due to persistent joint pain or limitation [28]. Hemispatial neglect (visuo-spatial deficit) may shape a need for adaptation of AT devices due to safety navigation purposes [29, 30, 31, 32]. Influence of pusher behavior on AT use is still under research.

Limitations of current study may include low number of factors regarded as predictors of AT use - it may limit the strength of the study outcomes. More prognostic signs should be taken into consideration, including combinations of both factors and complications. We intend to continue this study on a bigger sample of patients based on randomized controlled trail design. The convenience sample of population in the study may be skewed, not representative – but such process reflects real patients of neurorehabilitation wards and is more suitable as reference values for everyday clinical practice. In our opinion another limitation of our research - lack of assessment of the inter-rater reliability – may be omitted due to purely objective assessment with no bias.

This report is perceived preliminary and very general. Results of the study may support assumption that despite AT is regarded as important tools within functional recovery and independence in post-stroke patients, in practice only a few post-stroke patients really use AT devices. Many factors influence aforementioned situation, including former experiences with AT use and perceptions of the patients, their families/caregivers, and health professionals. We are aware that potential of AT equipment in supporting functional independence in this group of patients is huge, but may be unrealized. Thus, we need further research covering topics of factors (including barriers) influencing current situation, and effective strategies aiming at significant improvement. AT offers huge opportunity, and coordinated, creative system for AT provision and use should be maintained by researchers, device manufacturers, health professionals, service funders, patients with stroke, and their families/caregivers. Patient-oriented therapy, common goal setting, increased knowledge and training in AT devices'use should decrease the mentioned before AT abandonment. Assistance for activities of daily living and associated independence can be the most precious achievement for post-stroke patients [33].

Scientists and clinicians suppose that novel technologies can provide another breakthrough in AT provision thanks to exoskeleton, brain-computer interfaces and neuroprostheses, but barriers my remain the same or similar.

CONCLUSIONS

Knowledge in the area of wheelchair use among post-stroke patients should be extended. Presented findings confirm presented new and important basic and clinical information extending existing knowledge in the area of AT use in post-stroke patients. Further studies especially concerning patients' motivation and factors influencing AT use are needed.

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