Innovative Robot-Assisted Rehabilitation for Quality-of-Life Improvement: Experience from Cooperation Between Centres in Hungary and Slovakia

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ABSTRACT

Purpose: This study aimed to analyse the experience of two participating workplaces in introducing innovative robotically assisted rehabilitation in clinical practice and influencing the quality of life of patients.

Methodology/Approach: Online questionnaires were distributed to the rehabilitation staff of the two workplaces, and the Functional Independence Measurement (FIM) and Barthel index were measured before the start of rehabilitation and after the completion of rehabilitation. Results showed that the robots were highly effective, easy to use, and significant in achieving the therapeutic goal. Rehabilitation specialists who already have experience in robotic rehabilitation perceive the expected impacts with a higher efficiency of 10% compared to those who do not have experience with robot-assisted therapy. In a selected group of patients, a significant positive effect on the functional status of patients and their quality of life was demonstrated.

Research Limitation/Implication: Robotically assisted rehabilitation has a positive effect on functional status and quality of life, motivating rehabilitation workers even when treating patients with severe disabilities.

Originality/Value of paper: Data collected are beneficial for health, educational, and social fields.

Category: Research paper

Keywords: robotically assisted rehabilitation; quality of life; efficiency of the introduction of new technologies

1 INTRODUCTION

Stroke is the second most common cause of death and the leading cause of adult disability in the European Union. It is estimated that the number of people with stroke in the next three decades (2017–2047) will increase by 27%, mainly due to the aging of the population (Wafa et al., 2020). According to this report projected number of incident strokes (in thousands) between 2017 and 2027 is different in Slovakia 15.4 (14.9-15.9) vs 17.6 (16.4-18.8), and in Hungary 26.8 (25.9-27.8) vs 26.2 (24.6-27.9). There is also a difference between the projected number of prevalent strokes (in thousands) in this period in Slovakia: 130.9 (127.5-134.4) vs. 158.5 (149.9-167.7), and in Hungary: 263.1 (253.2-273.5) vs. 268.7 (251.2-287.6) (Wafa et al., 2020). Variations are expected to persist between European countries, showing opportunities for improvement in prevention and case management, including rehabilitation, particularly in Eastern Europe. In recent years, rehabilitation robots have become increasingly important owing to the availability of new technologies and the growing demand for physical rehabilitation. Approximately two-thirds of stroke survivors have some degree of residual impairment, especially in terms of limitations in everyday activities mobility and quality of life (Veerbeek et al., 2017). Physical and occupational therapy are essential for restoring function. Successful rehabilitation involves task-oriented training with high repetition, which, although effective, may be laborious and time consuming for clinicians. Rehabilitation robotic devices are one approach to addressing this issue. There is significant evidence that the inclusion of rehabilitation robots in conventional treatments may enhance the recovery of motor deficits and functions in both clinical and home settings (Laut, Porfiri and Raghavan, 2016; Mehrholz et al., 2020). However, the use of rehabilitation robots during stroke rehabilitation is low because of the high cost, heterogeneity of clinical settings, patient accessibility, and other obstacles (Fong et al., 2022). A shortage of qualified clinicians is anticipated (Bessler et al., 2021), therefore, international cooperation among experts is expected to be beneficial. Eastern European states lack the introduction of this supplementary method of treatment. Care procedures should be based on evidence-based practice, which means that healthcare providers should rapidly incorporate the best available research.

The aim of this article is to compare data from project partners and evaluate the benefits of innovative devices used in healthcare.

2 METHODOLOGY

Online questionnaires were distributed to the rehabilitation staff of the two participating workplaces. The opinions and experiences of health professionals on robotically assisted rehabilitation were sought, along with opinions on the cooperation project. Using the Functional Independence Measurement (FIM) and Barthel index, which were measured before the start of rehabilitation and after the completion of rehabilitation, the impact of robotically assisted rehabilitation

on the functional state of patients and the quality of life after a stroke was analysed. The results were analysed using box-plot analysis and statistical testing of hypotheses. Because of non-normal distribution of the data and their ordinal character, the non- parametric statistical tests were used. For independent research samples, we used Mann-Whitney U Test to compare the distribution between samples. We also use paired Wilcoxon Signed Rank Test for paired samples.

2.1 Materials and Methods

The work used questionnaires (paragraph No. 1 and No. 2) as well as a statistical evaluation of a pilot sample of patients treated through robotically assisted rehabilitation in both cooperating rehabilitation workplaces. The research can be divided into three parts:

1. Health Care Professionals' views and experience of using rehabilitation robots – in this study, an online questionnaire was devised by the authors for health care professionals at both centres in Budapest (N = 18) and Košice (N = 9) with current or previous experience of stroke rehabilitation within any clinical setting (with or without the use of rehabilitation robotics). Workers who had no prior experience with robotically assisted rehabilitation received the same questionnaire. It had sections with both open and closed questions. The answers to the closed questions were given on a Likert scale (Mcleod, 2008). The first covered the respondents' demographics, clinical experience, and experience of using rehabilitation robots. The second concern was professionals' experience and views of using clinical rehabilitation robots. The questionnaire was based on research done by Li, Tyson and Weightman (2021), but it was changed to fit our needs;
2. Assessment of the benefit of the INTERREG Robot-Assisted Rehabilitation (RaRe) project for clinical practise – this questionnaire was distributed to the workers of both centres in Budapest and Košice who were directly involved in the work with robotic devices within the INTERREG RaRe project. The aim of this questionnaire was to find out the relevant indicators of the effectiveness of the joint project from the point of view of the evaluation of the involved health care professionals. The questions focused on possibilities of consultation regarding work with robotic devices, with patients included in robotic rehabilitation, evaluation of preferred forms of mutual cooperation at present and in the future, and evaluation of the benefits of the INTERREG RaRe. Questions related to quality were rated on a Likert scale (Mcleod, 2008). The evaluation was attended by 24 respondents from both workplaces who worked within the project with devices for robotically assisted rehabilitation. Both partners rated the possibility of mutual professional consultation regarding devices and work with patients highly positively: Košice 80% (70%) excellent,

Budapest 85.7% (92.9%) excellent. The most used forms of cooperation were face-to-face and online workshops (Košice 50%, 50%; Budapest 29%, 35%);

3. Comparison of a selected pilot group of patients.

2.2 National Institute of Medical Rehabilitation, Hungary

In our data analysis, we followed the changes in the condition of stroke patients treated between 01.01.2022 and 30.09.2022. Patients whose complex rehabilitation included robot-assisted therapy were included. Their robot-assisted therapy was performed with either Andago or ArmeoSpring. A total of 34 patients were selected, 18 of whom were treated with ArmeoSpring and 16 with Andago. To provide appropriate conclusions, we considered the patient's sex, age, and type of stroke, and we used the results of the arrival and closure FIM, arrival and closure Barthel to quantify their change in condition.

2.3 Department of Physiatry, Balneology, and Medical Rehabilitation, Slovakia

The fundamental difference between the two centres is that the National Institute of Medical Rehabilitation in Hungary has several years of experience working with robotically assisted devices. In contrast, the Department of Physiatry, Balneology, and Medical Rehabilitation in Košice, Slovakia, has not yet worked with robotically assisted devices and acquired the first devices within the project INTERREG, Project ID SKHU/1902/4.1/093. These devices are: Armeo®Spring V2.0, Hocoma AG; OMEGO PLUS, TYROMOTION GmbH; PABLO® system, TYROMOTION GmbH; TYMO® system, TYROMOTION GmbH; Tyrostation, TYROMOTION GmbH. The advantage of this series is that they complement each other functionally, so their selection for a specific patient can be made and suitably combined according to the present functional deficit. We chose patients with stroke treated between 1.7.2022 and 30.11.2022 OMEGO PLUS, TYROMOTION GmbH, for the purposes of this study. A total of 14 patients were selected for purposes of this study, who were treated with OMEGO PLUS. We used the results of the arrival and closure FIM, arrival and closure Barthel, to quantify their change in condition. In the statistical evaluation, we observed the changes in the monitored parameters in the whole group of rehabilitated patients in both centres after robotic-assisted rehabilitation. We carried out statistical processing using statistical software IBM SPSS 26.

3 RESULTS

3.1 Evaluation of the Usefulness of Robotically Assisted Rehabilitation

Our analysis starts with evaluation of usefulness of robotically assisted rehabilitation. We investigated differences between countries using responses to the question for rehabilitation workers using robots: On a scale from 1 to 10 indicate how useful you consider devices for robotically assisted rehabilitation? The results of our study are presented in Figure 1 and Table 1. As can be seen from the figure below the rehabilitation workers from both countries perceived robotically assisted rehabilitation as useful (median score for both countries is 10 and first quartile was 9), and the are no statistically significant differences between responses from different countries at level of significance 5%.

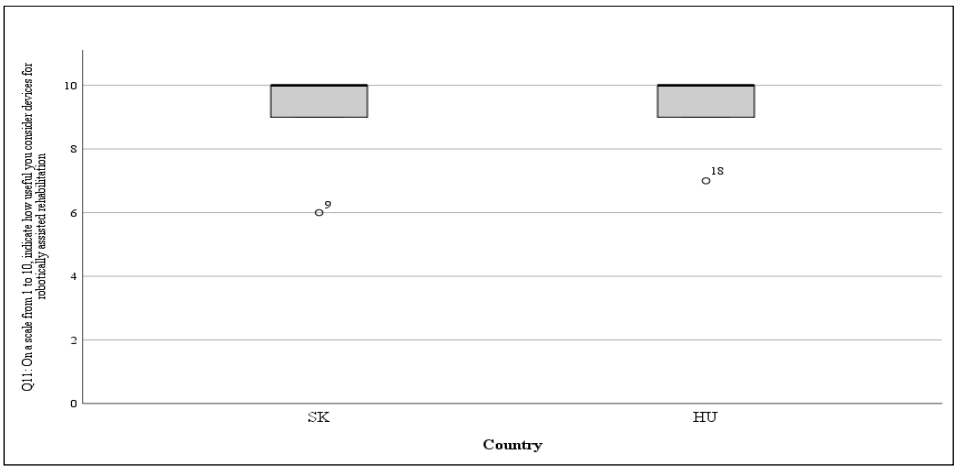

Figure 1 – Usefulness of Robotically Assisted Rehabilitation by Country

Table 1 – Results of Hypothesis Testing Regarding the Perceived Effectiveness of Devices for Robotic-Assisted Rehabilitation Based on Country

Hypothesis Test Summary (Independent-Samples Mann-Whitney U Test)			
	Null Hypothesis	P-value	Decision
A1	The distribution of Q11: On a scale from 1 to 10, indicate how useful you consider devices for robotically assisted rehabilitation is the same across categories of Country.	0.776	Retain the null hypothesis.

3.2 Evaluation the Ease of Use of Devices for Robotic-Assisted Rehabilitation

Secondly, we investigated differences between countries using responses to the question for rehabilitation workers using robots: How easy it is to use devices for robotically assisted rehabilitation? Results are presented in Table 2.

Table 2 – Results of Hypotheses Testing Regarding the Usefulness of Devices for Robotic-Assisted Rehabilitation

Hypothesis Test Summary (Independent-Samples Mann-Whitney U Test)			
	Null Hypothesis	P-value	Decision
B1	The distribution of Q12: How easy it is to use devices for robotically assisted rehabilitation? is the same across categories of Country.	0.119	Retain the null hypothesis.

3.3 Evaluation of the Effectiveness of Robotic Therapy to Achieve Therapeutic Goals Depending on the Country as Well as Experience in Working with Robotic Devices

This part of our research, analysed how experience influences the answers to the question: How effective do you think the robot-assisted device was in achieving treatment goals? Question have been asked in both countries separately for workers who have been directly involved in working with robotic-assisted rehabilitation devices and separately for workers who have never worked with robotic-assisted rehabilitation devices. We test whether there are differences in the perceived effectiveness of robotic therapy to meet therapeutic goals based on country and the experience (see Figure 2 and Table 3).

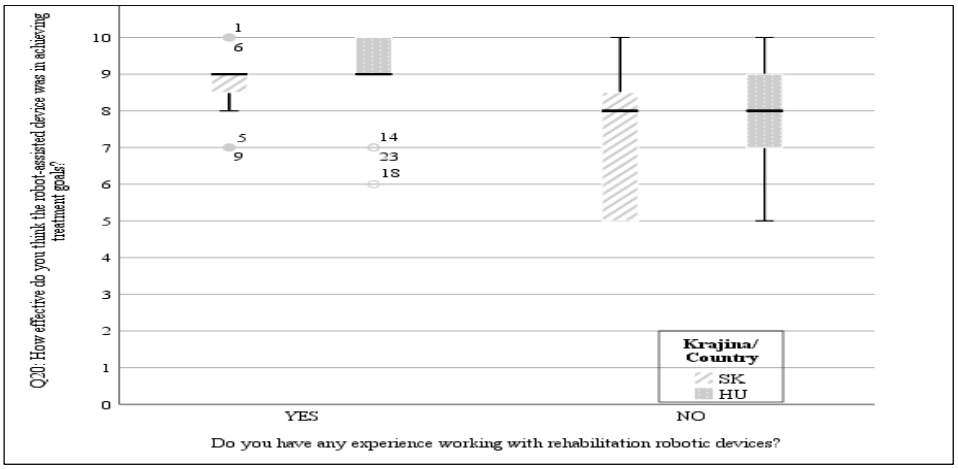

Figure 2 – Effectiveness of the Treatment Based on Experience

As can be seen in Box-plot analysis and validated by hypothesis testing, no statistically significant differences (at $\alpha = 5\%$) between countries were found. (Table 3). On the on the other hand there are statistically significant differences (at $\alpha = 5\%$) between those who already have experience in robotic treatment and those who do not. The graph (Figure 2) shows that rehabilitation workers who do not have experience in treatment perceive the expected impacts with a lower efficiency of 10% compared to those who already have experience.

Table 3 – Results of Hypothesis Testing Regarding the Perceived Effectiveness of Devices for Robotic-Assisted Rehabilitation Based on Country

Hypothesis Test Summary (Independent-Samples Mann-Whitney U Test)			
	Null Hypothesis	P-value	Decision
C1	The distribution of Q20: How effective do you think the robot-assisted device was in achieving treatment goals? is the same across categories of Country.	0.209	Retain the null hypothesis.
C2	The distribution of Q20: How effective do you think the robot-assisted device was in achieving treatment goals? is the same across categories of Do you have any experience working with rehabilitation robotic devices?	0.008	Reject the null hypothesis.

3.4 Evaluation of the Usefulness of the Feedback Function in Robotically Assisted Rehabilitation

The next part of the research tries to determine whether experience have impact of perceived helpfulness of feedback provided by robot-assisted device. A group of rehabilitation workers who were directly involved in working with devices for robotically assisted rehabilitation and a group of workers who had never worked with devices for robotically assisted rehabilitation, were asked the same question and we measure difference in answers. The question was: On a scale of 1 to 10, how helpful do you think it is for a robot-assisted device to provide feedback on a patient's changing condition? Feedback is an information during the performed movement through the sensory system. This information may be corrective in nature (correction of movement technique) or have evaluation character, describing results during movement. The results can be found at Figure 3 and Table 4.

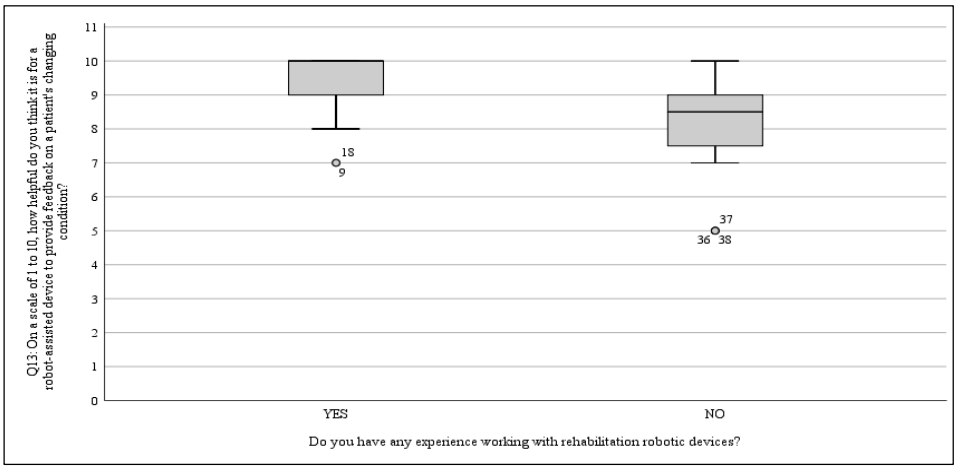

Figure 3 –Perceived Helpfulness Feedback Based on Experience

Table 4 – Results of Hypothesis Testing Regarding the Helpfulness of Feedback from Devices for Robotic-Assisted Rehabilitation Based on Experience

Hypothesis Test Summary (Independent-Samples Mann-Whitney U Test)			
	Null Hypothesis	P-value	Decision
D1	The distribution of Q13: On a scale of 1 to 10, how helpful do you think it is for a robot-assisted device to provide feedback on a patient's changing condition? is the same across categories of Do you have any experience working with rehabilitation robotic devices?	0.001	Reject the null hypothesis.

The Box-plot analysis showed, and hypothesis testing confirmed that at significance level 5%, statistically significant difference of perceived helpfulness of feedback has been found between rehabilitation workers who have experience with robotically assisted rehabilitation and those rehabilitation workers who do not have this experience.

3.5 Evaluation of the Effectiveness of Robotically Assisted Rehabilitation at Different Degrees of Disability Depending on the Experience of Rehabilitation Workers with Robotic Devices

Further, we compared how perception of effectiveness robotic-assisted rehabilitation based on severity of the stroke changes based on experience of workers. As can be seen on Figure 4, regardless of experience, the majority workers perceive that most effective use of robotic devices is in the treatment of moderate stroke. However, the main difference between experienced and non-experienced workers is that non experienced worked cannot even perceive that robotic devices can be mostly effective in treatment of patients with severe strokes, whereas not unsignificant percentage of experienced workers sees that it is the treatment of sever strokes where robotic devices are most effective.

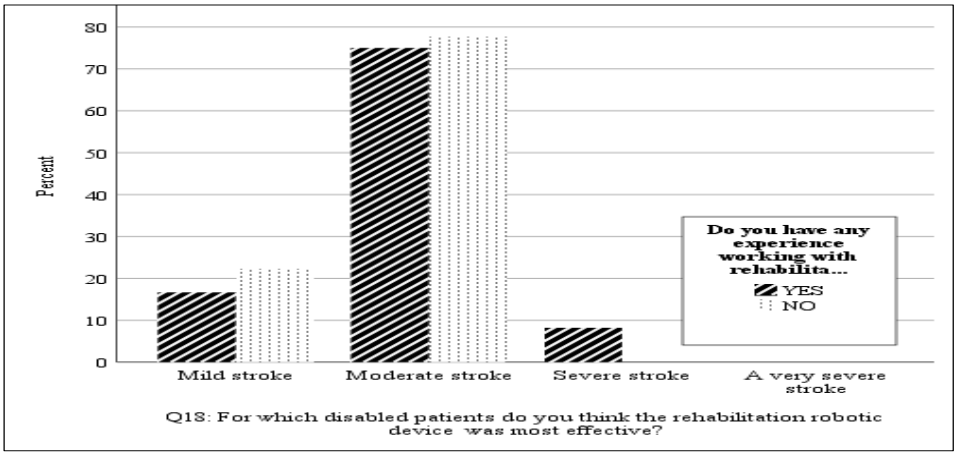

Figure 4 – Comparison of Perceived Effectiveness of Robotically Assisted Rehabilitation Based on Type of Disability and Experience of the Respondent

3.6 Evaluation of the Degree of Effectiveness of Robotically Assisted Rehabilitation in Achieving Treatment Goals at Different Degrees of Disability

Similar to previous research cases, we investigated how perceived effectiveness of achievements of treatment goals changes based on severity of the stroke (see Figure 5).

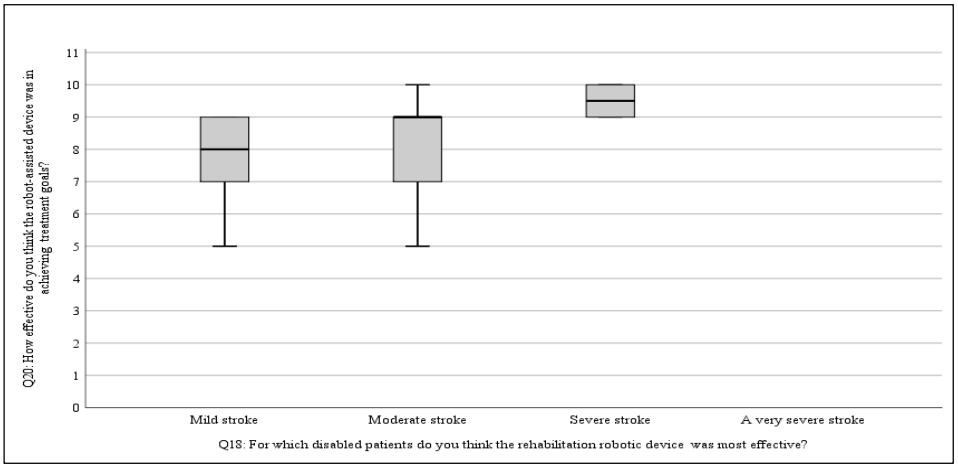

Figure 5 – Comparison of Effectiveness of Robotically Assisted Rehabilitation to Achieve Treatment Goals Based on Type of Disability

As can be seen on box-plot analysis, the median score increases with severity of strokes.

3.7 Assessment of the Impact of Robotically Assisted Rehabilitation on the Functional Status of Patients

To assess the functional status of patients after stroke (N = 30), we used some of the most used scales to assess the functional status of patients in connection with rehabilitation therapy. These are Functional Independence Measurement (FIM) and Barthel index. The questionnaires were evaluated by rehabilitation workers before (in) and after treatment (out) with robotically assisted rehabilitation. With the help of these questionnaires, rehabilitation medicine routinely measures a patient's ability to perform activities of daily living. The direct correlation between these indices and patients' quality of life has been considerable. The results are presented in Figure 6 and Table 5.

The box-plot analysis showed and tests of hypotheses confirmed statistically significant difference (at significance level 5%) in values of both FIM and Barthel indices, which were collected before and after the treatment with robotically assisted rehabilitation.

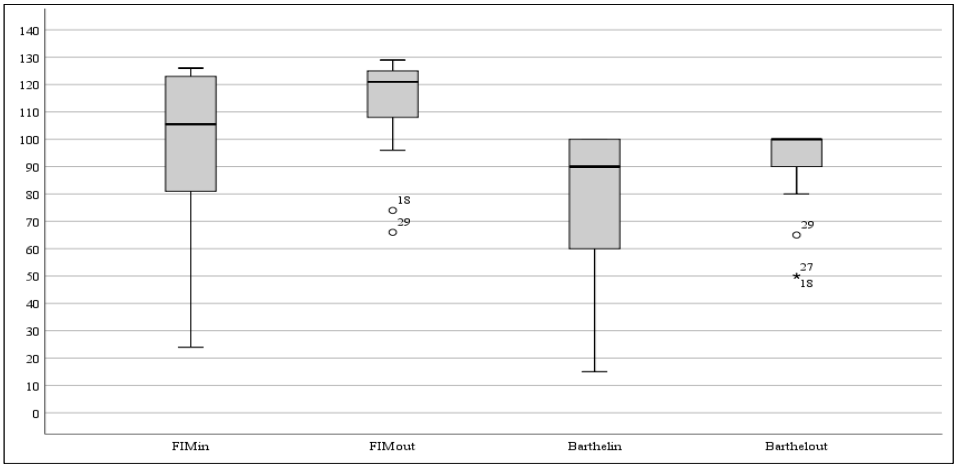

Figure 6 – Evaluation of Functional Indices Before (in) and After (out) Robotic-Assisted Rehabilitation

Table 5 – Results of Hypothesis Testing Differences in Functional Indices Before (in) and After (out) Robotic-Assisted Rehabilitation

Hypothesis Test Summary (Related-Samples Wilcoxon Signed Rank Test)			
	Null Hypothesis	P-value	Decision
F1	The median of differences between FIMin and FIMout equals 0.	0.000	Reject the null hypothesis.
F2	The median of differences between Barthelin and Barthelout equals 0.	0.000	Reject the null hypothesis.

4 DISCUSSION

Globally, stroke is the second leading cause of death and third leading cause of long-term disability (Veerbeek et al., 2017). Approximately two-thirds of stroke survivors have some degree of residual impairment, especially in terms of limitations in everyday activities and mobility. These consequences have increased the demand for quality rehabilitation care. There is substantial evidence that the addition of rehabilitation robots to traditional therapy may improve the recovery of motor deficits and functions in both clinical and home settings (Laut, Porfiri, and Raghavan, 2016; Mehrholz et al., 2020). Despite this, the application of rehabilitation robots during stroke rehabilitation is limited due to the high cost, diversity of clinical settings, and other difficulties (Fong et al., 2022). The studies found that stroke survivors believe the lack of support from qualified personnel, as well as their educational level and expertise, affects the treatment provided; therefore, this can be a barrier to participation in rehabilitation treatment (Tavares et al., 2022). It is essential to understand the perceptions of the rehabilitation workforce, as they play an integral role in providing rehabilitation care

(Fernandes et al., 2022). For the reasons given above, we focused on the evaluation of healthcare professionals' views and experience of using rehabilitation robots, an assessment of the benefit of the project cooperation for clinical practice from the point of view of the workers involved, and a comparison of a selected pilot group of patients. Using questionnaires distributed among the workers of both participating workplaces, we aimed to determine the difference between workplaces in opinions about the effectiveness and usability of working with these devices. Despite the different lengths of experience, we did not find significant differences between the two workplaces, either when asked about the usefulness of the devices for robotically assisted rehabilitation or how easy it is to use these devices. When asked how effectively you consider the use of robotic devices to achieve the therapeutic goal, we did not find statistically significant differences between countries. However, we found a significant difference between the group of workers who used the robotic devices and the workers who never used these robotic devices. Workers who have used rehabilitation devices perceive impacts with a higher efficiency of 10% compared with those who have never used robots. Positive impact of experience with robotically assisted rehabilitation has been confirmed. We also evaluated this result favourably from the point of view of clinical practice, testifying, in our opinion, that working with robotic devices is also motivating for rehabilitation workers, who have positive experiences with it. In the next question, we focused on evaluating the important function of the feedback within the robotic device. Biofeedback is an important source of various kinds of information during the treatment. We compared views on the usefulness of the feedback feature between workers who worked with robotic devices and a group of workers who did not work with robotic devices. Workers working with robotic devices rated the importance of feedback significantly better than those without experience. This result is to be expected, but we consider it significant that workers working with robotic devices can appreciate this function in both workplaces. When determining the effectiveness of robotically assisted rehabilitation at different degrees of post-stroke disability, we did not find any differences between the workplaces in both countries. However, workers with experience in robotic rehabilitation expect a better outcome, even in those with more severe disabilities. A similar interesting finding is that a positive shift in expectations to achieve treatment goals has been observed even in more severe post-stroke conditions. However, these findings would need to be verified using a larger sample size. Using the commonly used FIM and Barthel indices in clinical rehabilitation, we assessed the impact of robotically assisted rehabilitation on the quality of life and found statistically significant improvements in both indices. The advantage of these questionnaires is that in addition to the functional state, a close correlation with the patient's quality of life has been proven (Van Exel, Scholte op Reimer and Koopmanschap, 2004; Fatema, Sigamani and Manuel, 2022). The article is based on the experience of cooperation between two workplaces that have been dealing with the rehabilitation of patients after a stroke for a long time.

5 CONCLUSION

The study showed a positive effect on patients' functional status and quality of life in a selected sample of patients. Among the rehabilitation workers involved, this new technology was perceived highly positively, and the possibility of international cooperation reinforced these attitudes and contributed to motivating workers to improve the quality of their daily work in clinical practice. These results also provide an incentive for further research.

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REFERENCES

Bessler, J., Prange-Lasonder, G.B., Schaake, L., Saenz, J.F., Bidard, C., Fassi, I., Valori, M., Lassen, A.B. and Buurke, J.H., 2021. Safety assessment of rehabilitation robots: a review identifying safety skills and current knowledge gaps. *Frontiers in Robotics and AI*, [e-journal] 8, p.602878. DOI: 10.3389/frobt.2021.602878.

Fatema, Z., Sigamani, A.G.V. and Manuel, D., 2022. 'Quality of life at 90 days after stroke and its correlation to activities of daily living': A prospective cohort study. *Journal of Stroke and Cerebrovascular Diseases*, [e-journal] 31(11), p.106806. DOI: 10.1016/j.jstrokecerebrovasdis.2022.106806.

Fernandes, S., Almeida, A.S., Peças, D., Ferreira, N. and Roldão, L., 2022. Rehabilitation workforce challenges to implement person-centered care. *International Journal of Environmental Research and Public Health*, [e-journal] 19(6), p.3199. DOI: 10.3390/ijerph19063199.

Fong, J., Crocher, V., Klaic, M., Davies, K., Rowse, A., Sutton, E., Tan, Y., Oetomo, D., Brock, K. and Galea, M.P., 2022. Promoting clinical best practice in a user-centred design study of an upper limb rehabilitation robot. *Disability and Rehabilitation: Assistive Technology*, [e-journal] 17(5), pp.531-538. DOI: 10.1080/17483107.2020.1785567.

Laut, J., Porfiri, M. and Raghavan, P., 2016. The Present and Future of Robotic Technology in Rehabilitation. *Current Physical Medicine and Rehabilitation Reports*, [e-journal] 4(4), pp.312-319. DOI: 10.1007/s40141-016-0139-0.

Li, L., Tyson, S. and Weightman, A., 2021. Professionals' views and experiences of using rehabilitation robotics with stroke survivors: a mixed methods survey. *Frontiers in Medical Technology*, [e-journal] 3, p.780090. DOI: 10.3389/fmedt.2021.780090.

Mcleod, S., 2008. Likert scale definition, examples and analysis. Simply Psycgology, [online] Updated 8 March 2023. Available at: <https://www.simplypsychology.org/likert-scale.html> [Accessed 28 March 2023].

Mehrholz, J., Thomas, S., Kugler, J., Pohl, M. and Elsner, B., 2020. Electromechanical-assisted training for walking after stroke. *Cochrane Database of Systematic Reviews*. [online] Available at: <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD006185.pub5/full> [Accessed 28 March 2023].

Tavares, E., Coelho, J., Rogado, P., Correia, R., Castro, C. and Fernandes, J.B., 2022. Barriers to gait training among stroke survivors: an integrative review. *Journal of Functional Morphology and Kinesiology*, [e-journal] 7(4), p.85. DOI: 10.3390/jfmk7040085.

Van Exel, N.J.A., Scholte op Reimer, W.J.M. and Koopmanschap, M.A., 2004. Assessment of post-stroke quality of life in cost-effectiveness studies: The usefulness of the Barthel Index and the EuroQoL-5D. *Quality of Life Research*, [e-journal] 13(2), pp.427-433. DOI: 10.1023/B:QURE.0000018496.02968.50.

Veerbeek, J.M., Langbroek-Amersfoort, A.C., Van Wegen, E.E.H., Meskers, C.G.M. and Kwakkel, G., 2017. Effects of Robot-Assisted Therapy for the Upper Limb After Stroke: A Systematic Review and Meta-analysis. *Neurorehabilitation and Neural Repair,* [e-journal] 31(2), pp.107-121. DOI: 10.1177/1545968316666957.

Wafa, H.A., Wolfe, C.D.A., Emmett, E., Roth, G.A., Johnson, C.O. and Wang, Y., 2020. Burden of stroke in europe: thirty-year projections of incidence, prevalence, deaths, and disability-adjusted life years. *Stroke*, [e-journal] 51(8), pp.2418-2427. DOI: 10.1161/STROKEAHA.120.029606.

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Conceptualization, P.T. and G.F.; Methodology, P.T., G.F., K.S. and A.K.; Validation, P.T., G.F and M.T.; Formal analysis, A.K. and M.T..; Investigation, P.T., S.K., A.K. and G.F.; Resources, P.T.; Data curation, P.T., S.K. and M.T.; Original draft preparation, P.T., G.F. and M.T.; Review and editing, P.T. and M.T; Visualization: M.T.; Project administration, P.T. and G.F.

CONFLICTS OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.