

Postural stability and risk of falls in patients with acquired brain injury during home-based coordinated rehabilitation program in Czech Republic

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## Abstract

The number of people with acquired brain injury has been increasing over the last two decades, this can be explained by the higher levels of acute medical care and a faster and more hazardous pace of life. The consequences of a brain injury depend on the specific functional damage, which can be manifested as an increased risk of falls. The aim of this study was to determine the effect of a 9-month, home-based coordinated rehabilitation program on postural stability and risk of falls in 17 clients with acquired brain injury. Standardized functional stability tests (the Four Step Square Test and the Berg Balance Scale) were used to make an objective assessment of the program. The results indicated positive effect for 9-month coordinated rehabilitation program, relative to postural stability and the risk of falls in persons with acquired brain injury. A coordinated rehabilitation team, consisting principally of a physiotherapist and ergotherapist, should cooperate on the selection of functional tests suitable to test postural stability and the risk of falls. Provided neurorehabilitation care should be more structured and mutual cooperation with general practitioners should be intensified. From a long-term perspective and to prevent secondary changes (immobility), we consider the motivation of the home environment to be an important advantage of our study, when it is used the reality and variability of the home environment and the clients feel more secured.

*Keywords:* acquired brain injury, postural stability, risk of falls, FSST, BBS

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Acquired brain injury (ABI) is a brain injury or trauma most commonly caused by a cerebrovascular event, trauma, inflammatory brain disease, tumor, hypoxia, or neurotoxic disorders (McIntyre et al., 2015; Giustini et al., 2013; Powell, 2010; Janečková, 2011); additionally, the term can be used for any non-degenerative injury to the brain (García-Hernández et al., 2013). The number of people with ABIs has been increasing over the last two decades, which can be explained by improvements in acute ABI health care and at the same time by a faster and more hazardous way of life (Powell, 2010). Sixty-nine million individuals worldwide are estimated to sustain a TBI each year (Dewan et al., 2018). Worldwide, cerebrovascular events are the second leading cause of death and the third leading cause of disability (Global Health Estimates, World Health Organization, 2018).

According to the Institute of Health Information and Statistics of the Czech Republic (IHIS), in terms morbidity, the most common reason for hospitalization in the Czech Republic are circulatory system diseases, which also include cerebrovascular diseases (Hospitalizování v nemocnicích ČR 2015, 2016). The IHIS also reported, that 18,441 hospitalizations occurred in Jihočeský kraj (South Bohemian Region) in 2015, and nationwide in 2015, 29,769 patients were hospitalized for intracranial injury and 51,432 patients were hospitalized for cerebrovascular disease (Hospitalizování v nemocnicích ČR 2015, 2016). Fatal outcomes were most common for cerebrovascular disease hospitalizations, occurring in 10% of cases (Hospitalizování v nemocnicích ČR 2015, 2016).

The consequences of a brain injury depend on the extent, form, and combination of specific functional damage. Limitations due to an ABI often include balance disorders (Lippertová-Grünerová, 2015). Postural stability is a complex set of functional motor skills that

are related to the processes of postural control, which from the functional point of view, are described with respect to activities of daily living such as walking, handling objects, standing up from a chair, putting objects away, reaching, etc. (Bizovská et al., 2017). The purpose of postural control is to adapt body posture to the intended task and thus to ensure postural stability, or in other words, to achieve a level of security to prevent a fall (Bizovská et al., 2017). Disorders of balance, movement coordination, and cognitive functions in persons with ABI may manifest as an increased risk of falls and negatively impact gait (Vařeka, 2002). Concerns about falling can have mental consequences such as anxiety, depression, and lack of self-efficacy that may include self-imposed limitations on social activities, which can reduce the quality of life. The clients' quality of life is directly dependent on prompt initiation of neurorehabilitation, provided continuously from the onset of the disease, in the form of inpatient and later outpatient rehabilitation, up to social, family, and occupational reintegration (Lippertová-Grünerová, 2015). A postural stability disorder is seen in 83% of patients with an acute cerebrovascular event (Tyson et al., 2006). The risk of falls, during the first 6 months after a cerebrovascular event, is 40-73% (Cho et al., 2015; Weerdesteyn et al., 2008). In the chronic phase of the disease, postural stability often impacts the quality of life through lost mobility skills and self-sufficiency (Schmid et al., 2013). As such, rehabilitation of postural functions seems to be decisive for achieving independence in common daily activities (Hugues et al., 2017).

The standards of acute care of ABI patients are very high in the Czech Republic, a nationwide network of 32 medical ictus centers (IC) and 13 larger complex cerebrovascular centers (CCC) exists, providing complex diagnostic and therapeutic care to patients with cerebrovascular events (Cerebrovaskulární péče v ČR, Věstník MZ ČR, 2015). But most ABI patients are transferred from acute care departments to (1) long-term care institutions, which are

not primarily designed for rehabilitation of these patients, or (2) home care (Cerebrum, 2010). In the home settings, usually only nursing care is provided, not structured neurorehabilitation. This is precisely where the problem of limited availability of coordinated rehabilitation occurs. Long-term specialized neurorehabilitation care depends on the region. There is one rehabilitation day care center, several outpatient spasticity centers, repeated rehabilitation stays in hospitals, spa rehabilitation stays, convalescent homes. However, the availability of this care is limited and is often searched by the patient and his family. Care in the Czech Republic is covered by compulsory health insurance and approved by an auditing doctor. At your own expense, it is possible to undergo physiotherapy in several institutions. The aim of this study is to determine the effects of a 3-month physiotherapy program provided in a home setting by a coordinated rehabilitation team, on postural stability and the risk of falls in clients with ABI.

## **Methods**

### **Study population**

The study population included 17 patients, two with traumatic brain injury and 15 with stroke, living at home in the South Bohemian Region of the Czech Republic (Table 1). The basic criterion for the selection of clients with non-inflammatory brain damage was defined as follows: (1) preservation of the communication skills needed for a guided interview based on the Functional Independence Measure questionnaire (The FIM Instrument: Its Background, Structure, and Usefulness, 2014) and WHO Disability Assessment Schedule 2.0 (WHO Disability Assessment Schedule 2.0 (WHODAS 2.0), World Health Organization, 2018), including additional questions related to physiotherapy and social work and the ability to complete informed consent, (2) cooperation of the client and his/her family, and (3) a consideration the

need for frequent travel to the client's home/family, as such only clients living within 30 km of České Budějovice were included.

After discharge from hospital inpatient brain injury rehabilitation to home care, each client was followed for 9 months. The clients were visited by the coordinated rehabilitation team at home, with one physiotherapist, one ergotherapist, and two social workers visiting each family. A 3-month intensive physiotherapeutic intervention was provided to each client, emphasizing coordinated rehabilitation and cooperation with the social worker and ergotherapist.

Individual physiotherapy, 30–60 minutes based on the actual abilities of the client, was undertaken twice weekly. The physiotherapy was adapted to the home setting, was individualized to focus on the most significant problems and was conducted to meet specific functional aims (e.g., grasp a cup, walk up and down stairs, overcome a curb, etc.). Specific neurophysiological concepts were used (i.e., elements of the Bobath concept, Dynamic Neuromuscular Stabilization, and Proprioceptive Neuromuscular Facilitation). Other methods included soft tissue techniques, anti-edema techniques, Kinesio taping, balance training, locomotor training, sensory-motor training, conditioning training, and cognitive physiotherapy.

Ergotherapy and social work were provided individually based on the client's needs. The ergotherapist detected partial function deficits and self-care in the daily activities, recommended compensatory aids and adjustment to the apartment. The social worker coordinated a multidisciplinary team, mapped the social situation, provided information support (social security benefits), mediated contact with the social environment, assisted in asserting rights, legitimate interests, handling personal matters, and provided social activating activities.

Each client was followed for 9 months, including follow-up visits of the coordinated rehabilitation team 3 and 6 months after completion of the physiotherapeutic intervention, data

were collected from October 2016 to December 2018. The research was approved by the Ethics Committee of Faculty of Health and Social Sciences at University of South Bohemia in České Budějovice for the implementation of the research.

### **Measurement methods**

Standardized functional tests were used to assess the client's functional status – the Four Square Step Test (FSST) (Dite & Temple, 2002), the Berg Balance Scale (BBS) (Berg et al., 1992), and the FIM instrument (FIM) (The FIM Instrument: Its Background, Structure, and Usefulness, 2014). All measurements for each of the functional tests were done for each client – the baseline measures at home as soon as possible after discharge (identified as FSST 0, BBS 0, FIM 0), after the 3-month intervention by the coordinated rehabilitation team in the home setting (FSST 3, BBS 3, FIM 3) and at the follow-up measurements after 3 (FSST 6, BBS 6) and 6 (FSST 9, BBS 9) months after completing the intervention, or respectively, 6 and 9 months from the baseline.

These tests were chosen because they provided an objective evaluation of the physiotherapy program, including an assessment of static postural stability, risk of falls, dynamic balance, and the cognitive components of postural control. These tests are easy to complete, are not demanding in terms of time and space, require no special aids, and their evaluation is simple; additionally, they require no special adaptation for use in the home setting.

The purpose of FSST is to assess the ability to maintain balance when quickly stepping into four squares made of four sticks laid on the floor (Figure 1) (Dite & Temple, 2002). In order to adapt the FSST test to the home setting, two cords, 1 cm thick, were used instead of sticks, and they were laid on the floor in the form of a cross. After the practice run, the time needed to complete the entire sequence was measured, and the best (fastest) of the two trials were recorded.

The test was not assessed if the patient did not complete the sequence with success, touched a line, or lost balance. Best times in excess of 15 seconds were evaluated as a predictor of risk of falls (Dite & Temple, 2002). An inability to complete the test was also viewed as a risk factor of falls (Blennerhassett & Jayalath, 2008).

The BBS is used to assess balance and the risk of falls especially in patients after a cerebrovascular event (Berg et al., 1995). Balance is assessed using 14 tasks that require the engagement of various components of postural control – sitting down, standing up from a sitting position and vice versa, movement between chairs, standing, standing with eyes closed, standing with feet together, standing with one foot in front, standing on one foot, turning to look behind, retrieving an object from the floor, turning 360 degrees, stepping onto a stool, reaching forward in the standing position (Berg et al., 1992). Every item is scored from 0 to 4. The maximum score is 56 points; 41–56 indicates a low risk of falls, 21–40 indicates moderate risk, and 0–20 indicates a high risk.

The FIM instrument (version 5.2) (The FIM Instrument: Its Background, Structure, and Usefulness, 2014) was used for client enrollment in the study; this test was done by the ergotherapist at the baseline (FIM 0) and after the 3-month intervention by the coordinated rehabilitation team (FIM 3). This instrument captures essential ADL (Activities of Daily Living) abilities and uses a 7-point scale for quantification (1 = full assistance to 7 = full self-sufficiency) and includes a precisely defined manual for the assignment of individual levels of functional disability; a basic set of tests are used to assess 18 activities in 6 categories (personal care, continence, transfers, locomotion, communication, and social aspects) (The FIM Instrument: Its Background, Structure, and Usefulness, 2014). The FIM is one of the essential standardized tests for assessing patient self-sufficiency and is used as an internationally recognized assessment of

the degree of disability, changes in the course of rehabilitation, and therapy effectiveness (The FIM Instrument: Its Background, Structure, and Usefulness, 2014).

## **Results**

Testing was conducted with 17 clients (Table 2); of these, one client (CL 10) deceased during the research period and the follow-up measurements, i.e., at 6 and 9 months from baseline, are missing for this client; the patient's other data points were included in the study. Missing data points indicated that cooperation with the client ended prematurely, most often due to the client or their family moving outside the covered region.

### **Client distribution according to FIM values (Table 3)**

At the baseline, only 3 clients had the FIM score higher than 6, i.e., CL 2, CL 6, and CL 15 who managed common daily activities with confidence and without the assistance of another person; however, a cognitive function deficit, psychomotor retardation, quickly becoming tired during mental exertion and a high level of anxiety were seen in CL 2. CL 15 also exhibited psychomotor retardation. Four clients with a baseline (FIM 0) score below 5 required all-day assistance by at least one person and were not able to successfully complete the FSST test. They included the following clients: CL 1 who had a slightly unstable standing position, the gait was also unstable, and was possible only with the assistance of another person or while holding onto furniture; the client was able to use a four-wheel walking frame. Client CL 4 was only able to stand with support, i.e., holding onto a handrail or something similar, the sitting position was unstable. The client walked, with little assistance at home, using a four-wheel walking frame and used a mechanical wheelchair to move outside the home; the condition of this client was complicated by

dyspnea. Client CL 14 was unable to stand up without assistance and mobility required a using a high walking frame and help from two assistants. Client CL 21 was only able to sit in a mechanical wheelchair and needed help from two assistants for other mobility tasks.

#### **Client distribution according to BBS scores (Table 4)**

At the baseline (BBS 0), 8 clients had a score of 20 or less; this was the group with the highest risk of falls. These clients included all clients with the baseline FIM value below 5 (CL 1, CL 4, CL 14, and CL 21), see above, and clients CL 3 and CL 11, who had unstable gaits and required the assistance of another person or needed to hold onto furniture, client CL 12 had an unstable, wide-based gait and needed to use one French crutch, and client CL 20 was only able to walk inside, using a four-wheel walking frame. After the 3-month intervention, an improvement of BBS 3 values was seen in all 16 clients; client CL 21 remained immobile with a 0 score on both measurements. Testing after 6 months (BBS 6) further improved in 8 clients, by an average of 5.3 points. BBS 6 values were unchanged in four clients: CL 2 with the maximum score. Client CL 4 was moved to a nursing home, and self-reported during follow-up evaluation, “I became somewhat lazy – they prepare everything for me and help me with everything, I don’t have to take care of myself;” the client attended group physiotherapy but did not receive the same level of individualized care as in our study program. Client CL 14 reported feeling very tired after a recent viral infection, with elevated temperature; this client complained that after the infection it was harder to practice walking using the walking frame. Client CL 21 also had no change in BBS 6 values; they remained mobile only with a mechanical wheelchair despite having completed spa treatment; the spa treatment was complicated by a broken right ankle while at the spa. BBS 6 values worsened, on average, by 2.5 points in four clients: client CL 13 completed a 4-week stay

at a rehabilitation institute, however, was disappointed by the lack of progress. During this time the client moved to a barrier-free flat and was coping with serious personal problems, which was reflected in their psychological condition. Clients CL 17 and CL 20 started using their arms again to stand up from a sitting position. Client CL 19 completed a spa treatment although she sustained a minor wrist injury, she had an epileptic seizure too, and her condition slightly worsened; however, she was able to walk without an aid inside and with assistance or with a French crutch outside.

#### **Client distribution based on the FSST (Table 5)**

The baseline FSST (FSST 0) could not be performed under standard conditions in three clients; however, the clients were mobile with an aid (CL 4 used a four-wheel walking frame and CL 10 and CL 12 used one French crutch). The test was experimentally performed, with the use of the aid, in these clients. Four clients needed more than 15 seconds to complete the test at baseline, and thus they were classified as being at high risk of falls. Client CL 11 see above. Client CL 13 had a wide-based unstable gait and walked with a shuffling gait; inside the home, the client was able to move without support for a short time, and outside, the client was able to walk about 1 km using a four-point cane; the client was able to get over uneven surfaces only with an assistant; this client also experienced a cognitive deficit, especially of short-term memory. Client CL 18 had a slightly unstable standing position as well as an unstable gait, they could move independently, but suffered from a cognitive deficit, psychomotor retardation, and worsened short-term memory. Client CL 19 had a wide-based standing position to reduce the load on the left leg associated with neglect syndrome of the left-sided limbs while walking; the client was able to walk with assistance or with a French crutch inside but was fearful of walking outside.

After the 3-month physiotherapeutic intervention, 11 clients were mobile without an aid; these clients completed the FSST 3 in less than 15 seconds, i.e., none of them were evaluated as being at risk of falls.

The risk of falls was still present in two clients during the FSST 6 follow-up testing. Client CL 19, see above, and client CL 1, who had not been able to complete the FSST 0 at all, and the FSST 3 was complete using a four-wheel walking frame; the FSST 6 was completed under standard conditions without any aid, although they exceeded the time limit. Nonetheless, improvement was clearly apparent.

At the time of the FSST 9 follow-up testing (i.e., after 9 months), the number of people in the group at risk of falls had increased to four. They included: CL 1; however, this client had improved their FSST 9 time compared to FSST 6, see above. Client CL 12 had achieved a considerable improvement on FSST 6 based on the positive effects of their spa treatment, but the FSST 9 time had worsened by 4 s. Client CL 17 had sustained a fall while on stairs and suffered from a fear of falling when walking.

The development of FSST measurements in the course of the 9 months is summarized in Tables 6 and 7.

After the 3-month, in-home, physiotherapeutic intervention, the clients had no other interventions from the coordinated rehabilitation team; however, eight patients did have privately arranged individual rehabilitation care: CL 2 – outpatient physiotherapy; CL 3 – rehospitalization at hospital rehabilitation department; CL 11 – convalescent homes; CL 12 – spa treatment; CL 13 – rehabilitation institute; CL 14 – visited at home by a physiotherapist; CL 18 – outpatient physiotherapy; CL 21 – spa treatment.

The measurement results of FSST 6 indicate the positive impact of follow-up rehabilitation in five persons – CL 2, CL 3, CL 11, CL 12, and CL 13 (Table 8, Figure 2). Improvement was apparent from the FIM values in two clients CL 14 and CL 21, who were still unable to complete the FSST. Of the eight clients who did not have subsequent rehabilitation between month 3 and month 6, FSST values worsened in five – CL 4, CL 7, CL 15, CL 17, and CL 19 (Figure 3). The condition of CL 18 worsened despite outpatient physiotherapeutic care. The client reported being in a depressed mood due to hip joint pain. The client's psychological condition worsened, there was a decline in ADL activities and assigned tasks, less frequent dog walks, and the client stopped cooking at home. For two other clients, there was an improvement even though they received no further rehabilitation care: CL 1 trained on a regular basis, but the improvement was based mainly on their improved psychological condition. Initially, the client was resigned and dejected, however, at the follow-up visits he was much more communicative, calm, and contented. Client CL 6 trained on a regular basis alone and reported feeling that they had made significant improvement. Client CL 20, also without further rehabilitation, showed improvement in FIM values, although unable to complete FSST testing.

### **Discussion**

When comparing clients according to the FIM assessment at the baseline, it was shown that those with ABI and FIM less than 5 could not complete the FSST under standard conditions. According to our research the FIM testing appears to be a useful instrument for physiotherapists when deciding what functional tests should be used to test postural stability and the risk of falls. The study results indicate that the FSST is not advisable for persons with an FIM less than 5 points. Given that FIM testing is commonly performed by ergotherapists and not

physiotherapists, the study results provide an important recommendation for practice that would apply to other countries, i.e., the use of a coordinated rehabilitation team with both a physiotherapist and an ergotherapist.

Considering our assessment of the effect of a 3-month, in-home, physiotherapy program, we observed similar trends over time and score point quantifiers based on our evaluation of FSST and BBS measurements. BBS scores increased over time with the gradual improvement of balance skills from baseline through the last measurements, taken at 9 months; this test did not reveal any worsening of postural functions after completion of the physiotherapeutic intervention. Although BBS is the most widely used measure of balance, due to the wide spectrum of stability, its use may not always assess all components of postural control (Pollock et al., 2011). FSST measurements improved (decreased) for all clients after the 3-month physiotherapy program, a slight worsening of postural functions was seen during the period that followed the intervention, especially in clients who did not undergo additional individual rehabilitation care. A follow-up assessment provides more relevant information about the duration of the intervention effects (Geraldo et al., 2018). The FSST seems to be more sensitive with respect to the termination of rehabilitation in these clients. The effect of the clients' psychological condition on postural function development was also observed; e.g., the condition of one demotivated and depressed client worsened despite having completed subsequent outpatient physiotherapeutic care, while two positive and motivated clients improved their postural stability even without any subsequent rehabilitation. These findings support the hypothesis of Sumec et al. (2015) that balance and mental well-being are interconnected and should not be overlooked (Sumec et al., 2015).

FSST combines tasks that are demanding from the motor and cognitive point of view (Dite & Temple, 2002). It was verified in this study when clients with independent mobility, but

with cognitive deficits, psychomotor retardation, or short-term memory problems had difficulties completing the FSST.

A study by Roos et al. (2016) recommends the modified FSST for patients after a cerebrovascular event; instead of using sticks laid on the floor, tape was applied to the floor to form the four square pattern. In our study, instead of sticks or tape, we used two cords 1 cm thick and laid out to form a cross. If the patient made contact with the cord during the test, the test was not assessed. According to Langford (2015), it is very difficult to successfully complete the standard test while using a walking frame. Three of our clients completed the modified FSST measurements while using a walking aid, i.e., either a four-wheel walking frame or a French crutch. Three other clients were unable to complete the FSST while using a walking aid. Therefore, the effectiveness of their therapy was assessed based on kinesiology analysis and the FIM.

Reduce concerns about falling through walking rehabilitation includes non-negligible psychological motivation for the patient and an improved sense of self-sufficiency, communication and can result in a substantial enhancement in the quality of life, including the resumption of social activities and the possibility of occupational reintegration (Burget, 2015). One of the components of quality of life is also the process of satisfying human needs. The two main needs are the need to return to the life that client lived before the brain damage and if he or she is prevented from doing so by some factors influencing the satisfaction of this need, the client is forced to turn his attention to the need to find a new system of activities – i.e. a different way of activities, functioning, doing things, so that the client can re-integrate as effectively as possible into social, family or working life. Because as Matoušek (2013) states, people with disabilities do not just want to be regretted and served, even in the best institutions and hospitals,

they want to live a normal personal and family life in their apartment, in the company of their loved ones, have a job and decide for yourself how they will spend their time.

Our clients specifically express this need with the need to return to normal daily activities and active lifestyle, the need to return to the home environment, but also to the work process. "To achieve what was before, to play the guitar again, I played in a band, but now the hand is holding me back" (CL 12). "But I think when I feel better about it, it will come again. That I will enjoy solving crossword puzzles" (CL 9). "Go to work. I used to work on an excavator for about 20 years, I would like to drive an excavator again (CL 13). "To walk 3-4 kilometers, we have already received a schedule from the club of tourists, with whom we often went out. At the end of September we go to Blaník mountain. This is my dream, I would like to see it" (CL 3).

### **Study limitations**

The absence of a control group, for ethical reasons when the control group would not receive any care, is one of the limitations of this study. Additionally, the functional improvement of clients may have been associated with spontaneous recovery. Furthermore, this research was an intervention study, and organizations providing services of this magnitude do not exist in the Czech Republic. To compare the data, studies are not so comprehensively focused on a multidisciplinary team at home care using the same methodology. Due to the scope of the research, it was not possible to publish content with ergotherapy and social work in one study. The design of this study is focused on the physiotherapy part of the research. Given the qualitative type of research and the small number of patients (compared to extraordinary care), the presented results cannot be generalized, and we recommend performing further studies using larger groups of patients.

### Conclusions

Results indicate a substantial positive impact for the 3-month, in-home, physiotherapy program relative to postural stability and the risk of falls in persons with ABI.

Based on BBS measurements and the assessment of the risk of falls, improvement was achieved in 15 out of 17 clients after the 3-month physiotherapeutic intervention, none of the clients worsened, and the number of clients with at high risk of falls decreased from 8 to 3 clients.

According to FSST measurements, the 3-month physiotherapeutic intervention resulted in an improvement in 15 out of 17 clients, and none of the clients worsened. All 11 clients who were mobile without a walking aid managed to complete FSST in less than 15 seconds, i.e., they were not classified as at risk of falls. Three clients using mobility aids and 3 clients unable to complete the tests remained at risk of falls according to the FSST.

The FSST seems to be a more sensitive test compared to the BBS in assessing postural function and the cognitive component of postural control, especially after physiotherapy.

As shown by the FIM assessments, those with ABI and FIM assessments below 5 points were unable to complete the FSST under standard conditions. Given that FIM testing is commonly performed by ergotherapists and not physiotherapists, the study results provide an important recommendation for practice that would apply to other countries, i.e., the use of a coordinated rehabilitation team with both a physiotherapist and an ergotherapist. A coordinated rehabilitation team should cooperate on the selection of functional tests suitable to test postural stability and the risk of falls.

From a long-term perspective, it is important to think about the prevention of secondary changes (immobility). Provided neurorehabilitation care should be more structured - focused on

walking, fitness, risk of falls and contractures, etc. We also recommend increasing the awareness of general practitioners about the possibilities of subsequent neurorehabilitation care and intensifying mutual cooperation. General practitioners are often first physicians that interact with the client after discharge to the home setting, and they are responsible for subsequent medical supervision.

Improving postural stability, reducing the risk of falls and returning to the home environment leads to meeting needs and improving the quality of life. The home environment can be defined as an environment in which we perform mainly daily self-service activities (Macháčová et al., 2014). Chiatti and Iwarsson (2014) consider the home environment as the main determinant of health, quality of life and overall well-being. The home environment is also a reflection of individual values and is associated with the identity of the individual.

Reducing concerns about falling and satisfying the need to return to the life that client lived before, or find a new system of activities, through coordinated rehabilitation includes non-negligible psychological motivation for the patient, so that the client can re-integrate as effectively as possible into social, family or working life.

We consider the motivation of the home environment to be an important advantage of our study, when we used the reality and variability of the home environment and the clients felt more secured. The involvement of family members was also very advantageous, because based on education from a physiotherapist, they were able to participate in therapy at a time when the physiotherapist was not present.

Proposed future – implementation of coordinated rehabilitation into executive power with regard to political decision and setting conditions for realization of physiotherapy in home care,

including financial security, as a means of preventing further injury and maintenance of gains established in the acute-care settings.

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## Tables

Table 1

Essential characteristics of clients in the research set

Client	Year of birth	Age	Sex	Diagnosis	Clinical presentation	Relationship status	Employment status
CL 1	1941	77	M	iCVE	l.dx.	married	pensioner
CL 2	1966	52	F	iCVE	l.sin.	married	orderly
CL 3	1947	71	F	iCVE	l.sin.	married	pensioner
CL 4	1946	72	M	iCVE	l.sin.	married	pensioner
CL 6	1940	78	F	iCVE	l dx.	widowed	pensioner
CL 7	1936	82	F	iCVE	l sin.	married	pensioner
CL 10	1948	70	M	iCVE	l.dx.	married	electrician
CL 11	1944	74	F	iCVE	l.sin.	married	pensioner
CL 12	1970	48	M	hCVE	l sin.	single	invalidity pensioner
CL 13	1976	42	M	craniotrauma	l.sin.	divorced	machinist
CL 14	1960	58	M	iCVE	l.sin.	married	policeman
CL 15	1955	63	M	iCVE	l.dx.	divorced	self-employed
CL 17	1941	77	F	iCVE	l.sin.	married	pensioner
CL 18	1983	35	M	polytrauma	l.sin.	cohabitation	technician
CL 19	1949	69	F	iCVE	l.sin.	married	pensioner
CL 20	1932	86	M	iCV	l.sin.	married	pensioner
CL 21	1976	42	F	hCVE	tetraplegic	married	radiologic assistant

*Note:* F: female; M: male; hCVE: hemorrhagic cerebrovascular event; iCVE: ischemic cerebrovascular event

Table 2

Measurement results for standardized functional tests of stability in clients with ABI

Client	Age	Sex	FIM 0	FIM 3	FSST 0	FSST 3	FSST 6	FSST 9	BBS 0	BBS 3	BBS 6	BBS 9	RHB 3-6	Note
CL 1	77	M	4.39	4.78	unable	30.6 WF	29.2	27.6	14	39	43	46	no	
CL 2	52	F	6.27	6.72	10	9.5	7.5	8	56	56	56	56	yes	
CL 3	71	F	5.83	5.89	14.5	10.4	10.3	10.2	20	36	47	48	yes	
CL 4	72	M	3.28	5.61	26.0 WF	26.0 WF	29.0 WF	35.0 WF	6	10	10	10	no	
CL 6	78	F	6.39	6.94	14.7	11.1	10.6	10.7	48	52	56	56	no	
CL 7	82	F	5.5	6.11	11.8	8.1	10.1	10.4	48	52	53	53	no	
CL 10	70	M	5.61	6.33	15.8 FC	12.7	†	†	23	51	†	†	x	
CL 11	74	F	5.94	6.83	16.1	11.7	10.4	11.1	10	40	47	47	yes	
CL 12	48	M	5.83	6.5	16.5 FC	14.1 FC	13.4	17.4	13	32	41	41	yes	
CL 13	42	M	5.56	6.5	42	14.7	14.3	13.5	35	42	40	45	yes	
CL 14	58	M	3.67	3.94	unable	unable	unable	unable	0	5	5	7	yes	HWF
CL 15	63	M	6.33	6.89	12.5	7.1	11	12.6	45	53	54	55	no	
CL 17	77	F	5.11	6.17	14.9	11.3	13.7	16.3	31	40	39	39	no	
CL 18	35	M	5	6.44	20	11	14	13	50	56	56	56	yes	
CL 19	69	F	5.72	6.44	30.3	12.4	16.2	16.2	29	52	47	47	no	
CL 20	86	M	5.22	5.5	unable	unable	unable	unable	13	24	22	22	no	WF
CL 21	42	F	1.44	2.17	unable	unable	unable	unable	0	0	0	0	yes	IM

*Note:* FIM 0, BBS 0, FSST 0: FIM, FSST and BBS at baseline; FIM 3, FSST 3, BBS 3: FIM, FSST and BBS after the 3-month intervention by the coordinated rehabilitation team; FSST 6, BBS 6: FSST and BBS 6 months from the baseline; FSST 9, BBS 9: FSST and BBS 9 months from the baseline; RHB 3–6: individually arranged physiotherapy between months 3 and 6 of follow-up; WF: four-wheel walking frame; FC: 1 French crutch; HWF: high walking frame; IM: immobile.

Table 3

Client distribution according to FIM values

FIM Values	N for FIM 0	N for FIM 3
Under 5	4	3
Between 5 and 6	10	3
Over 6	3	11

*Note:* N: number of clients; FIM 0: FIM at baseline; FIM 3: FIM after the 3-month intervention by the coordinated rehabilitation team.

Table 4

Client distribution and the risk of falls based on the BBS

BBS points	Risk of falling	N for BBS 0	N for BBS 3	N for BBS 6	N for BBS 9
0–20	High	8	3	3	3
21–40	Moderate	4	6	3	2
41–56	Low	5	8	10	11

Note: N: number of clients; BBS 0: BBS at baseline; BBS 3: BBS after the 3-month intervention by the coordinated rehabilitation team; BBS 6: BBS 6 months from the baseline; BBS 9: BBS 9 months from the baseline

Table 5

Client distribution and completion of the FSST

FSST results	N for FSST 0	N for FSST 3	N for FSST 6	N for FSST 9
Unable to complete the test	4	3	3	3
Complete with aide	3	3	1	1
Over 15 Seconds (High risk of falling)	4	0	2	4

*Note:* N: number of clients; FSST 0: FSST at baseline; FSST 3: FSST after the 3-month intervention by the coordinated rehabilitation team; FSST 6: FSST 6 months from the baseline; FSST 9: FSST 9 months from the baseline

Table 6

Development of FSST measurements according to the number of clients

FSST times	N for FSST 0–3	N for FSST 3–6	N for FSST 6–9
Improved	13	7	4
Worsened	0	6	8
Unchanged	1 + 3x incomplete	3x incomplete	1 + 3x incomplete

*Note:* N: number of clients; FSST 0-3: from baseline to month 3; FSST 3-6: from month 3 to month 6; FSST 6-9: from month 6 to month 9.

Table 7

Development of FSST measurements according to the time change in seconds

FSST changes	FSST times	N for FSST 0–3	N for FSST 3–6	N for FSST 6–9
Improved	0–5 s	8	7	4
	5.1–10 s	2	0	0
	>10 s	3	0	0
Worsened	0–5 s	0	6	7
	5.1–10 s	0	0	1
	>10 s	0	0	0
Unchanged		1 + 3x incomplete	3x incomplete	1 + 3x incomplete

*Note:* N: number of clients; FSST 0-3: from baseline to month 3; FSST 3-6: from month 3 to month 6; FSST 6-9: from month 6 to month 9.

Table 8eth

Evaluation of the period between month 3 and month 6 after the physiotherapeutic intervention based on subsequent rehabilitation

FSST times	RHB	N for FSST 3–6
Improvement	Yes	7
	No	3
Worsened	Yes	1
	No	5

*Note:* N: number of clients; RHB: individually arranged physiotherapy between month 3 and month 6 of follow-up.



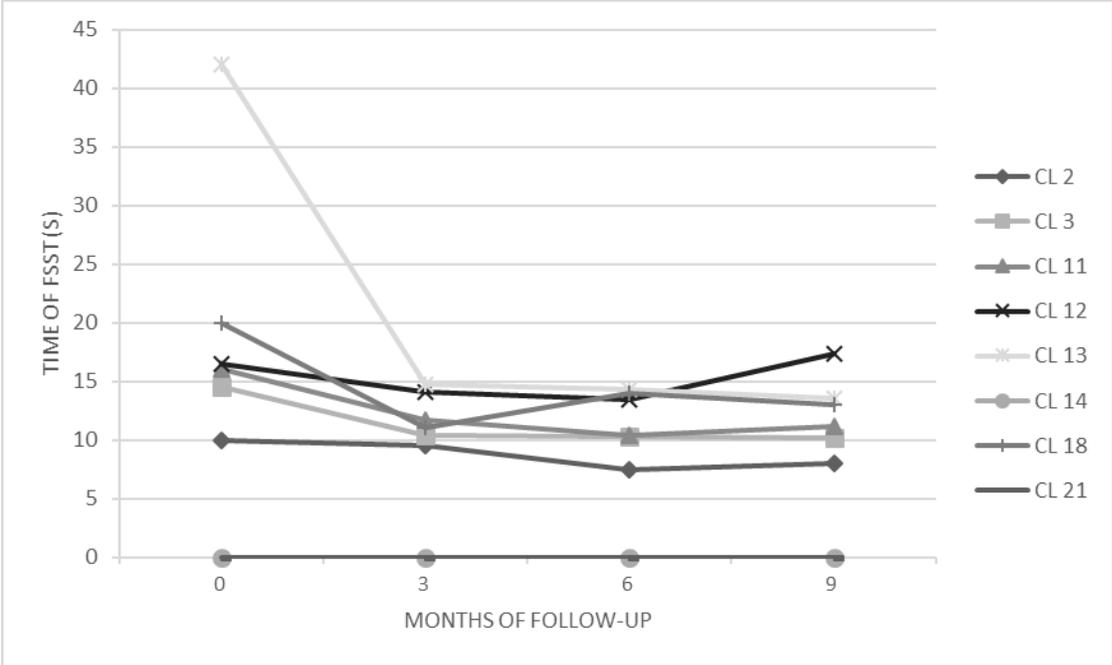


Figure 2. FSST development in clients who had individually arranged rehabilitation care between month 3 and month 6.

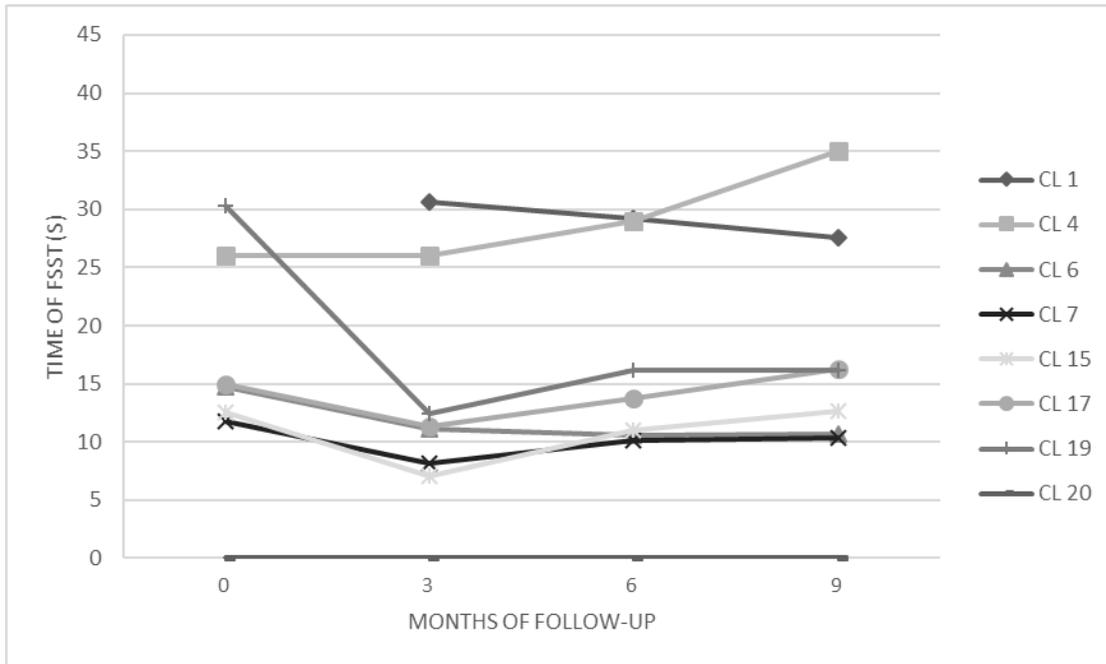


Figure 3. FSST development in clients who had no individually arranged rehabilitation care between month 3 and month 6.