

## THE EFFECT OF THERAPEUTIC ACTIVITIES WITH DOLPHINS FOR BALANCE, GAIT AND QUALITY OF LIFE IN PATIENTS AFTER HEMORRHAGIC STROKE: CASE ANALYSIS

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**Key words:** hemorrhagic stroke, balance, gait, quality of life, dolphin assisted therapy.

### Summary

The aim of this research was to assess the effect of dolphin assisted specialized aquatic program applied in rehabilitation of psychomotor functions of persons after hemorrhagic stroke. The research was carried out in 2018 in Lithuania. Two persons with diagnosed hemorrhagic stroke have been surveyed. In the course of the investigation, the effect of aquatic dolphin assisted physical activities on coordination of arms, legs without using balance was assessed; static and dynamic change of dynamics, the effect on gait in water with dolphins were assessed. Additionally, the data on life quality aspects obtained by the SF-36 questionnaire was investigated. It is observed that after application of aquatic dolphin assisted therapeutic activities improvement of both static and dynamic balance has been recorded; three weeks later, most indicators remained the same. The conducted research revealed that therapy had a highly beneficial effect on persons with neurological diseases in terms of assessment of their dynamic balance, gait and gait speed (motor skills) as well as quality of life. Significant changes of motor skills in water in both surveyed individuals have been recorded. Therapeutic aquatic dolphin assisted activities are an effective method to improve the parameters of balance, gait and quality of life in patients; however, psycho-emotional and psycho-social factors, such as support of the social network supplementing continuing therapeutic activities, are a highly significant factor in ensuring further improvement of patient's condition.

### Introduction

The stroke is one the most relevant current problems (medical, economic and social). Majority of patients who experienced the stroke have a disability, they need continuous treatment and care. This disease can cause palsy, memory, speech, swallowing disorders, pain, altered behavior of the patient and loss of the skills of self-service and maintenance. These disorders lead to a more settled way of life and are an opportunity to cause side complications [1].

Morbidity with the stroke depends on environment, social, cultural, economic and genetic factors [2]. Each year, some 1 million people become ill with the stroke in Europe [3, 4]. Each year, more than 22,524 new cases of cerebrovascular diseases are registered in Lithuania [5].

In some 90 per cent of patients the stroke causes disordered balance. Balance disorders are one of major factors limiting daily activities of people. The conducted scientific research studies [6, 1] show that management of dynamic balance in patients after the stroke is affected by the changes of muscle tone, disordered senses, reduced amplitude of movements of joints and disordered control of the body position, i.e. the mechanism of pre-preparation for changing one's body position. Balance disorders increase the risk of falling down in patients after the stroke. The return to a full-fledged social life for a person after the stroke is limited with disordered balance, increased fear to fall down, reduced mobility, depression, fast fatigue and used compensatory measures [6, 1]. Gait also performs an important role in person's daily activities and affects bio-social functions of person's activities which make the biggest effect on the quality of life. Scientific research studies demonstrate that the gait speed is the most important measure in analysis of person's gait [7, 6]. It is an efficient indicator of qualitative functional condition and gait disorder which is measured

when assessing person's condition and efficiency of treatment (recovery). The main goal of therapeutic activities is development of balance and return of the function of gait in a person after the stroke [7]. After conducting various investigations, it has been found out that after the stroke the function of gait recovers in 60–80 per cent of patients; nevertheless, only 7 per cent of them can walk a distance of 500 meters at a speed 1.0 m/s [8].

The Center of Dolphin Assisted Therapy at Lithuanian Sea Museum provides services in compliance with the Hygiene Norm HN 133:2013 [9]. In Lithuania, dolphin assisted therapy is included into the package of complementary alternative medical methods [10] and is being implemented in compliance with three directions of the effect: psycho-emotional, sensory and motor [9]. Since 2001 being implemented in Lithuania, dolphin assisted therapy has been extensively investigated because of its impact on the social network [11–13], internal coherence [14], psycho-emotional change [15–17], psycho-social aspects [18], wellbeing [13], its long-term effect [17, 18] and other parameters have been measured [1, 2, 5, 7, 10, 11]. All these scientific research studies were focused on investigation of children with disability and the effect of the immediate environment. Whereas the change of parameters of balance, gait and quality of life in post-stroke adults who participate in the dolphin assisted rehabilitation program has never been investigated neither in Lithuania nor abroad, since the authors of this article found none of such research studies conducted.

**The aim of the research** is to assess the effect of the specialized aquatic dolphin assisted program applied in rehabilitation of psychomotor functions of individuals after the hemorrhagic stroke.

**Research hypothesis:** By applying the aquatic dolphin assisted therapeutic program, motor functions and assessment of the quality of life will improve in patients after the hemorrhagic stroke.

## Materials and Methods

### *Participants and procedure*

The surveyed sample consisted of two persons who were diagnosed with the hemorrhagic stroke. The criteria for selection of the surveyed:

- Six months after the experienced hemorrhagic stroke;
- aged 50–55 years;
- having no adjacent diseases;
- having not experienced the repeated stroke;
- Barthel index is 50–65 points;
- 6CIT (six item cognitive impairment test) does not exceed 10 points.

*The first surveyed* is a man at the age of 52. He is dia-

gnosed with intracerebral hemorrhage on the right-side hemisphere, left-side hemiplegia of the body. The investigation commenced six months after the beginning of the disease. The man can independently stand, though walks with assistance, dynamic balance, coordination, gait are disordered. He consciously communicates, understands and implements the orders. He has left-side hemiparesis, speech is mildly disordered. Barthel index is 65 points, 6CIT is 3 points.

*The second surveyed* is a woman at the age of 54. The female surveyed is diagnosed with intracerebral contusion on the right hemisphere, sub-cortex, deep intracerebral bleeding, left-side hemiplegia. The investigation commenced six months after the beginning of the disease. The woman can independently stand, though walks with assistance. She is conscious, understanding, implementing the orders. The surveyed person has left-side hemiparesis, speech is mildly disordered. Barthel index is 55 points, 6CIT is 2 points.

Two persons who met the selection criteria signed the “Personal Informed Consent Form” and were acquainted with the process of the conducted research presented to the Bioethics Commission of the Rehabilitation Department of Klaipėda University (permission No. 46SV-RK-5), the researchers have signed a contract with the Center of Dolphin Assisted Therapy, Lithuanian Sea Museum concerning the implementation of the research.

The investigation lasted for two weeks. The surveyed patients attended aquatic dolphin assisted therapeutic activities. The procedures took place for 30 minutes in the morning once per day, five times per week (10 activities in total). The activities were held with dolphins in special therapeutic pools, at depth from 20 cm to 170 cm. The procedures would last for 30 minutes for each surveyed person individually. Aquatic dolphin assisted therapeutic activities were arranged with regard to the ability of the patients to walk, stand and change a position. Both surveyed patients performed static and dynamic exercises on balance and coordination in water. The activities would involve the surveyed patient, a dolphin trainer and a physical therapist.

The assessment was carried out three times: before the activities, after 10 activities and in a distant time period (three weeks after the activities ended).

### *Tests*

- o Coordination test not requiring balance.
- o Berg balance test [19].
- o Dynamic gait index (DGI) [20]
- o Rubricelle test [21]. Rubricelles are used to assess surveyed patients' motor skills in water. *This test has been taken during the first and tenth activities.*

### *Questionnaire-based survey*

- o SF-36, the Short Form 36 Medical Outcomes Study

Questionnaire.

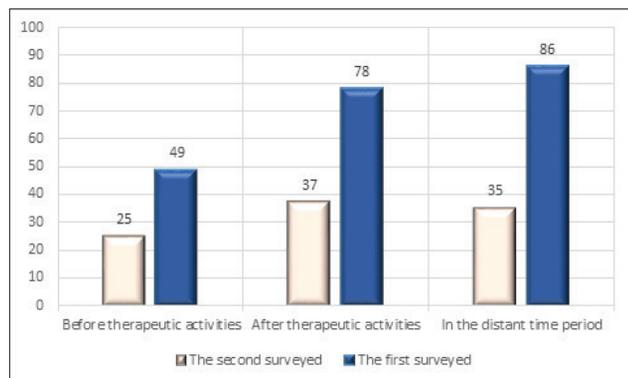
#### Data analysis

Statistical analysis was undertaken using the IBM SPSS version 32.0. The following characteristics were calculated: median, mean and standard deviation of the sample. To test the statistical hypotheses, the significance level of 0.05 ( $p < 0.05$ ) was chosen.

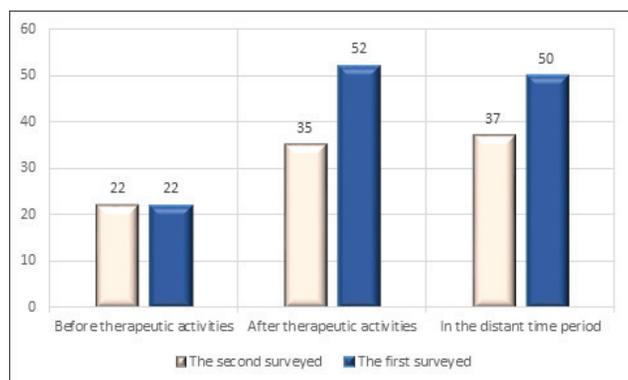
### Results and Discussion

The test of coordination not requiring balance demonstrated quite significant differences between the two surveyed persons ( $p < 0.05$ ) (Fig. 1). The investigation found out that coordination of movements of the woman (the second surveyed patient) while attending the therapeutic activities improved; however, after some time period the intervention the results worsened again. The results of the first surveyed person improved gradually not only during the activities, but also significant positive changes are observed after some time period past the intervention (see Fig. 1).

Significant changes have been found in static and dynamic balance of the surveyed patients (Fig. 2) when applying



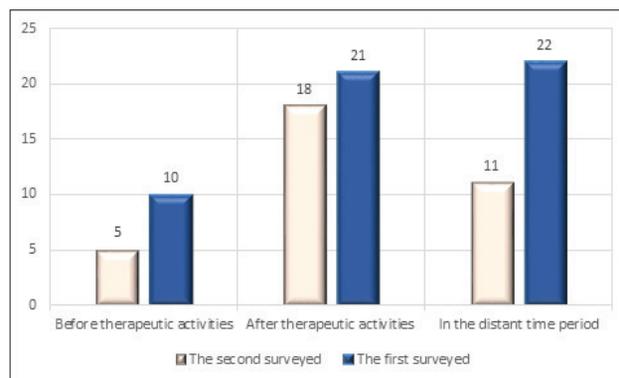
**Fig. 1.** Results of the coordination test not requiring balance, by points.



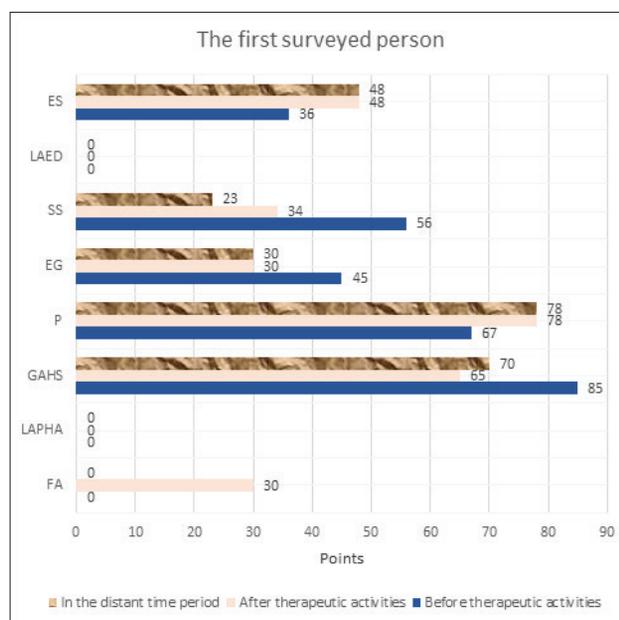
**Fig. 2.** Results of Berg balance test, by points.

aquatic dolphin assisted therapeutic activities: there was statistically significant improvement in both surveyed patients ( $p < 0.05$ ). However, three weeks after the activities, such significant changes have not been found.

The gait of the surveyed persons being assessed according to the dynamic gait index (DGI) has been statistically significantly changing throughout the activities (Fig. 3). When assessing in the distant time period after the intervention, the index in the case of the first surveyed remained stable, whereas the index of the second surveyed significantly de-



**Fig. 3.** Results of assessment of the dynamic gait index (DGI), by points.



**Fig. 4.** Results of the first surveyed person in the quality of life (SF-36) questionnaire, by points.

Note: FA - physical activity; LAPHA - limitation of activities caused by physical ailment; GAHS - general assessment of the health status; P - pain; EG - energy/vitality; SS - social sphere; LAED - limitations of activities caused by emotional disorders; ES - emotional status

**Table 1.** Results of the assessment of motor skills while standing on both legs in water, by rubricelles.

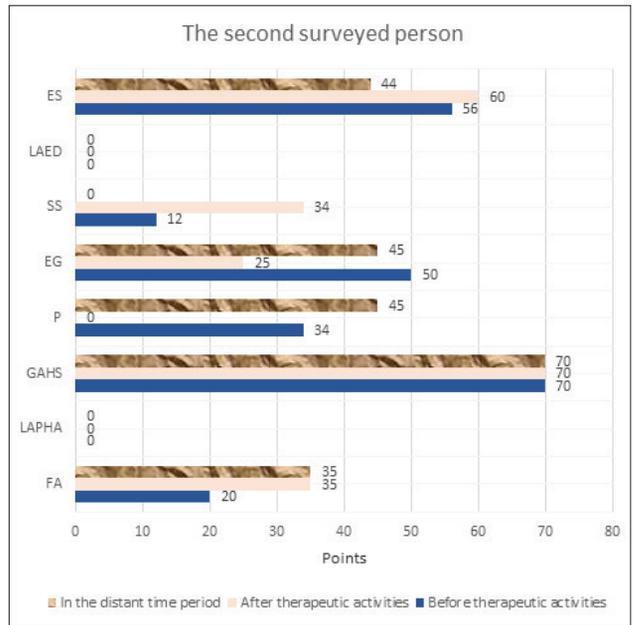
Note: assessment by points: 1 - can stand up, but keeps standing when someone is helping, holding at coxae; 2 - can stand up, but does not remain in the position; 3 - can remain standing for 10 seconds; 4 - can remain standing for 30 seconds; 5 - can remain standing for 30 seconds in whirling water.

|   | During the first activity |                 | During the tenth activity |                 |
|---|---------------------------|-----------------|---------------------------|-----------------|
|   | Surve-<br>yed 1           | Surve-<br>yed 2 | Surve-<br>yed 1           | Surve-<br>yed 2 |
| Can stand while holding onto the pool wall with both hands              | 3                         | 4               | 5                         | 5               |
| Can stand while holding onto the pool wall with one hand                | 2                         | 3               | 5                         | 5               |
| Can stand while holding onto both hands of a therapist                  | 2                         | 4               | 5                         | 5               |
| Can stand while holding onto one hand of a therapist                    | 2                         | 3               | 5                         | 5               |
| Can stand while holding onto a dolphin with both hands                  | 2                         | 2               | 5                         | 5               |
| Can stand while holding onto a dolphin with one hand                    | 1                         | 1               | 5                         | 5               |
| Can stand while moving one's arms and elbows under the water            | 1                         | 1               | 5                         | 5               |
| Can stand while holding folded arms on one's chest                      | 1                         | 1               | 4                         | 4               |
| Can stand while holding folded arms on one's chest with the eyes closed | 1                         | 1               | 5                         | 5               |

**Table 2.** Results of the assessment of motor skills while standing on the affected leg in water, by rubricelles

Note:  
Assessment by points: 1 - can stand up, but keeps standing when someone is helping, holding at coxae; 2 - can stand up, but does not remain in the position; 3 - can remain standing for 10 seconds; 4 - can remain standing for 30 seconds; 5 - can remain standing for 30 seconds in whirling water.

|   | During the first activity |                 | During the tenth activity |                 |
|---|---------------------------|-----------------|---------------------------|-----------------|
|   | Surve-<br>yed 1           | Surve-<br>yed 2 | Surve-<br>yed 1           | Surve-<br>yed 2 |
| Can stand while holding onto the pool wall with both hands              | 1                         | 1               | 4                         | 3               |
| Can stand while holding onto the pool wall with one hand                | 1                         | 1               | 4                         | 3               |
| Can stand while holding onto both hands of a therapist                  | 1                         | 1               | 4                         | 3               |
| Can stand while holding onto one hand of a therapist                    | 1                         | 1               | 4                         | 3               |
| Can stand while holding onto a dolphin with both hands                  | 1                         | 1               | 4                         | 3               |
| Can stand while holding onto a dolphin with one hand                    | 1                         | 1               | 4                         | 3               |
| Can stand while moving one's arms and elbows under the water            | 1                         | 1               | 3                         | 2               |
| Can stand while holding folded arms on one's chest                      | 1                         | 1               | 3                         | 2               |
| Can stand while holding folded arms on one's chest with the eyes closed | 1                         | 1               | 4                         | 1               |



**Fig. 5.** Results of the second surveyed person in the quality of life (SF-36) questionnaire, by points.

Note: FA - physical activity; LAPHA - limitation of activities caused by physical ailment; GAHS - general assessment of the health status; P - pain; EG - energy/vitality; SS - social sphere; LAED - limitations of activities caused by emotional disorders; ES - emotional status.

creased, even returned to the primary level.

Rubicelles used to assess motor skills in water, i.e. the ability to keep balance while standing on both legs and the ability to keep balance while standing on the affected leg, are presented in Tables 1–2.

It had been found out that both surveyed patients could stand on both legs in water while holding onto a therapist before the dolphin assisted therapeutic activities started (Table 1), and stood on the affected leg only when held at coxae (Table 2). After 10 aquatic dolphin assisted therapeutic activities, the second surveyed would remain standing for 30 seconds in the whirling water, holding onto the pool wall with her both hands, with her one hand, holding both hands of a therapist, one hand of a therapist; could keep the position while holding onto a dolphin with both hands and one hand. After the aquatic dolphin assisted therapeutic activities, the male patient (the first surveyed person) remained in the position for 30 seconds in the whirling water, holding onto pool wall with one hand, holding onto a dolphin with one hand, moving arms and elbows under the water, holding folded arms on his chest.

After ten activities, the second surveyed person could remain standing on her left leg (Table 2) for 10 seconds while holding onto a dolphin with one hand and performing

other movements; and the first surveyed person already could perform all these movements while standing on the affected leg for more than 30 seconds. The results of general assessment of motor skills and ability of the surveyed patients to keep balance in water show significant changes after the intervention.

Having analyzed the results of the quality of life SF-36 questionnaire (Fig. 4 and 5), it was found out that both surveyed assessed life quality parameters after aquatic dolphin assisted therapeutic activities better than three weeks later.

In general, both surveyed persons in all evaluating moments (before/after therapeutic activities and in distant time period) evaluated most positively general health status, least positively – limitations of activities caused by emotional disorders.

### Discussion

Two persons participated in the investigation: a woman and a man, who both were diagnosed with the hemorrhagic stroke. Aiming to recover gait, balance, quality of life in the patients after the hemorrhagic stroke, aquatic dolphin assisted therapeutic activities have been applied. All procedures have been carried out with regard to the abilities of the patients. Efficiency of aquatic dolphin assisted therapeutic activities is shown by the change of the results of the taken tests.

The improvement of static and dynamic balance of the surveyed is observed after applying dolphin assisted therapeutic activities; however, three weeks later, almost all indicators remained the same. A similar investigation was conducted by Katey Duffy and other researchers who applied remedial aquatic exercises after the stroke aiming to improve balance, muscle power, to reduce the tone of muscles [22]. Investigations conducted by Kim Kyoung et al. aimed at improvement of balance and gait by applying double tasks in water for those who experienced the stroke [23]. The assessment involved the same tests, i.e. the dynamic gait index (DGI) and others. The results of the research demonstrate improvement of all indicators, like in our investigation case.

After conducting the investigation, obvious changes in both patients' motor skills in water are observed. A. R. Marinho-Buzelli and other researchers carried out the investigation and provided the results demonstrating a positive effect of aquatic therapy on movement functions in persons ill with neurological diseases [24]. The conducted research pointed out that aquatic therapy had a highly beneficial effect on persons with neurological diseases when assessing dynamic balance, gait and gait speed (motor skills). Similar research studies have been carried out by Luciola Vasile et al. with children having neurological illnesses, too; the researchers assessed motor skills and coordination when applying aquatic

therapy [25]. Their research results demonstrate positive changes in balance and coordination of children. After analysis of our research results, significant changes are observed in movement coordination, balance, gait, and this allows stating that the current investigation not only involved aquatic activities but also dolphin assisted therapy, which rendered the surveyed patients a positive psycho-emotional condition that influenced the entire psycho-motor performance. After conducting the research, positive results are observed in assessment of the life quality, too. Kent W. Myers and other researchers present the results of the aquatic therapy applied to persons ill with Alzheimer's disease carried out in compliance with Halwick methods [26]. The research has proven that aquatic therapy allows achieving better results when seeking to improve balance disorders and the quality of life.

Many research studies have been carried involving children with the autism disorder in Lithuania and abroad. Namely majority of the research works have been conducted at the Center of Dolphin Assisted Therapy of Lithuanian Sea Museum, while analyzing reaction of children with the autism disorder to dolphin assisted therapy seeking to improve the quality of life and other aspects. Results of the conducted research allow us assume that dolphin assisted therapy improves person's independence, integration into society, forms self-confidence, helps to better focus attention and makes them even calmer; the psychomotor functions improve as well [12-15, 18]. This research reveals that aquatic dolphin assisted therapeutic activities can be successfully applied to persons after the hemorrhagic stroke; however, when aiming at better outcomes, likely, continuous therapeutic activities or continuity of dolphin assisted activities are necessary.

### Conclusions

The dolphin assisted therapeutic program is organized at Lithuanian Sea Museum with regard to person's bio-psycho-social needs. Since both surveyed individuals were asked to fill in a free-form feedback questionnaires after the therapeutic program ended, it can be stated that psychomotor and social aspects are closely interrelated. The feedback form filled in by the woman mentioned disappointment for the "program ended so quickly" and "I will have to continue staying dependent on my husband"; a significantly decreased social network and depression developed after the disease, which, as the woman thinks, "will manifest again after the therapeutic activities ended" are mentioned. This is perfectly illustrated by assessment of the quality of life as well: the surveyed woman assesses two parameters, i.e. social sphere and vitality/ energy, most negatively. Whereas the man's feedback form includes the reverse aspects: he has it that "dolphin assisted activities inspired him to change himself,

improve the condition”, “to put endeavors to improve own motor condition”, “I’ve discovered the desire to live again”, “I’d got the belief that I was needed to someone”.

The research results demonstrate an obviously positive effect of aquatic dolphin assisted therapeutic activities. The results of both individuals who participated in the investigation were different in particular areas; nevertheless, after ten therapeutic activities, changes in the assessment criteria of gait, balance, coordination and motor skills in water were quite positively significant. However, when analyzing obtained research results, we found out that the assessment results at the distant time period, i.e. three weeks after completing therapeutic activities, worsened again in the second surveyed female person, whereas in the first surveyed male person’s case the results gradually improved. These differences of the results of the surveyed persons allow stating that, if seeking that the applied intervention would make a long-term positive effect, it is necessary to regard the primary results of the research and to appropriately extend the time period of the intervention.

This first investigation of adults has some limitations related to its sample; nevertheless, it is especially important in construction of further investigations because of the assessment of motivation and motor achievements and the correlation of psycho-emotional/ psycho-social and motor factors.

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**TERAPINIŲ UŽSIĖMIMŲ SU DELFINAIS POVEIKIS  
 PACIENTŲ, PATYRUSIŲ HEMORAGINIŲ GALVOS  
 SMEGENŲ INSULTĄ, PUSIAUSVYRAI, EISENAI IR  
 GYVENIMO KOKYBEI: ATVEJO ANALIZĖ**

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Raktažodžiai: hemoraginis smegenų insultas, pusiausvyra, eisena, gyvenimo kokybė, terapiniai užsiėmimai su delfiniais.

**Santrauka**

Šio tyrimo tikslas buvo įvertinti terapinių užsiėmimų su delfiniais poveikį paciento po hemoraginio smegenų insulto psichomotorines funkcijas. Tyrimas buvo atliktas Lietuvoje, 2018 metais. Buvo surinkti dviejų pacientų po hemoraginio smegenų insulto duomenys. Tyrimo metu buvo analizuojamas terapinių užsiėmimų su delfiniais poveikis šių pacientų rankų, kojų koordinacijai, statinei ir dinaminei pusiausvyrai, eisenai ir pažeistos kojos raumenų jėgai. Papildomai buvo renkami duomenys prieš ir po terapinių užsiėmimų su delfiniais apie pacientų gyvenimo kokybę, naudota SF-39 gyvenimo kokybės klausimynas. Dviejų atvejų analizė atskleidė, jog terapiniai užsiėmimai su delfiniais pagerino pacientų statinę ir dinaminę pusiausvyrą. o praėjus trims savaitėms po terapinių užsiėmimų su delfiniais šis rezultatas išliko nepakitęs. Šių dviejų pacientų duomenų analizė parodė, jog terapiniai užsiėmimai su delfiniais turi ženklų poveikį žmonių su neurologinėmis ligomis eisenai, eisenos greičiui (motoriniai įgūdžiai), pažeistos kojos raumenų jėgai bei gyvenimo kokybei. Tyrimo metu išmatuoti ženklūs, statistiškai reikšmingi pokyčiai po terapinių užsiėmimų su delfiniais šių pacientų motoriniams įgūdžiams vandenyje. Tyrimas yra ribotas savo imtimi, tačiau ši pirmoji mokslinė studija parodė, kad terapiniai užsiėmimai su delfiniais sėkmingai gali būti taikomi pacientams, patyrusiems hemoraginį galvos smegenų insultą, siekiant pagerinti jų pusiausvyrą, eisena ir gyvenimo kokybę, tačiau psichoemociniai ir psichosocialiniai faktoriai, kaip socialinio tinklo pagalbos ir paramos teikimas po terapinių užsiėmimų yra kritinis, siekiant tolesnės paciento psichofizinės būklės gerėjimo.

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