

Integrated music therapy in patients with acquired brain injury (ABI) with predominant cognitive impairment

An exploratory pilot study of interdisciplinary neurorehabilitation care in the Day Hospital of the Department of Rehabilitation Medicine of the 1st Faculty of Medicine at Charles University in Prague

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Abstract

Background and purpose: The Department of Rehabilitation Medicine at the 1st Faculty of Medicine, Charles University, and the General University Hospital in Prague have had a 20-year experience running an intensive rehabilitation program for patients after ABI. Until 2020, however, there had been no intensive rehabilitation program for the population of patients with minimum or no motor deficit who at the same time suffer from a major cognitive deficit. In October 2020 a special program for these patients was started.

The program is scheduled for four weeks, daily 8:30 a.m. to 3:30 p.m., and it includes individual and group therapies (consisting of 4 patients). Music therapy is a part of this intensive rehabilitation program together with neuropsychology, occupational therapy, special education, art therapy and physiotherapy (involving dual-task training).

The applied multidisciplinary approach to the therapy relies on the interconnection of individual specializations. The aim of this article is to describe the constituting elements of this approach used at the Department of Rehabilitation.

Type of study: Explorative pilot study.

Methods and process: Initial and final examinations are carried out before starting and after finishing the program with standardized test batteries used for every specialization. By comparing values in individual sub-tests (immediate and delayed memory, visuospatial, speech and executive functions, attention, depressivity) it is possible to give evidence of specific improvements in those areas.

All patients underwent psychological assessment within two weeks before and after completion of the daily cognitive rehabilitation program. Cognitive performance was evaluated with Short Neuropsychological Battery (SNB). This is a repeatable battery for the evaluation of the following cognitive domains: memory (immediate recall, delayed recall, and recognition), attention, executive functions, language, and visuospatial functions. All 17 subtests of SNB were administered and cognitive profile was set. Non-verbal problem solving and spatial reasoning ability were measured with Matrix Reasoning, a subtest of Wechsler Adults Intelligence Scale-III. Moreover, the 60-item Boston Naming Test was administered for the evaluation of confrontational word retrieval in patients with aphasia. Depressive symptoms were evaluated using Beck Depression Inventory-II. The State-Trait Anxiety Inventory was used to measure state (part X-1) and trait (part X-2) anxiety symptoms. Subjective complaints on cognitive performance were evaluated using Cognitive Difficulties Scale, responses were obtained from the patient and his/her relative.

Ten patients (7 women and 3 men) aged 26–78 years (median value of 46 years) with acquired brain injury completed the program. Originally, twelve patients started the program, but two of them fell ill. Out of these ten patients, five of them had experienced ischemic stroke, three of them in dominant left hemisphere, two with a multifocal stroke. Three patients suffered a severe cranial trauma, two within a multiple trauma. Two patients had hypoxic ischemic diffuse lesion after cardiopulmonary resuscitation in cardiac arrest due to massive pulmonary embolism. The time from the incident to starting the program ranges from 5 to 24 months, with a less intensive therapy applied in the meantime.

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In the process of music therapy, we aim primarily at training hearing perception, attention and memory. We combine various music therapy techniques including elements of neurologic music therapy. Specific techniques are selected individually according to the patient's needs and therapeutic goals which are set together with the whole interdisciplinary team.

Outcomes: The psychological assessment results show a significant improvement in most indicators measured (with the exception of one patient who showed increased depression indicator).

Discussion and further perspectives: We expect that with the growing number of patients the results will become more demonstrable. The entire team is now implementing a method of setting and evaluating patients' goals according to GAS. Furthermore, music therapy assessment is planned to become more elaborate, too.

The therapy of patients with ABI involves a complex effect; interaction and efficiency of individual elements cannot be separated. The role of music therapy is not insignificant in this process: in quantitative assessment of the efficiency of the therapy, changes (often positive) may be seen in individual areas. Assessment, however, remains to be largely qualitative, as described in Marketa Gerlichova's PhD thesis.

Keywords: music therapy, neurorehabilitation, cognitive function, acquired brain injury, interdisciplinary team

Integrierte Musiktherapie bei erworbener Hirnschädigung (ABI) mit kognitiven Störungen

Eine explorative Pilotstudie zur interdisziplinären neurorehabilitativen Tagesklinik

Zusammenfassung

Hintergrund und Ziel: Die Abteilung für Rehabilitationsmedizin der 1. Medizinischen Fakultät der Karlsuniversität und das allgemeine Universitätsklinikum in Prag blicken auf eine zwanzigjährige Praxis intensiver Rehabilitation von Patientinnen und Patienten mit erworbener Hirnschädigung – etwa nach Schlaganfall – zurück. Allerdings blieben bis zum Jahr 2020 Personen mit einer ABI-Diagnose und minimalen oder keinen motorischen Defiziten, dafür aber erheblichen kognitiven Beeinträchtigungen als eigene, spezifisch definierte Klientel weitgehend unberücksichtigt.

Im Oktober 2020 begann in Antwort darauf ein sowohl klinisches als auch forschungsorientiertes Programm, das dieses pathologische Profil in den Mittelpunkt rückte. Musiktherapie ist in der Neurorehabilitation der Prager Uniklinik traditionell gut etabliert und entsprechend auch ihre Rolle in diesem Projekt platziert.

Forschungscharakteristik: Das vorliegende interdisziplinäre rehabilitative Tagesklinikprogramm wurde nach metasynthetischen Verfahren auf der Basis relevanter Theorien sowie klinischer Erfahrungen konstruiert und Ende des Jahres 2020 an der Abteilung für Rehabilitationsmedizin der 1. Medizinischen Fakultät der Karlsuniversität in Prag installiert.

Bevor es hier sinnvoll zu einer größer angelegten quantitativen Studie zur Abschätzung von Effektgrößen kommen kann, sind Untersuchungen mit Mixed-Methods-Charakteristik erforderlich, in die auch Richtlinien personalisierter Medizin wesentlich eingehen und die in der Lage sind, standardisierte Therapieverfahren mit individuellen Zugangsweisen für optimierte Therapieeffekte abzustimmen. Dieses Anspruchsprofil gab den Ausschlag für eine explorative Pilotstudie, die ein breites Wirkspektrum im Auge behält und sowohl spezifische Rehabilitationsparameter – etwa die Verbesserung kognitiver Fähigkeiten – als auch die Lebensqualität und das Selbstbild der Patientinnen und Patienten ins Kalkül zieht.

Setting und Klientel: Das hier vorgestellte Rehabilitationsprogramm wurde an der Abteilung für Rehabilitationsmedizin der 1. Medizinischen Fakultät der Karlsuniversität in Prag (Klinika rehabilitačního lékařství VFN a 1. LF UK, Prag Albertov) im Tagesklinik-Modus installiert und ist jeweils auf eine Interventionsdauer von vier Wochen ausgelegt. Die einzelnen Therapien werden täglich zwischen 8.30 Uhr und 15.30 Uhr durchgeführt und sind interdisziplinär ausgerichtet. Musiktherapie wird dabei als integrativer Teil eines therapeutischen Systems verstanden, das auch neuropsychologische Interventionen, Ergotherapie, förderpädagogische Maßnahmen, Kunsttherapie und Physiotherapie umfasst, wobei letztere insbesondere auch Dual-task-Trainings einbindet.

Dieser interdisziplinäre Zugang ist allerdings flexibel gehalten und kann nuanciert an individuelle Bedürfnisse und Fähigkeiten angepasst werden. Damit soll eine optimale Balance zwischen re-

habilitativem Progress und achtsamem Umgang mit der Persönlichkeit und dem Selbst-Profil von Patientinnen und Patienten ermöglicht werden.

An der explorativen Pilotstudie nahmen sieben Frauen und drei Männer im Alter zwischen 26 und 78 Jahren ($\mu = 46$) in vollem Umfang teil. Zwei Teilnehmende fielen während der Forschung aufgrund akuter Ereignisse aus.

Von diesen zehn Patienten hatten fünf einen ischämischen Schlaganfall, drei davon dominant linkshemisphärisch und zwei multifokal. Drei weitere Patienten litten an schweren kranialen Traumata, zwei davon in multipler Ausprägung. Die letzten beiden Patienten hatten hypoxisch-ischämische Läsionen nach kardiopulmonaler Reanimation aufgrund von Herzstillstand im Zusammenhang mit Lungenembolie. Die Zeitspanne zwischen pathologischem Event und Beginn des hier vorgestellten Rehabilitationsprogramms betrug zwischen 5 und 25 Monaten. Rehabilitationsmaßnahmen während dieser Zeit sind als geringfügig einzustufen.

Datengenerierung: Die Datengenerierung erfolgte im Hinblick auf die Kernsymptomatik kognitiver Beeinträchtigungen durch standardisierte Testbatterien für die jeweiligen Problemsektoren. Dabei bildeten eingehende psychologische Untersuchungen vor und nach der Teilnahme am Rehabilitationsprogramm die Eckpfeiler der Effektabschätzung. Im Unterschied zu Studien, die mit inferentieller Statistik arbeiten und beispielsweise Effekttärken und Trennschärfen berechnen, wurden in der vorliegenden Studie für jede Patientin und jeden Patienten individuell prä- und postinterventionelle Datenprofile erhoben.

Diese umfassten insbesondere: differenzierte Gedächtnisleistungen (Immediate and Delayed Memory Task IMT/DMT), visuell-räumliche Funktionsfähigkeit (visuospatial functioning), Sprachverfügbarkeit und Sprachdefizite, Exekutivfunktionen, Aufmerksamkeit und Depressivität. Durch komparatistische Verfahren konnten ganzheitliche Veränderungen gegenüber Verbesserungen in den einzelnen Sektoren individualspezifisch abgeschätzt werden. Letzteres sollte insbesondere über unterschiedliches Ansprechen auf Interventionen und entsprechend unterschiedliche rehabilitative Benefit-Profile Aufschluss geben.

Als Hauptmessinstrument zur Einschätzung des kognitiven Status kam die Short Neuropsychological Battery (SNB) zum Einsatz. Dieses im Testverlauf wiederholt einsetzbare Tool umfasst 17 Unterbereiche wie Arbeitsgedächtnis, Wiedererkennung, Aufmerksamkeit, exekutive und visuell-räumliche Funktionen und sprachliche Skills. Nonverbales Problemlösen und Raumorientierung wurden mit einem Untertest der Wechsler Adults Intelligence Scale-III, dem Matrix Reasoning Inventar, gemessen. Zudem kam der 60-Item-Boston-Naming-Test zur Evaluation situationsbezogener Wortauffindung bei Personen mit Aphasie zum Einsatz. Depressions- und Angstsymptomatik wurden mit dem Beck Depression Inventory-II und dem State-Trait Anxiety Inventory (Teil X-1: state und Teil X-2: trait) gemessen. Zur Einschätzung der subjektiv empfundenen Belastungen durch die eigenen kognitiven Schwächen wurde die Cognitive Difficulties Scale mit den Antworten sowohl der Betroffenen selbst als auch ihrer nächsten Angehörigen herangezogen. Alle Tests wurden jeweils in ihrer tschechischen Fassung angewandt.

Musiktherapeutische Intervention: Die vor allem trainingsorientierten musiktherapeutischen Aktivitäten zielten primär auf Verbesserungen der auditiven Fähigkeiten, der Aufmerksamkeit und des Gedächtnisses ab. Dabei kamen insbesondere kombinierte Modelle auf der Basis neurologischer Musiktherapie zum Einsatz. Manche Techniken wurden nach individuellen Bedürfnissen, Therapiezielen und musikalischen Affinitäten der Teilnehmenden neu entwickelt, im interdisziplinären Team besprochen und im Konsens zur Umsetzung verabschiedet. Die musiktherapeutischen Interventionen basierten dabei auf vier Säulen:

- 1) Gedächtnistraining durch Singen bekannter Lieder (Erinnerung), repetitives Lernen neuer Lyrics und zeitverschobene Abrufmechanismen, Deklamation tschechischer Reime aus dem Gedächtnis – auch zusammen mit rhythmischer Bewegungsimprovisation;
- 2) Rhythmusbasiertes funktionales Lesetraining mit Fokus auf Textverständnis und Abspeicherung;
- 3) Ausdruck und Symboldarstellung von Emotionen und Stimmungen durch Instrumental- und Bewegungsimprovisation einschließlich verbal-kommunikativer Reflexion;
- 4) Training hör- und körperorientierter Selbststeuerung von Konzentration und Entspannung.

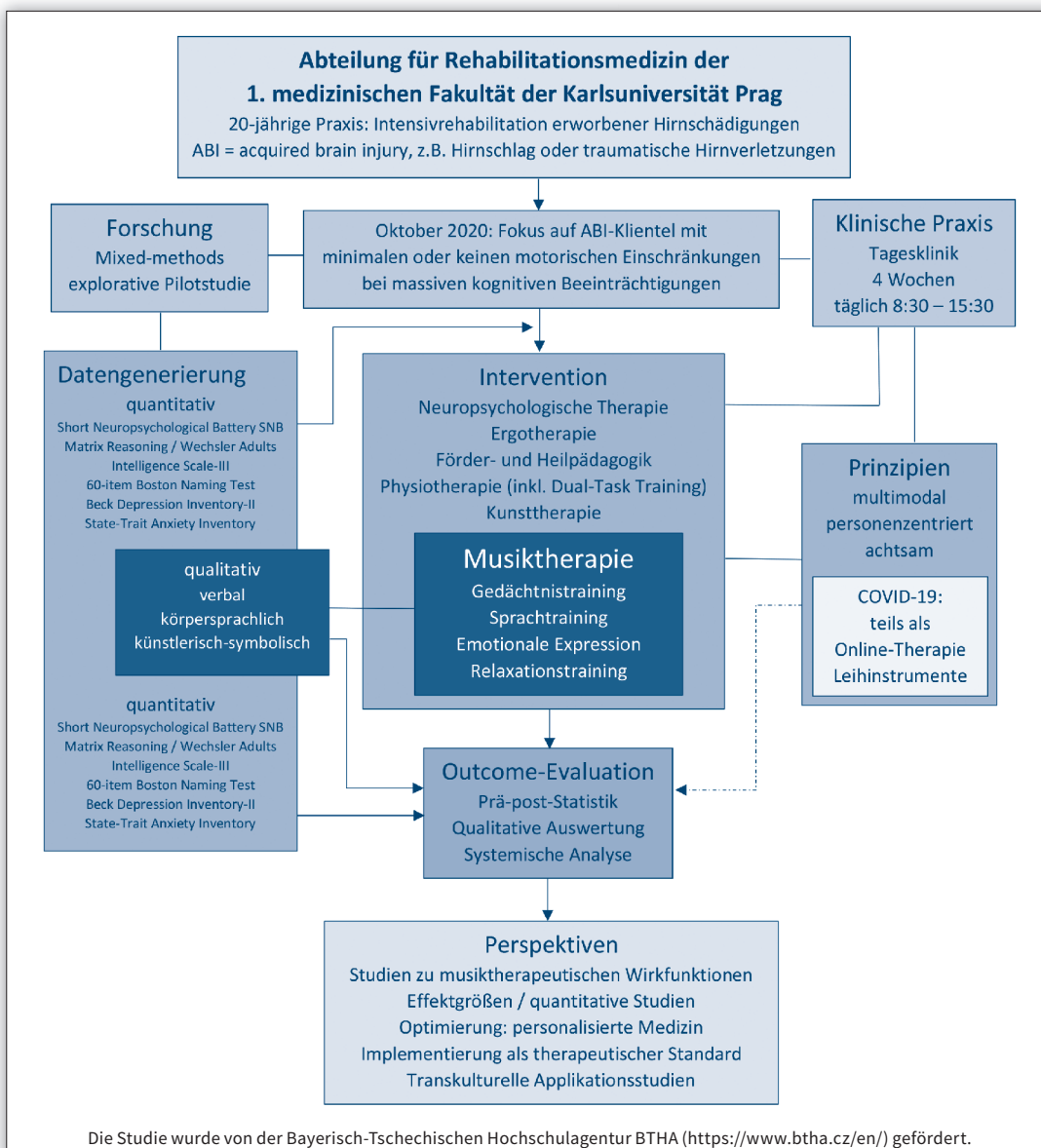
COVID-19-Restriktionen: Aufgrund von phasenweise rigiden Lockdown-Maßnahmen in der Tschechischen Republik war Präsenztherapie teils nicht durchgängig möglich, was zum Angebot von Online-therapie führte. Zu ihrer Durchführung stellte das Klinikum Leih-Musikinstrumente zur Verfügung. Wenn patientenseitig die technische Ausstattung ausreicht und entsprechende Handlungskompetenzen, eventuell auch mit Unterstützung von Angehörigen, gegeben sind, so ist „remote therapy“ ein gangbarer Weg, der im Hinblick auf künftige Pandemien beziehungsweise eine medizinethisch gerechte Versorgung entlegener ruraler Gebiete noch weiter elaboriert werden soll. Die finanzielle Förderung seitens der Bayerisch-Tschechischen Hochschulagentur BTHA floss besonders in diesen innovativen und zukunftsorientierten Bereich ein.

Ergebnisse: Hinsichtlich der neuropsychologischen Parameter (SNB) (i) unmittelbare und (ii) verzögerte Gedächtnisleitung, (iii) visuell-räumliche Orientierung, (iv) Sprache, (v) Aufmerksamkeit und (vi) Exekutivfunktionen ergaben sich in den vier Testgruppen der Studie die folgenden gesampelten Ergebnisse (Angabe der Daten in prä-/postinterventionell): $-0.77/-0.03$; $-2.13/-2.21$; $-1.01/-0.76$; $-0.99/-0.34$. Trotz einer deutlichen Tendenz zur Symptomverbesserung gab es ersichtliche Schwankungen, die deutlich für die Integration standardisierter und individualisierter Zugänge sprechen. Insgesamt sind die numerischen Daten sowohl mit den informellen klinischen Beobachtungen als auch mit den qualitativen Daten der Studie verträglich.

Diskussion und Zukunftsperspektiven: Aufgrund der ausgesprochen ermutigenden Ergebnisse dieser explorativen Pilotstudie sind quantitative Arbeiten mit einem entsprechend großen Sample – insbesondere zur inferentiell-statistischen Abschätzung von Effektgrößen und Trennschärfen – angedacht. Zudem richtet das interdisziplinäre Team zur Zeit seinen Fokus auf die Exploration und Evaluation der subjektiven Rehabilitationsziele der Betroffenen, wobei das Goal Attainment Scaling (GAS) standardisiert-vergleichbare Daten liefern soll. Weitere musiktherapeutische Forschungsperspektiven umfassen störungsspezifische Optimierungen, individualmedizinische Modelle und multifaktorielle Wirkmechanismen.

Neurorehabilitative Therapie von ABI-Patienten ist komplex, wobei interaktive Prozesse, individuelle Dispositionen und therapeutische Effizienz eng miteinander verzahnt sind. In diesem Gesamt dürfte Musiktherapie eine zunehmend wichtige Rolle spielen. So sehr im medizinischen Metier quantitative Effizienzmessungen unerlässlich sind, so sehr gehen sie an der Abhängigkeit der Musiktherapie von individuellen musiksensiblen Dispositionen vorbei. Das hebt die Bedeutung qualitativer Zugänge hervor, was die Erstautorin bereits in ihrer Doktorarbeit zur Musiktherapie eingehend be-

Graphical abstract
(W. Mastnak)



schrieben hat. In Zukunft dürften gerade in der neurologisch und neurorehabilitativ orientierten Musiktherapie Mixed-Methods massiv an Bedeutung gewinnen.

Förderung: Die vorliegende Forschung wurde von der Bayerisch-Tschechischen Hochschulagentur/Česko-bavorská vysokoškolská agentura/Bavarian-Czech Academic Agency (<https://www.btha.cz/en/>) als Zusammenarbeit zwischen der Abteilung für Rehabilitationsmedizin der 1. Medizinischen Fakultät der Karlsuniversität in Prag und der Hochschule für Musik und Theater, München gefördert.

Schlüsselwörter: ABI (acquired brain injury), erworbene Hirnschädigung, funktionale Musiktherapie, Interdisziplinarität, kognitive Funktionen, Neurorehabilitation, tschechische Musiktherapie

Background and objective

The Department of Rehabilitation Medicine of the 1st Faculty of Medicine of Charles University and the General University Hospital in Prague has provided intensive multidisciplinary rehabilitation for patients with acquired brain injury (ABI), most often after stroke or brain injury, for more than twenty years. However, until 2020, this rehabilitation programme focused on patients with predominant motor impairment and those diagnosed with ABI with minimal or no motor deficits were largely neglected. An intensive and comprehensive rehabilitation programme targeted at these patients did not exist anywhere in the Czech Republic – therefore, in response to this finding, a clinical and research programme targeting this particular pathology profile was initiated in October 2020. That is, post-ABI patients with dominant cognitive impairment and minimal or no motor impairment, as a separate, specifically defined clientele.

Since the beginning of this concept, music therapy has also been part of the intensive full-day rehabilitation programme. Music therapy is traditionally well established in neurorehabilitation at the Department of Rehabilitation Medicine of the 1st Faculty of Medicine at Charles University in Prague (the first incorporation of music therapy into the therapeutic process of the clinic was in 1996) and its role in this project corresponds to this fact.

In addition to presenting the pilot study itself, the article also focuses on music therapy in the context of interdisciplinary care, describing the therapeutic intervention and its effect in the context of quality of life of patients after brain injury.

Neurorehabilitation and cognitive rehabilitation

Neurorehabilitation is a specialized field of neuroscience that deals with the study and use of complex therapeutic processes. The aim of these processes is to recover the patient from damage to the nervous system and to minimize or compensate for the functional changes resulting from this. Neurorehabilitation thus represents a multidisciplinary, team-based approach to the

rehabilitation process applied to patients with neurological symptoms.

If we think of neurorehabilitation in a narrower sense, specifically of a person after damage to the central nervous system, then its goal is:

- to achieve the highest possible level of recovery,
- minimize functional changes, and finally,
- to help the individual to participate as fully as possible in ordinary life in society.

Cognitive rehabilitation is considered to be a systematic and dynamic intervention dealing with the compensation of cognitive deficits in order to improve the patient's quality of life, self-sufficiency and inclusion in society (Válková, 2015). According to the focus, cognitive programs can be divided into cognitive stimulation, training and rehabilitation. The concept of cognitive stimulation aims to support cognitive functions in a non-specific way, e.g. through discussion or leisure activities with supervision. The definition of cognitive training is more specific. Cognitive training uses a set of standard tasks to improve cognitive functions that specifically target training of the impaired cognitive domain (Stepankova & Steinova, 2009). It promotes strategies and skills of the individual that lead to optimization of cognitive functions. It is also used in the prevention of cognitive disorders in terms of involuntional changes in healthy individuals (Klucká & Volfová, 2009). In practice, the two terms are often confused. In a broader sense, cognitive rehabilitation and cognitive training can be merged into one term. The term would then encompass both training and remediation (Klucká & Volfová, 2009).

Cognitive rehabilitation is a form of treatment for cognitive deficits in patients following brain injury that aims to improve cognitive and psychosocial functioning (Sohlber & Mateer, 2001; Tsousides & Gordon, 2009). In the Czech context, Kulishchak (2003) defines cognitive rehabilitation as a systematic effort to improve brain deficits that interfere at some level with the processing of information flowing into the brain from inside and outside the body. Cognitive rehabilitation is used in various stages of treatment for patients after acquired brain injury. It involves an individual approach, both in hospital settings and during further outpatient treatment and therapy in the home environ-

ment. Interventions take into account the individual's normal daily activities in each stage of the disease (Tsaousides & Gordon, 2009; Simon et al., 2012).

The importance of cognitive rehabilitation has increased due to research on brain neuroplasticity. There is a significant correlation between an increase in the number of dendritic connections, structured environmental stimulation, and the correction of cognitive deficits (Kays et al., 2012). The importance of cognitive rehabilitation is supported by the use of new technologies that provide greater opportunities in individualizing rehabilitation programs for patients with cognitive limitations. Technology can generally make the patient's life easier in situations outside of rehabilitation; this may include smartwatches, mobile phones with apps and/or computers that make it easier for the patient to interact with the outside world despite their cognitive deficit (Pompeu et al., 2012).

Characteristics of the research

The current interdisciplinary programme of the day rehabilitation inpatient unit has been designed according to metasynthetic procedures based on relevant theories and clinical experience and was implemented at the end of 2020 at the Department of Rehabilitation Medicine, 1st Faculty of Medicine, Charles University in Prague.

Before large-scale quantitative studies can be meaningfully conducted to estimate effect sizes, mixed-methods studies need to be conducted that incorporate personalized medicine guidelines in a meaningful way and that are able to coordinate standardized treatments with individualized approaches to optimize treatment effects. This profile of requirements was a decisive factor for the exploratory pilot study, which takes into account a wide range of effects and considers both specific rehabilitation parameters – such as improved cognitive abilities – and patients' quality of life and self-concept.

Environment and clientele

Characteristics of persons after ABI

People with acquired brain injury (ABI) can have a very diverse clinical picture and problems of many different kinds. The condition of such a person depends on the circumstances of the injury, the location and extent of the injury, the length of resuscitation, the method of treatment, etc. The most common disorders are motor, sensory, cognitive, psychosocial, fatal and affective. Some people may be very severely affected – for example, they are in a prolonged vegetative state.

A large group of our patients are young men who have been injured in a car accident or in a high-risk sport. These are often people who are at the time of their studies, starting their family life, and therefore it is very important for them how well the impaired functions can be restored. They may have a predominant problem in the motor or cognitive area, sensory or communication area – or they may have various combinations of these problems.

As for the mechanisms of brain damage, the most common are head injuries from car accidents, adrenaline sports, and acquired diseases such as stroke, brain tumour surgery, drowning, poisoning, etc.

Characteristics of the research workplace

The Clinic of Rehabilitation Medicine, 1st Faculty of Medicine, Charles University and General University Hospital in Prague (KRL 1. LF UK and VFN) is a specialized medical facility primarily for patients after acquired brain damage. It mainly accepts patients who are at risk of disability and reduced participation.

For patients after brain damage with motor, cognitive, fatal, etc. problems, there is a day hospital with an eight-hour programme. Based on an initial assessment by an interdisciplinary team, an individual intensive rehabilitation programme is prepared, in most cases lasting four weeks. An interprofessional team of specialists works at the clinic: rehabilitation doctors with different basic expertise (from neurology, internal medicine, surgery), physiotherapists, occupational therapists, psychologists, speech therapists, special educators and music therapists, social workers and nurses. The clinic's staff also collaborates with a number of other specialists (prosthetists, developers of medical technology for rehabilitation, etc.).

Since 2006, the Clinic has been an accredited workplace in the field of Rehabilitation and Physical Medicine of the Ministry of Health. It is also the only workplace in the Czech Republic that has been accredited by PRM UEMS as a Training Centre in Physical and Rehabilitation Medicine. The clinic is also a teaching and methodological centre for the application of ICF (International Classification of Functioning, Disability and Health WHO) in the Czech Republic. It is the only centre licensed to teach this classification in the Czech Republic and the EU.

The Department of Comprehensive Rehabilitation was founded in 1988 by Prof. J. Pfeiffer. The aim is to provide therapeutic, psychological, pedagogical, social and occupational rehabilitation to rehabilitation patients – especially those who have suffered brain damage – and thus help them to reintegrate fully into society and improve or at least maintain their health.

The clinic accepts patients from the departments of other clinics who need rehabilitation, it mainly accepts more complex patients who are at risk of disability and reduced participation, from other hospitals, or from general practitioners and specialists. It operates as a super-consilient unit. The clinic can also operate as a 'Rehabilitation Centre' if staffing and physical standards are met. Since 2006, the clinic has been an accredited workplace in the field of 'Rehabilitation and Physical Medicine' by the Ministry of Health of the Czech Republic.

Characteristics of the intervention programme of the Day Hospital

The rehabilitation programme presented here was introduced at the Department of Rehabilitation Medicine of the 1st Faculty of Medicine at Charles University in Prague in the mode of a day hospital and is designed for an intervention of four weeks in each case. Individual therapies take place daily from 8:30 a.m. to 3:30 p.m. and are interdisciplinary in nature. Music therapy is viewed as an integral part of a therapeutic system that also includes neuropsychological interventions, occupational therapy, remedial education, art therapy and physiotherapy, which includes, in particular, dual training.

However, this interdisciplinary approach remains flexible and can be adapted to individual needs and abilities. The aim is to achieve an optimal balance between rehabilitative progress and respectful treatment of the patient's personality and self-profile.

The structure of cognitive rehabilitation in the KRL Day Hospital programme is fixed. It is an intensive full-day, four-week program that often follows outpatient therapies. Indication criteria for inclusion in the KRL Day Hospital programme are: acquired brain damage with cognitive deficits limiting the performance of normal daily activities, partial insight into the difficulty, a minimum of three months post-accident or accident, patient motivation and a stable psychological state that allows for understanding and cooperation. Contraindication criteria are: negative opinion of a clinical psychologist, inability to complete initial test batteries, increased fatigability, depressive and anxiety symptoms preventing participation in normal activities, a fatal disorder significantly limiting comprehension and expression, and significantly impaired reading, writing and arithmetic skills.

Two weeks prior to the start of the Day Hospital, a comprehensive examination is carried out from the perspective of all involved specialties, based on which goals and plans for comprehensive neurorehabilitation intervention are set. Individual goals are then adjusted weekly based on current therapy outcomes.

Data collection and creation

Data on the root causes of cognitive impairment were obtained using standardized test batteries for the respective problem domains. The basis for the effect assessment was an in-depth psychological examination before and after the participation in the rehabilitation program. Unlike studies that work with inferential statistics and calculate, for example, effect size and discriminatory power, in this study individual profiles of pre- and post-intervention data were collected for each patient.

These included: performance on the Immediate and Delayed Memory Task (IMT/DMT), visuospatial function, language ability and language deficits, executive function, attention, and depression. Through comparative procedures, it would be possible to estimate holistic changes versus improvements in each domain on an individual basis. In particular, this should provide information on differential responses to interventions and the corresponding differential profile of rehabilitation benefits.

The Short Neuropsychological Battery (SNB) was used as the main measurement tool to assess cognitive status. This instrument, which can be used repeatedly during the test, includes 17 subdomains such as working memory, recognition, attention, executive and visuospatial functions, and language skills. Nonverbal problem solving and spatial orientation were measured by the Wechsler Adults Intelligence Scale-III subtest, Matrix Reasoning Inventory. In addition, the 60-item Boston Naming Test was used to assess situational word retrieval in persons with aphasia. Depression and anxiety symptoms were measured using the Beck Depression Inventory-II and the State-Trait Anxiety Inventory (Part X-1: state and Part X-2: trait). The Cognitive Difficulties Scale was used to assess the subjectively perceived burden of self-perceived cognitive impairment with responses from both the sufferers themselves and their next of kin. All tests were used in the Czech version.

Further testing and evaluation criteria are mentioned in the description of each therapeutic intervention below.

Seven women and three men aged between 26 and 78 years ($\mu = 46$) fully participated in the exploratory pilot study. Two participants withdrew during the course of the study due to acute events.

Out of these ten patients, five had ischemic stroke, three of them left hemisphere dominant and two multifocal. Three other patients suffered severe cranial injuries, two of which were multiple. The last two patients had hypoxic-ischemic lesions after cardiopulmonary resuscitation due to cardiac arrest associated with pulmonary embolism. The time interval between the pathological event and the initiation of the rehabilitation program presented here ranged

from 5 to 25 months. Rehabilitation measures during this time should be classified as minor.

Therapeutic interventions, diagnostics and testing

As already mentioned, a number of targeted therapeutic interventions take place within the day care programme – e.g. physiotherapy, occupational therapy, special education, speech therapy, neuropsychology, art therapy and, last but not least, music therapy. We have the opportunity to mention some of the specialties in more detail below – the music therapy will be discussed the most.

Physiotherapy intervention

Physiotherapy generally focuses on the treatment of the musculoskeletal system. However, for this target group of patients, it focuses on linking the motor and cognitive components. Therefore, the main exercises are dual task exercises, which focus on two tasks at the same time (motor and cognitive). For example, the patient maintains balance on an unstable platform, or practices a regular step, or practices a selected exercise and at the same time has a specific task selected according to his individual problem in the cognitive area (for example, subtract the number 7 from the number 100, name words from a selected letter, or answer yes or no, according to a question given by the therapist).

Based on the search of clinical trials, three tests were selected to investigate whether any improvement in cognitive function would be reflected in an effect on cognitive parameters. The HomeBalance feedback system was used to assess the effect of the therapies. The second test was the miniBESTest and the third was a comparison of speed in the Timed Up and Go (TUG), Timed Up and Go Cognitive (TUG-COG) gait tests. The cognitive day care program lasted four weeks, the number of individual physiotherapy sessions was four times/week, with one session lasting 45 minutes, of which one third of the time was devoted to aerobic training, the other third was devoted to dual task training (combination of cognitive and motor tasks) and the last part was devoted to balance training using virtual reality (Nintendo Wii or HomeBalance).

Occupational therapy intervention

Occupational therapy in cognitive rehabilitation focuses on increasing the patient's self-sufficiency and connects the three phases of neurorehabilitation:

1. The acquisition phase of the neurorehabilitation procedure, which involves setting a goal

for specific skill training, its acceptance, and agreement on specific stages of the therapy procedure.

2. The application phase brings the compensation of the deficit and the training of the proposed compensation strategies.
3. The adaptation phase involves supporting the transfer of learned skills to less structured tasks and increasing independence. (Sohlberg & Mateer, 2001)

The occupational therapist uses a wide range of standardized and non-standardized examination methods which are listed in the diagnostic occupational therapy methods section. The occupational therapy treatment plan is also based on the neuropsychological examination. When the patient's condition permits, the Canadian Occupational Performance Measure (COPM), which provides an assessment of performance in the patient's chosen areas of functional performance (self-sufficiency, leisure, work activities) as well as the patient's satisfaction with that performance, is also used in setting individual therapy goals. The therapy is comprehensive and, in addition to cognitive training, the patient receives sensorimotor training. In outpatient occupational therapy, we draw on the cognitive function training program for patients after acquired brain injury by Malia and Brannagan (2010) and the set of exercises that go with this program.

At the same time, we try to involve families and caregivers as much as possible in the rehabilitation process. The family is also involved in the counselling on the possibilities of home training, as they play a key role in the whole process of the patient's recovery. The results of the individual therapeutic blocks are regularly evaluated within the interdisciplinary team.

The occupational therapy assessment includes an assessment of self-sufficiency using the Functional Independence Measure (FIM) and the Community Integration Questionnaire (CIQ-R). The standardized Rivermead Behavioral Memory Test (RBMT) is used to determine problem areas in the memory and attention domain. It is an ecologically valid memory test that complements neuropsychological testing in the cognitive domain of memory. We also use the Multifactorial Memory Questionnaire (MMQ), which assesses subjective perceptions of memory problems, satisfaction with performance, and use of internal and external memory strategies in everyday life. We use the Canadian Occupational Performance Measure (COPM) to set individual goals.

Specific occupational therapy interventions focus on different therapeutic goals. The choice of procedures and strategies is based on the three-stage training model of cognitive rehabilitation (Sohlberg & Mateer, 2001) which divides the phases of cognitive rehabilitation into Acquisition, Application and Adaptation.

Special education intervention

Special education intervention links the functional use of cognitive functions in relation to learning. In particular, it focuses on training in reading, writing and arithmetic, as well as functional learning techniques and preparation for integration back into learning or return to work.

The special educator relies on medical reports, neuropsychological tests and other examinations, as well as her own percentage rating scales developed by the author for use in the above-mentioned workplace. In this way, we are able to assess how much the patient has read and what facts they were able to interpret (or select from a menu), whether he/she is able to write functionally (signature, copying, dictation, etc.), and whether he/she is capable of basic mathematical operations and logical word problems.

The course of therapy is planned according to the results of the examination before admission to cognitive day care program.

The training of reading involves diagnosing the problem so that we are able to make good choices about the form and the process of training. Most often the problem is in visual or auditory perception, information processing or expression.

In lexical training, after we have treated the possibilities of improving auditory and visual perception, the correct method of reading re-education is essential. From a music therapy perspective, we use two well-tested approaches:

- 1) Functional reading training based on the rhythmization of texts, with the focus on comprehension,
- 2) Functional reading training using rhythmic accents, with the focus on retaining essential information in memory.

It is always important to take into account whether the patient himself/herself perceives that their biggest problem is the comprehension of what he/she is reading, remembering the information from the text, or rather the pronunciation when reading. Sometimes it is necessary to help with the dynamics, pace or rhythm of reading, which works well when reading in pairs.

We measure functional reading as a percentage of the patient's interpretation of what they have read, or our predetermined questions. By this method of measurement, it is easy to quantify whether and what progress the patient is making.

When training writing, we follow the classical graphomotor training from the root joints to the acres, from large movements to finer ones. This exercise makes it very easy for us to recite rhythmic rhymes and to guide the movements according to the rhythm of the spoken words.

In the training of counting, we use spatio-temporal imagination, multisensory stimulation, symbol work and rhythmic body play.

From the music therapy point of view, we emphasize the phenomenon of rhythm in the methods of special education intervention.

Speech therapy intervention

Speech therapy is concerned with communication disorders and combines both comprehension and expression of speech. In patients after ABI, we encounter acquired neurogenic communication disorders based on disorders of motor realization of speech (dysarthria, verbal apraxia), disturbances of individual use of the language system (aphasia), disorders of primary function of the orofacial tract (dysphagia and oral apraxia) and cognitive-communication disorders. The aim of speech therapy is to restore, improve or at least maintain existing communication skills.

For speech therapy diagnostics, we use mainly qualitative examination procedures, especially the Examination of Fatal Functions (Cséfalvay, Košťálová & Klímošová, 2003), Dysarthric Profile – 3F test (Roubíčková, Hedánek & Stráník, 2011). Comprehension is tested with the standardized Token test (Bolceková, Preiss & Krejčová, 2015).

Individual as well as group speech therapy for cognitive inpatients always combines speech, language and extralinguistic therapy with elements of cognitive training.

Speech therapy is usually long-term, its effect is reflected in the numerical values of the tests performed only after a longer period of time. When evaluating the effectiveness of speech therapy in the cognitive hospital, we use mainly qualitative criteria.

From the perspective of music therapy, we emphasize both auditory perception and melody as well as the tempo and rhythm of speech.

Music therapy intervention

Music therapy within an interdisciplinary team

A music therapist can work very well with other professionals in a multidisciplinary rehabilitation team and this approach is an advantage for the rehabilitation and music therapy process. Since each discipline draws on different premises and emphasizes different themes, the various perspectives of the collaborating professionals build an advantage (Gerlichová, 2020).

The collaboration with *physicians* can enable the music therapist to provide the necessary consultation regarding rehabilitation therapy goals, monitoring of the patient's condition, etc.

The collaboration with a *psychologist* can be important to take into account the psychological component and experience of a person in a difficult life situation. The music therapist and psy-

chologist may also conduct some forms of psychotherapy together, and may also be involved in various forms of relaxation, for example.

The cooperation with *physiotherapists* is aimed at training rhythm where there are certain problems with locomotion, improving the quality of movement, rhythmization of exercises, warming up the affected body parts to music, as well as inducing rhythmic elements – e.g. in patients with extrapyramidal lesions; we also include appropriate compositions when practicing walking, etc.

The music therapist cooperates with *occupational therapists* in practicing various grips important in playing musical instruments, in practicing transfers, in using and manipulating compensatory aids (e.g. splints, braces, etc.).

The cooperation between music therapists and *speech therapists* is very important in most speech disorders, and significant progress is obvious, for example, in aphatics, who often learn to sing earlier than to speak. We can also use music therapy elements in the complex training of nonverbal and verbal communication. For people with stuttering, rhythmic music relaxation techniques help significantly.

Cooperation with *special educators* is also necessary, e.g. in the rehabilitation of cognitive functions, in the correction of specific learning disabilities, etc.

To make rehabilitation comprehensive, it is crucial to find an appropriate way to involve family members in the rehabilitation process. It is necessary to achieve, if possible, a balanced approach – i.e. that the approach of the family is neither hyperprotective (which can be influenced more easily) nor neglectful.

Selected forms of music therapy intervention

Music therapy training activities have been primarily focused on improving auditory skills, attention and memory. In particular, combination models based on neurological music therapy were used (Thaut & Hoemberg, 2014). Some of the techniques were redesigned according to the individual needs, therapeutic goals, and musical affinities of the participants, discussed in an interdisciplinary team, and consensually approved for implementation.

Music therapy interventions were based on the following pillars:

- I. training of auditory perception,
- II. mindfulness training,
- III. memory training,
- IV. communication training,
- V. working with emotions, and
- VI. relaxation.

I. Auditory Perception Training (APT)

APT involves gradual differentiation and identification of the different qualities of sound (tempo, rhythm, length, pitch, colour, harmony, etc.) Depending on the difficulty level, we go through the following steps:

- 1) Sound and silence – recognising and expressing the absence of one or the other.
- 2) Dynamics: differentiating contrast dynamics, speaking louder or more softly.
- 3) Acoustic space: recognising the direction which the sound comes from.
- 4) Sounds of different colours: from basic distinguishing different sounds/instruments up to e.g. distinguishing different ways of playing instruments.
- 5) Distinguishing changes in tempo: rhythmic pulse at any tempo, acceleration and deceleration of tempo, contrasting tempos.
- 6) Pitch: reproducing a musical motif, differentiating the type of change.
- 7) Rhythmic patterns: imitating a rhythmic pulse from simple to more complex rhythmic combinations.
- 8) Melody: imitating a melody with the voice or a musical instrument and gradually increasing the melodic range and length of melodies, distinguishing changes.
- 9) Harmony: types of harmonies and their discrimination (by key, by being similar to a particular song, etc.).

II. Attention training

Drawing on the examined level of attention, I start at a level safe for the patient and continue in the following order:

- 1) Focused attention – following a selected music sample.
- 2) Sustained attention – following an entire piece of music or a selected motif.
- 3) Selective attention – focusing on a preselected musical line.
- 4) Divided attention – following two instruments playing simultaneously (two musical motifs).
- 5) Alternating attention – focusing on goal-directed switching of attention, e.g. to a key and then to a given rhythm, etc.

III. Memory training

We focus on the process of memorizing new information as well as storing it and retrieving it in a functional way. We use the so-called Musical Mnemonic Training (MMT) – see e.g. Thaut and Hoemberg (2014). This involves specific applying of musical exercises that relate to different memory functions for encoding, decoding and retrieving.

Musical stimuli often serve as mnemonic aids or memory templates. Due to this, it is good to examine the so-called individual musical anamnesis with emphasis on strong emotional experiences associated with musical memories.

We are trying to engage the following types of memory:

- 1) Singing familiar songs and recalling the lyrics or melody (Long-term memory).
- 2) Repetitive learning of new lyrics using regular rhythmic support, steady rhythm, with facilitation through declamation of simple rhymes. (Working memory).
- 3) Singing musical phrases learned a few hours ago (Intermediate-term memory).
- 4) Repetition of rhythmic structures or short musical motifs (Intermediate-term memory).
- 5) Training the retrieval of delayed responses, mechanisms for recalling newly learned information (Working memory).
- 6) Reciting Czech folk rhymes from memory – together with rhythmic-movement improvisation.

IV. Communication training

- 1) Non-verbal dialogues using musical instruments.
- 2) Chanting selected terms (individually important words) in rhythm, most often during anomie.
- 3) Couple non-verbal communication with musical instruments for better understanding in partnership (patient and partner), role-playing etc.

V. Working with emotions

- 1) Realising one's own emotions and expressing them through musical instruments, voice or rhythm. This is followed by expressing of what has been experienced (verbal or non-verbal according to individual possibilities).
- 2) Expressing and symbolic rendering of emotions and moods related to coping with difficult life events, i.e. with specific consequences of ABI, and the individual phases of coping and gradual acceptance of the different life situation. Again, we most often use musical instruments, but we may also use voice, movement, rhythmic body play, or other non-verbal expressive techniques.
- 3) Processing the receptive experience of listening to music verbally, non-verbally.
- 4) A process of musical improvisation focused on self-awareness, processing past experiences, current states and planning for the future. Instrumental and movement improvisation including verbal-communicative reflection.

VI. Relaxation training

Training of auditory and body-oriented self-control focused on bodily experiences and auditory perception and subsequent relaxation (different types according to individual needs). Accompanied by calm relaxing music or live

playing by the music therapist on a soft musical instrument.

Limitations of COVID-19

Due to strict lockdown measures in the Czech Republic, therapy in person was not always possible, which led to providing online therapy. The clinic lent patients musical instruments to enable it. If the patient's technical equipment is sufficient and the patient has the necessary skills, possibly with the support of relatives, 'distance therapy' is a viable option that will be further developed considering future pandemics and the ethically fair provision of medical care in remote rural areas. The financial support of the Bavarian-Bohemian University Agency (BTHA) has been particularly directed towards this innovative and future-oriented area.

Quality of life after brain injury

Quality of life is now becoming an increasingly discussed topic in various fields of interest. It can be encountered in the context of describing a person's social and environmental surroundings, physical and psychological health, value anchoring or subjective assessment of one's own life – being useful for others, personal well-being and satisfaction.

We think about how much our successes and failures in life are related to our assumptions. Are we more influenced by our genes or by the environment we grew up in, which continues to shape us? Are they external circumstances or our subjective experiences that influence our quality of life more importantly?

We may dispute many of the perceived 'quality of life factors'. But the presence of a serious illness or injury is a perfectly objective factor for a significant change in the way and quality of life for the person directly affected, as well as for their family and loved ones. Naturally, in addition to polarities such as illness or health, it is our cultural background, economic situation, education, gender, one's own value system, family background, social networks and religiosity that all influence our quality of life. The concept of quality of life is becoming an increasingly debated topic also in the field of health, special education and social issues.

In the health care sector, the issue of quality of life is addressed both in the context of the current technical possibilities of modern medicine and health care, and in the context of the possibilities of influencing the impact of primary disease on the complex psychosomatic system of a person, his or her social ties, education and employment opportunities, and the family system.

Music therapy and perception of quality of life

The influence of music therapy cannot be overestimated, but (especially because it is not an invasive therapy) its effect is perceived as clearly positive, which is confirmed by interviews with patients. Most music therapy approaches take MT as a 'soft' technique, which makes it easier to enhance the therapeutic effects towards the rehabilitation of specific functions (movement, communication, cognition, independence).

The following conclusions can be drawn from the observations and investigations made:

- Music therapy is perceived by respondents as a non-invasive therapy, with a positive effect. In a non-violent way, it leads the participants of group sessions to discover new dimensions in the area of coping with a changed life situation.
- Other information we obtained from the analysis of the interviews relates to social ties and communication. Respondents reflected on music therapy as a therapy in which it is easier to communicate and establish social bonds. The perception of communication in music therapy receives new impetus in the discovery of the non-verbal component of 'musical conversation' in a pair or group, and the respondents mostly reflect positively on the facilitated possibility of social interaction.
- Respondents realize that even if they suffer from a speech disorder, they can communicate more easily with MT, but also can be trained to develop more functional communication at the verbal and non-verbal level.
- Movement as a phenomenon is accepted in music therapy as one of the forms of expression of the current psychological state in the context of realized (active or receptive) musical expression. Against the background of the stated rehabilitation goal (stability training, locomotion training, etc.), the patient is sometimes not even aware that he/she is exercising because he/she is more focused on the music than on the specific movement. However, this in no way diminishes the completion of these therapeutic goals and effects of MT. With the support of dynamic music, many exercises are easier to perform and the desired muscle groups are more easily engaged. Often the sheer joy of movement is obvious in the facial expressions and 'body language'. In active therapy, the different parts of the body are engaged quite naturally, gross and fine motor skills are rehabilitated and exercised.
- However, the music therapy techniques also allow the spontaneous expression of experienced emotions and further work with them, which, according to the participants, is one of the essential phases of coping with

a difficult life situation. The emotional area is reflected in music therapy not only from the angle of relaxation, release and relaxation. The ease of expressing one's current mood is perceived as important, as well as the expression of deeper emotional memory traces. What is also essential is the 'liberating' feeling of being able to express oneself – regardless of performance.

Results

Regarding neuropsychological parameters (SNB)

1. short-term memory,
2. long-term memory,
3. visual spatial orientation,
4. language,
5. attention,
6. executive functions,

the selected results in the four study groups were as follows (data are shown pre/post intervention): $-0.77/-0.03$; $-2.13/-2.21$; $-1.01/-0.76$; $-0.99/-0.34$. Despite a clear trend towards symptom improvement, there were fluctuations that clearly support the integration of standardized and individualized approaches. Overall, the numerical data are consistent with informal clinical observations and the qualitative data of the study.

Based on a search of clinical trials, three tests were selected to investigate whether any improvement in cognitive function would be reflected in the effect on cognitive parameters. The HomeBalance feedback system was used to assess the effect of the treatments (1). The second test was the miniBESTest and the third was a comparison of speed in the Timed Up and Go (TUG), Timed Up and Go Cognitive (TUG-COG) gait tests. The cognitive day care program lasted four weeks, the number of individual physiotherapy sessions was four times/week, with one lasting 45 minutes, $\frac{1}{3}$ of which was devoted to aerobic training, $\frac{1}{3}$ was devoted to dual task training (combination of cognitive and motor tasks) (2) and the last $\frac{1}{3}$ was devoted to balance training using virtual reality (Nintendo Wii or HomeBalance). So far, two cognitive day care programs have been conducted (October and December 2020), the number of patients in each cognitive day care program was three, the mean age was 47.16 ± 19.91 years, five were female and one was male.

There was an improvement in all selected tests after cognitive day care program. In the miniBESTest there was an improvement of 1.67 points. In the HomeBalance system, the parameter evaluated was the number of remembered planets (Universe game), which was 3.5 at the input and 4.5 at the output. Input time in the TUG was 11.04 ± 2.36 sec, TUG-COG took an average of 18.67 ± 8.91 sec (slowed by a cognitive task of

7.62 sec). At the output, the time in the TUG was 9.28 ± 1.44 sec, the TUG-COG lasted on average 14.12 ± 5.43 sec (slowing down by 4.85).

Although there are no statistically significant differences in the number of patients, the cognitive day care program appears to be an appropriate form of rehabilitation that may benefit patients with a predominant cognitive deficit. In the pilot project, we have verified that the selected tests are suitable, available and applicable in regular physiotherapy practice. The disadvantages of the project are the low number of patients and the lack of a control group.

Detailed evaluation

There is not space in this article to comment in detail on assessments from individual professions. Therefore, we provide the most relevant information, the change in performance from the neuropsychological examination and the verbal conclusion from the music therapy.

Structure of description:

- 1) Brief assessment by the physician
- 2) Brief focus of music therapy
- 3) Entry/leave results
- 4) Brief output evaluation from music therapy point of view

Patient 1

Brief assessment

A 44-year-old woman, a victim of boat accident in Malaysia – severe brain concussion, multiple fractures of right extremities, during hospital stay and return flight no blood thinner was prescribed. On June 21, 2019 she suffered massive pulmonary embolization with cardiac arrest. Cardiopulmonary resuscitation was successful after 20 minutes. Brain MRI found ischemic lesions bilaterally in occipital and parietal lobes, laminar necrosis in left occipital lobe and cortical ischemia in right frontal lobe. Her main complaint was difficult walking with lack of stamina, yet she had some cognitive deficits detected during admission neuropsychology examination.

Main music therapy goals

- 1) Auditory perception and memory training – she made a purposeful effort to recognize pre-given melodic motifs and to write down how many and in what order she recognized them.
- 2) Spatiotemporal orientation and memory training – as instructed to move in space according to the sounds, e.g., go to the highest note first and then move to the stringed instrument, etc.
- 3) Training executive functions – planning and organizing musical improvisation in a group of patients.

Entry/leave results

See table 1.

Output evaluation

Objectively, she has improved her ability to plan and organize her day, and continues to improve in all items tracked. Subjectively: perceives improvement in memory – a steady upward shift.

Patient 2

Brief assessment

A 40-year-old-man, sudden onset of isolated speech disorder, October 2020, classified as severe mixed aphasia, no other neurological pathology found, acute occlusion of left middle cerebral artery on admission CTA, with ischemic lesion $85 \times 33 \times 44$ mm of left temporal lobe on follow-up CAT scan, probably due to paradoxical embolization via persistent foramen oval.

Main music therapy goals

- 1) Reading training – both for reading to one's own children and for successful integration into the workforce. We trained with a focus on rhythmization of words and melody interpretation.
- 2) Memory training – specifically wanted to memorize the words of a selected song. We trained by repetitive training with the accompaniment of rhythmic body play.
- 3) To improve naming during spontaneous speech. We practiced by singing the selected words in extreme emotional positions.

Table 1

Patient 1, entry/leave results

	Entry	Leave
Subtest	14/9/2020	3/11/2020
Immediate recall	-1.53 below average	-1.03 below average
Delayed recall	-2.30 significantly below average	0.07 average
Visuospatial functions	-0.70 lower average	-0.50 lower average
Speech functioning	-0.13 average	-0.10 average
Attention	-0.77 lower average	-1.13 below average
Executive functions	-0.10 average	-1.73 below average
OVERALL SCORE	-0.92 lower average	-0.72 lower average
BDI-II (depressive symptoms)	28 moderate	23 moderate

	Entry	Leave
Subtest	14/12/2020	14/4/2021
Immediate recall	-2.23 significantly below average	-0.83 lower average
Delayed recall	-1.00 below average	-0.23 average
Visuospatial functions	0.40 average	0.13 average
Speech functioning	-2.13 significantly below average	-0.33 average
Attention	-0.70 lower average	-0.30 average
Executive functions	-0.30 average	-0.47 average
OVERALL SCORE	-0.99 lower average	-0.34 average
Matrices (WAIS III)	23 higher average	25 above average
BDI-II (depressive symptoms)	9 (minimal)	10 (minimal)
Cognitive Difficulties Scale (patient/relative)	73/65	69/42
BNT (naming)	51/60 (42 +9 w f. prompt)	58/60 (57 +1 w f. prompt)

Table 2
Patient 2, entry/leave results

Entry/leave results

See table 2.

Output evaluation

Objectively: started working part-time, coping with the demands placed on him. Significantly improved in rhythmization. Subjectively: reflects improvement in memory and speech, handles children better at home. Steady upward movement.

- 2) To learn to name subjectively important words – choosing an atypical sound for each selected concept and repeating it when saying the word.
- 3) To improve writing – practicing graphomotor exercises to dynamic music.

Entry/leave results

See table 3.

Output evaluation

Objectively: is able to communicate more functionally. Subjectively: feels better, happy to be able to communicate better and sees progress.

Patient 3

Brief assessment

A 50-year-old man, suffered an ischemic stroke due to embolization from aneurysm of left internal carotid artery (January 2020). MRI 2/2020: multiple ischemic lesions in the territory of left middle cerebral artery mixed aphasia severe in deficit of expression, loss of perception, right hemiparesis with most severe deficit proximally on upper extremity, agraphia, alexia, learned non-use of right hand.

Main music therapy goals

- 1) Improve speaking (specifically speech expression) – we practiced rhythming words and singing, gradually he was able to articulate more reliably and learn more words.

Patient 4

Brief assessment

A 44-year-old woman. Initially right arm paraesthesia, with some progression – aphasia, light right hemiparesis, ischemic stroke in February 2019, MRI verified ischemic lesion of left gyrus postcentralis from parietal cortex to left ventricle.

Main music therapy goals

- 1) Attention training (focused and sustained) – purposefully trying to follow specific me-

	Entry	Leave
Subtest	10/2/2021	14/4/2021
Immediate recall	-3.00 significantly below average	-2.93 significantly below average
Delayed recall	-1.50 below average	-1.50 below average
Visuospatial functions	-0.80 below average	-1.10 below average
Speech functioning	-3.00 significantly below average	-2.80 significantly below average
Attention	-2.47 significantly below average	-2.63 significantly below average
Executive functions	-2.00 significantly below average	-2.27 significantly below average
OVERALL SCORE	-2.13 significantly below average	-2.21 significantly below average
Matrices (WAIS III)	18 average	13 average
BNT-60	22 + 2 + 23	24 + 1 + 28
BDI-II (depressive symptoms)	6 (minimal)	27 (moderate)
STAI (state/trait anxiety)	35/32 (mild)	40/43 (mild)
Cognitive Difficulties Scale (patient/relative)	20/46	25/36

Table 3
Patient 3, entry/leave results

Table 4

Patient 4, entry/leave results

	Entry	Leave
Subtest	5/2/2021	12/4/2021
Immediate recall	-1.17 below average	0.03 average
Delayed recall	-1.17 below average	0.07 average
Visuospatial functions	-0.53 lower average	0.50 higher average
Speech functioning	0.00 average	-0.23 average
Attention	-1.47 significantly below average	-0.50 lower average
Executive functions	-0.27 average	-0.07 average
OVERALL SCORE	-0.77 lower average	-0.03 average
Matrices (WAIS III)	24 above average	22 higher average
BDI-II (depressive symptoms)	10 (minimal)	5 (minimal)
STAI (state/trait anxiety)	43/36 (mild)	33/34 (mild)
Cognitive Difficulties Scale (patient/relative)	59/24	51/17

lodic or rhythmic motifs. Gradually, she was able to increase the sustained attention time up to 20 minutes (from the initial 5).

- 2) Memory training
 - a) long-term – recalling the words of the lyrics of various familiar songs and singing them.
 - b) intermediate – repeated recitation of rhythmic rhymes accompanied by rhythmic improvisation with the hands.
 - c) short-term – practicing functional reading and learning new information from the text through rhythmization of selected words. Recording the learned text and reflecting on listening to it.
- 3) Working with emotions – space and opportunity to express a variety of emotions on musical instruments through selected techniques of musical improvisation, realizing which ones she did not have space to process and the opportunity to attend to them or play the change of experience that is happening.

Entry/leave results

See table 4.

Output evaluation

Objectively: She is starting to work, reflects her emotions better, improves at memory domain tasks. Subjectively: She mostly perceives that she is gradually coming to terms with what happened to her and ‘sees the light at the end of the tunnel’.

Patient 5

Brief assessment

A 26-year-old woman. A shop assistant, in February 2019 sudden headache, admitted to neurology department, brain MRI found ischemia of both cerebellar hemispheres, of right thalamus and left occipital lobe, left vertebral artery was dissected while the right one was hypoplastic. Eight months after her stroke she still complained of clumsiness of left hand, damaged sensitivity especially for discriminating hot and cold on the right side. Neurologically, light dysarthria and left hemiparesis were found.

Main music therapy goals

- 1) Improve learning efficiency to be able to finish secondary school. We worked by structuring the learning text using rhythm, dynamics and melody of problem words.
- 2) Training dynamic body play with emphasis on left upper limb perception and repetition of selected movements.
- 3) Improve naming during spontaneous speech. We trained by singing selected words in extreme emotional positions.

Entry/leave results

See table 5.

Output evaluation

Objectively: She has managed to make a connection with the school; her speech is of a better standard. Subjectively: She perceives the joy of starting to believe she can both finish high school and find a better job. She enjoys singing.

Table 5

Patient 5, entry/leave results

	Entry	Leave
Subtest	10/11/2020	6/1/2021
Immediate recall	0.33 average	0.00 average
Delayed recall	-0.17 average	0.63 higher average
Visuospatial functions	-0.73 lower average	0.50 higher average
Speech functioning	-0.87 lower average	0.33 average
Attention	-0.37 average	-0.43 average
Executive functions	-0.73 lower average	0.07 average
OVERALL SCORE	-0.42 average	0.18 average
BDI-II (depressive symptoms)	7 (minimal)	10 (minimal)

	Entry	Leave
Subtest	21/10/2020	12/1/2021
Immediate recall	-3.00 significantly below average	-3.00 significantly below average
Delayed recall	-3.00 significantly below average	-2.73 significantly below average
Visuospatial functions	-0.03 average	0.63 higher average
Speech functioning	-3.00 significantly below average	-3.00 significantly below average
Attention	-1.40 below average	-1.63 below average
Executive functions	-2.10 significantly below average	-2.10 significantly below average
OVERALL SCORE	-2.09 significantly below average	-1.97 below average
BDI-II (depressive symptoms)	13 (minimal)	8 (minimal)

Table 6
Patient 6, entry/leave results

Patient 6

Brief assessment

A 78-year-old woman, a keen bike rider and tourist, in an accident with another cyclist in May 2020 she suffered polytrauma with traumatic brain injury, especially contusion of left temporal lobe and subdural hematoma along left hemisphere and fracture of skull base (pyramid bone) on the right, fracture of ribs, clavicle and one finger of left hand. All motor functions recovered fully during inpatient treatment but she suffers from aphasia and memory deficit, she has difficulty cooking and she cannot share details of her trips with her family and friends.

Main music therapy goals

- 1) Memory training – repeated recitation of rhythmic rhymes, later reciting individually composed words (e.g. cooking recipes) in the same rhythm.
- 2) Balance training connected with rhythmic walking and pronouncing individually important words.
- 3) Fine motor skills training by playing selected musical instruments linked to the repetition of words in rhythm (those she wants to learn).

Entry/leave results

See table 6.

Output evaluation

Objectively, minor progress in memory and balance. Subjectively: no perceived improvement.

Patient 7

Brief assessment

A 37-year-old man, an IT expert was in motorcycle accident in July 2019 and suffered severe polytrauma with traumatic brain injury (diffuse axonal injury, contusion of basal areas of frontal lobes, subdural hematoma), multiple fractures of skull and face bones, pneumothorax and acute respiratory failure, contusion of multiple parenchymatic organs. His recovery was successful; upon admission to our outpatient program he had mixed aphasia but sufficient for communication, complex cognitive deficit with alexia and agraphia and light right sided hemiparesis.

Main music therapy goals

- 1) Reading training – through rhythmization and singing the text.
- 2) Writing training – by practicing graphomotor exercises with dynamic music.
- 3) To improve naming skills during spontaneous speech. We trained by singing selected words in extreme emotional positions.

Entry/leave results

See table 7.

Output evaluation

Objectively: better naming and writing. Subjectively: Perceives that he speaks better but is not satisfied with how slow the improvement is.

Patient 8

Brief assessment

A 49-year-old woman, owner of a fashion boutique with known diagnosis of antiphospho-

	Entry	Leave
Subtest	21/9/2020	30/10/2020
Immediate recall	-1.27 below average	-0.20 average
Delayed recall	-1.70 below average	-1.30 below average
Visuospatial functions	-0.93 lower average	-0.43 average
Speech functioning	-0.63 lower average	-0.93 lower average
Attention	-1.57 below average	-1.53 below average
Executive functions	-0.87 lower average	-0.63 lower average
OVERALL SCORE	-1.16 below average	-0.84 lower average
BDI-II (depressive symptoms)	13 minimal	10 minimal

Table 7
Patient 7, entry/leave results

Table 8

Patient 8, entry/leave results

	Entry	Leave
Subtest	15/9/2020	3/11/2020
Immediate recall	-2.00 significantly below average	-1.40 below average
Delayed recall	-3.00 significantly below average	-2.13 significantly below average
Visuospatial functions	-1.87 below average	-1.03 below average
Speech functioning	-2.00 significantly below average	-0.93 lower average
Attention	-2.40 significantly below average	-2.03 significantly below average
Executive functions	-2.43 significantly below average	-2.43 significantly below average
OVERALL SCORE	-2.28 significantly below average	-1.66 below average
BDI-II (depressive symptoms)	29 moderate/severe	15 mild

lipid and Reynaud syndrome and high blood pressure was recommended by her G.P. to the hospital in November 2019 because speech and memory disorder noticed by the doctor while she was picking up a prescription for chronic medication. Brain MRI showed multiple ischemic lesions, acute, subacute and chronic – mainly in left temporal, frontal and parietal lobe, left cerebellum and pons. Complex cognitive deficit – memory, apraxia, acalculia – was most prominent six month after stroke, together with neocerebellar symptoms and light left hemiparesis.

Main music therapy goals

- 1) Apraxia training – repetitive declamation of rhythmic movements linked to specific words. Playing selected musical instruments with linking cooperation of both upper limbs.
- 2) Counting training – in the form of rhythmic exercises with intense dynamics and linking the movements of the hands or feet. Playing musical instruments according to numerical symbols.
- 3) Working with emotions – space and opportunity to express a variety of emotions on musical instruments or with the voice and to reflect them verbally.

Entry/leave results

See table 8.

Output evaluation

Objectively, she is improving in her ability to rhythmize and count and in functional coordination of both upper limbs. She is bothered by

great emotional instability. Subjectively: reflects that she enjoys music therapy but does not know where she is improving.

Patient 9

Brief assessment

A 53-year-old lady, a physician, who suffered from massive pulmonary embolism with cardiac arrest in 3/2020. After resuscitation she was treated at Intensive Care Unit, she had thrombolysis. Then she was on different rehabilitation settings until 11/2020. Magnetic resonance imaging (MRI) revealed diffuse post-hypoxic damage in different parts of brain. In objective findings she had at the beginning severe left-side hemiparesis, cognitive problems including neglect syndrome. Hemiparesis improved, she was able to walk without crutches although the gait was a little bit instable. After psychologic assessment it was clear that she had severe cognitive problems. Some of them (memory loss, attention) she was able to detect herself but some of them were seen only by the family and friends. She had no insight on them. She came to our department at the end of November 2020.

Main music therapy goals

- 1) Training of rhythm and regularity of walking – repeated declamation of rhythmic movements connected with specific words.
- 2) Memory training
 - a) long-term – recalling the words of the lyrics of various familiar songs and singing them,

Table 9

Patient 9, entry/leave results

	Entry	Leave
Subtest	7/12/2020	14/4/2021
Immediate recall	-1.03 below average	-1.37 below average
Delayed recall	-1.30 below average	-1.13 below average
Visuospatial functions	-0.90 lower average	-0.30 average
Speech functioning	-0.77 lower average	-0.57 lower average
Attention	-1.23 below average	-0.77 lower average
Executive functions	-0.80 lower average	-0.43 average
OVERALL SCORE	-1.01 below average	-0.76 lower average
Matrices (WAIS III)	14 average	17 average
BDI-II (depressive symptoms)	10 (minimal)	12 (minimal)
STAI (state/trait anxiety)	38/34 (mild/minimal)	36/47 (mild)
Cognitive Difficulties Scale (patient/relative)	81/77	75/86

	Entry	Leave
Subtest	10/12/2020	9/4/2021
Immediate recall	-1.87 below average	-1.43 below average
Delayed recall	-2.23 significantly below average	-0.20 average
Visuospatial functions	0.33 average	0.77 higher average
Speech functioning	-0.97 lower average	-0.57 lower average
Attention	-1.27 below average	-0.90 lower average
Executive functions	-1.90 below average	-2.10 significantly below average
OVERALL SCORE	-1.32 below average	-0.74 lower average
Matrices (WAIS III)	8 lower average	21 higher average
BDI-II (depressive symptoms)	8 (minimal)	13 (minimal)
Cognitive Difficulties Scale (patient/relative)	68/49	67/47
BNT (naming)	48/60 (26 +22 w f. prompt)	52/60 (31 +21 w f. prompt)

Table 10
Patient 10, entry/leave results

- b) medium-term – repeated declamation of rhythmic rhymes accompanied by rhythmic improvisation with the hands,
 - c) short-term – imitating the playing of a melody on the same musical instrument. Replicating of the played melody on musical instruments.
- 3) Speech fluency training – in the form of singing songs with emphasis on the emotionality of the song content.

Entry/leave results

See table 9.

Output evaluation

Objectively: The patient is improving in regularity of gait rhythm, speech fluency and all memory domains. Subjectively: She is very realistic about her condition, motivated to continue rehabilitation, but is very reserved about expressing where she sees improvement.

Patient 10

Brief assessment

A 59-year-old woman, a former builder. She suffered from rheumatoid arthritis, diabetes mellitus and depression as well as alcohol addiction in the last five years. In connection with her two deliveries she had postpartum psychosis. In October 2020 she fell down the staircase and sustained traumatic brain injury. She was found unconscious with alcohol abuse. CT scan revealed multiple contusions and bleeding in the brain. There were also fractures of the skull. Because of enlarging oedema, neurosurgeons decided to make the operation and they removed part of the skull which was placed back in several months. When she woke up, she had right side hemiparesis, aphasia, paresis of facial nerve and problems with equilibrium (vertigo). From the acute setting she went to different rehabilitations. She was first examined at our department in December 2020. She had no central paresis but problems with equilibrium. She complained about cognitive problems, anomia, problems with prospective and short term memory.

Main music therapy goals

- 1) Improve naming during spontaneous speech. We practiced by singing selected words in extreme emotional positions.
- 2) Memory training – repeated recitation of rhythmic rhymes, learning systematic melodic series by repeating playing musical instruments.
- 3) Attention training – focused on a pre-arranged response when playing an instrument (e.g., when hearing a stringed instrument, play a given motif on a similar type of musical instrument, when playing a drum, repeat the motif on the drum, etc.).

Entry/leave results

See table 10.

Output evaluation

Objectively, she has improved in the attention and memory domain. Subjectively: She emphasizes the joy of no longer being afraid to go out and express herself.

Discussion and future perspectives

Given the extremely encouraging results of this exploratory pilot study, quantitative work with a correspondingly large sample size is planned – particularly for inferential-statistical estimation of effect size and discriminatory power. In addition, an interdisciplinary team is currently focusing on examining and assessing the subjective rehabilitation goals of persons with disabilities, with Goal Attainment Scaling (GAS) expected to provide standardized comparable data. Other perspectives in music therapy research include disorder-specific optimizations, individual medical models, and multifactorial mechanisms of action.

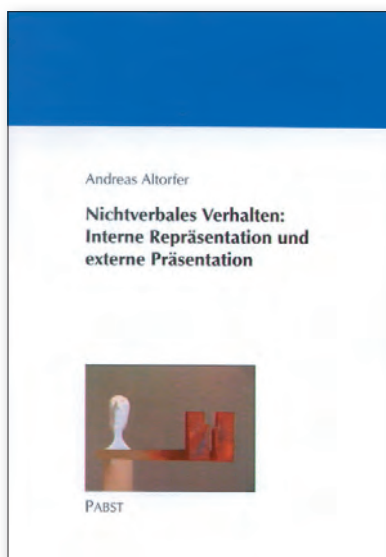
1. As there had been no intensive rehabilitation program for patients with dominant cognitive problem after ABI in the Czech Republic yet, we will continue with more data and objective results to follow.
2. We are beginning to introduce the GAS methodology into the planning of individual

rehabilitation goals, which is dedicated to joint goal setting that is not different for each profession, but instead is a mutual agreement (consensus) of all professions in the interdisciplinary team, including the patient and his/her family. For example, the target may be:

- a) learn to re-list the names of professional terms from the patient's profession,
- b) to be able to read better to their own children and, when reading aloud, to be able to perceive the content of what they are reading,

- c) maintain attention longer for a successful return to work.

Neurorehabilitation therapy of patients with ABI is a complex and interactive process, individual disposition and therapeutic efficacy are closely intertwined. In this overall context, music therapy is likely to play an increasingly important role. As necessary as quantitative measures of effectiveness are in the medical profession, they lack the dependence of music therapy on individual music-sensitive dispositions. This highlights the importance of qualitative approaches, which the first author has already described in



Andreas Altorfer

Nichtverbales Verhalten: Interne Repräsentation und externe Präsentation

Nichtverbale Verhaltensweisen spielen in Gesprächen eine wichtige Rolle. Für die Gesprächsteilnehmer ist es in den meisten Fällen nicht möglich, anzugeben, welche Verhaltensweisen sie im Interaktionsablauf anwenden. Die nichtverbale Kommunikationsforschung beschäftigt sich mit der systematischen Untersuchung der selbstverständlich und damit vielfach unbewusst eingesetzten nicht-sprachlichen kommunikativen Mittel.

In der Arbeit wird das Thema „Nichtverbales Verhalten“ in einem größeren Zusammenhang behandelt, indem einerseits Voraussetzungen im Bereich der Motorik, der Wahrnehmung und des Gedächtnisses erwähnt werden. Andererseits wird der Stellenwert von nichtverbalen Verhaltensweisen als Ausdrucksmittel v. a. auch im Verhältnis zu verbalen Äußerungen diskutiert. Im Besonderen wird auf die Untersuchung von Bedeutungen, die nichtverbale Verhaltensweisen im Gespräch erhalten können, eingegangen. Anhand verschiedener Datenanalysen werden die Untersuchungsverfahren beispielhaft dargestellt und diskutiert.

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detail in her doctoral thesis on music therapy. In the future, mixed methods are likely to become increasingly important, especially in neurologically and neurorehabilitation-oriented music therapy.

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References

- Aldridge, D. (Ed.). (2005). *Music therapy and neurological rehabilitation*. London: Jessica Kingsley.
- Beck, A. T., Steer, R. A. & Brown, G. (1996). *Beck Depression Inventory-II* [Database record]. Washington, DC: American Psychological Association. <https://doi.org/10.1037/t00742-000>
- Bolceková E., Preiss M. & Krejčová L. (2015). *Token test pro děti a dospělé*. Zlín: Propsyco.
- Cséfalvay Z., Klimešová M. & Košťálová M. (2003). *Diagnostika a terapie afázie, alexie, agrafie*. Praha: Asociace klinických logopedů ČR.
- Gerlichová, M. (2014). *Význam muzikoterapie pro neurorehabilitaci a pedagogickou rehabilitaci osob po poškození mozku v kontextu kvality jejich života* (Disertační práce). Univerzita Karlova, Praha.
- Gerlichová, M. (2020). *Muzikoterapie v praxi: příběhy muzikoterapeutických cest* (2nd ed.) Praha: Grada.
- Janatová, M. et al. (2015). Terapie poruch rovnováhy u pacientky po cévní mozkové příhodě s využitím vizuální zpětné vazby a stabilometrické plošiny v domácím prostředí. *Rehabilitácia*, 52(3), 140–148.
- Kaplan, E., Goodglass, H. & Weintraub, S. (1983). *The Boston Naming Test* (2nd ed.). Philadelphia, PA: Lea & Febiger.
- Katz, N. (1998). *Cognition and occupation in rehabilitation: cognitive models for intervention in occupational therapy*. New York: American Occupational Therapy Association.
- Kays, J. L., Hurley, R. & Taber, K. H. (2012). The dynamic brain: neuroplasticity and mental health. *Journal of Neuropsychiatry: Clinical Neuroscience*, 24(2), 119–124.
- Klucká, J. & Volfová, P. (2016). *Kognitivní trénink v praxi* (2. vyd.). Praha: Grada.
- Krivošíková, M. (2006). Ergoterapie u pacientů po poškození mozku. In M. Preiss (Ed.), *Neuropsychologie v neurologii* (s. 341–346). Praha: Grada.
- Krivošíková, M. (2011). *Úvod do ergoterapie*. Praha: Grada.
- Kulišťák, P. (2003). *Neuropsychologie*. Praha: Portál.
- Malia, K. & Brannagan, A. (2010). *Jak provádět trénink kognitivních funkcí: praktická příručka pro každého*. Praha: Cerebrum – Sdružení osob po poranění mozku a jejich rodin.
- Musilová, M. & Janura, M. (2020). Využití kognitivních duálních úloh při hodnocení úrovně posturální kontroly. *Rehabil Fyz Léč*, 27(1), 30–37.
- McNair, D. M. & Kahn, R. J. (1984). Self-assessment of cognitive deficits. In T. Crook, S. Ferris & R. Bartus (Eds.), *Assessment in geriatric psychopharmacology* (pp. 119–136). New Canaan, CT: Mark Powley.
- Pompeu, J. E., Mendes, F., de Silva, K. G., Lobo, A. M., Oliveira, T., Zomignani, A. P. & Piemonte, M. E. P. (2012). Effect of Nintendo Wii™-based motor and cognitive training on activities of daily living in patients with Parkinson's disease: A randomised clinical trial. *Physiotherapy*, 98(3), 196–204.
- Preiss, M. & Vacíř, K. (1999). *BDI-II: Beckova sebepozorovací škála pro dospělé*. Brno: Psychodiagnostika.
- Roubíčková, J., Hedánek, J. & Stráník, A. (2011). *Dysartrický profil Test 3F*. Praha: Galén.
- Simon, S. S., Yokomizo, J. E. & Bottino, C. M. C. (2012). Cognitive intervention in amnesic mild cognitive impairment: A systematic review. *Neuroscience and Biobehavioral Reviews*, 36(4), 1163–1178.
- Sohlberg, M. M. & Mateer, C. A. (2001). *Cognitive rehabilitation: An integrative neuropsychological approach*. New York: Guilford.
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R. & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Straková, E., Věchetová, G., Dvořáková, Z., Orliková, H. & Preiss, M. (2020). *Krátká neuropsychologická baterie (KNB): Manuál* (1st ed.). Národní ústav duševního zdraví.
- Štěpánková, H. & Steinová, D. (2009). *Trénování paměti: metodická příručka*. Praha: Psychiatrické centrum.
- Thaut, M. H. (2008). *Rhythm, music, and the brain: scientific foundations and clinical applications*. New York: Routledge.
- Thaut, M. H. & Hoemberg, V. (Eds.). (2014). *Handbook of neurologic music therapy*. Oxford: Oxford University Press.
- Tsaousides, T. & Gordon, W. A. (2009). Cognitive rehabilitation following traumatic brain injury: assessment to treatment. *Mount Sinai Journal of Medicine*, 76(2), 173–181.
- Válková, L. (2015). *Rehabilitace kognitivních funkcí v ošetrovatelské praxi*. Praha: Grada.
- Wechsler, D. (1997). *Wechsler adult intelligence scale* (3rd ed.). San Antonio, TX: The Psychological Corporation.
- Yeh, T. T., Wu, Ch. Y., Hsieh, Y. W., Chang, K. Ch., Lee, L. Ch., Lin, K. Ch. et al. (2017). Synergistic effects of aerobic exercise and cognitive training on cognition, physiological markers, daily function, and quality of life in stroke survivors

with cognitive decline: study protocol for a randomized controlled trial. *Trials*, 18(1), 405.
Zemanová, N., Bezdíček, O., Michalec, J., Nikolai, T., Roth, J., Jech, R. & Růžička, E. (2016). Vali-

dační studie české verze Bostonského testu pojmenování. *Česká a Slovenská Neurologie a Neurochirurgie*, 79/112(3), 307–316. <https://doi.org/10.14735/amcsnn2016307>



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