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Link between Cognitive Abilities and Physical Activity: Cognitive Training in Physical Rehabilitation

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ABSTRACT

Patients in physical rehabilitation programs need to learn motor skills that they previously performed automatically. Therefore, understating learning processes involved in physical rehabilitation may be useful to implement rehabilitation programs in terms of achieved goals, recovery speed, and patient satisfaction.

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Introduction

Patients in physical rehabilitation programs need to learn motor skills that they previously performed automatically. Therefore, understating learning processes involved in physical rehabilitation may be useful to implement rehabilitation programs in terms of achieved goals, recovery speed, and patient satisfaction.

Motor learning processes are influenced by mechanisms of brain plasticity and various cognitive skills related to memory, attention, and executive functions; actually, a bidirectional relationship between cognitive functions and physical activity seems to exist [1, 2].

Doing physical activity seems to have an important role in the prevention of cognitive decline and dementia; exercise has been associated with increased production of BDNF (Brain-Derived Neurotrophic Factor), and consequently with increased neurogenesis and increased hippocampal volume [3].

On the other hand, increased cognitive abilities (in particular, executive functions) are associated with increased investment in physical activity and a healthy lifestyle [4].

In light of these findings, it might be useful to evaluate whether the implementation of cognitive skills related to memory, attention, and executive functions can positively impact physical rehabilitation.

The role of cognitive abilities on physical rehabilitations

Motor learning processes seem to be influenced by specific cognitive abilities. For example, many authors found a significant association between episodic memory and attention and motor learning skills: people with better episodic memory and attention seems to be faster in movement acquisition phases [1].

Executive functions appear to play an important and bidirectional role in doing physical activity motivation. People with poor executive function had lower rates of participation in physical activity and people who engaged in exercise show high levels of executive function over time [2].

Best, Nagamatsu, and Liu-Ambrose reported that increased executive functions in their sample led to greater adherence to physical activity programs [4]. In another study by Best, Davis, and Liu-Ambrose, individual levels of executive functions and their implementation predicted subsequent improvements in physical performance, speed, increased time spent in physical activities, and a general greater investment in an active and engaged lifestyle [5].

Executive functions play a critical role in regulating impulses and inhibiting immediate responses to promote more rational and calculated ways of thinking and acting. Moreover, through the brain areas responsible for executive functions, there is a suppression of the impulse to obtain immediate rewards and a preference for activities that delay gratification but are intended for a more long-term goal [4].

For these reasons, having high levels of basic executive functions or enhancing them through specific training leads to a more active and healthier lifestyle and promotes behaviours associated with physical and psychological well-being [4, 5].

Cognitive abilities and well-being

Enhancing cognitive abilities is correlated with psychological skills development such as increased self-esteem, increased sense of self-efficacy, and reduced stress [6, 7].

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Interventions on cognitive abilities directed at a sample of soccer players were found to correlate not only with better physical performance but also with positive psychological components, such as higher self-esteem, elevated mood, and greater motivation. Cognitive skills increase the ability to use problem-solving in many situations, feeling more able and confident, and to self-regulate in stressful situations [7].

Moreover, Papadopoulos notes that high cognitive abilities observed in a group of gifted children are associated with high levels of self-esteem and self-efficacy. Cognitive skills level influences the possibility of school success, involving a better view of oneself [6].

Another beneficial component found in the literature regarding the use of cognitive training is its impact on motivation, a crucial aspect in rehabilitation programs as it can influence adherence to treatment and its subsequent effectiveness. Adhering to intensive cognitive training sessions over time leads to a substantial decrease in apathy, resulting in increased motivation and investment in proactive behaviours [8].

The relationship between cognitive abilities and psychological well-being suggests that better level of cognitive skills can be associated with a better quality of life.

Cognitive training in physical rehabilitation: effects of consolidation of cognitive skills on intervention outcome.

Given the role of cognitive abilities, particularly executive functions, in promoting physical activity, movement acquisition and well-being variables, improving the learning of cognitive skills could increase adherence to treatment in rehabilitation contexts and enhance the effectiveness of physical intervention programs.

With this purpose, the PhD research project entitled Cognitive training in physical rehabilitation: effects of consolidation of cognitive skills on intervention outcome (COGREB) has two goals:

- Strengthening cognitive skills (memory, attention and executive functions) in patients who undergoing physical rehabilitation using cognitive training.
- Valuate if an increase in cognitive skills can have a positive impact on physical rehabilitation both in terms of clinical outcome and in terms of patient satisfaction.

Materials and Methods

The project is carried out in the health and learning sciences doctoral course of University of Foggia (Foggia, Italy) in partnership with care centre Universo Salute Opera Don Uva (Foggia and Bisceglie, Italy).

It is planned to recruit patients aged between 18 and 75 who must undergo physical rehabilitation sessions for 30/40 days at University Salute Opera Don Uva. Patients are given a neuropsychological assessment, using the R-BANS and the FAB and a global and specifically physical quality of life assessment with WHOQOL – BREF (World Health Organization, 2004) and scale on physical well-being of WHOQOL [9-12].

Physical functions are assessed by the physiotherapy team.

The patients included in the study do not have moderate or severe cognitive impairment, or difficulties with the Italian language.

After neuropsychological and psychological assessment, patients are randomly assigned to the experimental and control group. Patients in the experimental group carry out computerised cognitive training sessions of 40 to 50 minutes twice a week during the physical rehabilitation intervention (30-40 days) for a total of 8-10 session of cognitive training.

Patients in the control group only carry out the physical rehabilitation intervention.

Assessments are carried out before the physical rehabilitation intervention (pre-test), after the physical rehabilitation intervention (post-test) and at a follow-up of 6 months.

Measurements

Cognitive variables (memory and attention)

Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (Randolph, 1998) is a neuropsychological battery investigating five different domains of cognition: attention, language, visuospatial and visuo-constructive ability, immediate memory and delayed memory.

Executive function

Frontal Assessment Battery (FAB) it is a screening or first-level battery to examine global executive functioning consisting of cognitive and behavioural tests including S-word generation, similarities, Luria's test, grasp reflex, and the Go-No-Go test [10].

Quality of life

World Health Organization Quality Of Life – Bref (WHOQOL - BREF) (World Health Organization, 2004) is tool for assessing the quality of life experienced, consisting of 26-item and four domains: physical health, psychological health, social relationships, and environmental health.

For a more detailed assessment of physical well-being, the 100-item WHOQOL (physical domain scale is use [12].

Physical functioning

Physical functioning is assessed through clinical observation by physiotherapists who evaluate posture, mobility, muscle strength, flexibility, coordination and sensitivity, before and after physiotherapy intervention.

Computerized cognitive training

Brainer is a web platform for cognitive enhancement developed by the Politecnico di Torino in collaboration with a scientific committee of neurologists, phoneticians, geriatricians, speech therapists and neuropsychologists. Contains extensive exercises on memory, attention, executive functions, language and coordination with different difficulties.

Expected outcomes

Considering the high use of cognitive training in clinical practice, it expected that cognitive skills will be found to be implemented compared the baseline, in patients who have carried out the training sessions.

In addition, due to the relationship found between memory attention and motor learning and executive functions and physical activity and physical performance it is expected that a strengthening of cognitive skills can have a positive impact on

the physical rehabilitation in terms of better clinical outcome and more satisfaction of patients [1, 2, 4, 5].

Finally, given the correlation between the level of cognitive skills and self-esteem, self-efficacy, stress management and motivation it is expected that increased cognitive skills lead to a better quality of life [6, 7, 8].

Conclusions

If results will show more satisfactory recovery following the intervention of physical rehabilitation combined with cognitive training, we might ask what moderators operate in this relationship and what applications it might have in clinical practice.

Should the objectives be met, the results could lead to a new organisation of rehabilitation interventions, the inclusion of different domains in addition to the motor domain, the enrichment of the multidisciplinary team, in order to offer a service that is effective, efficient and aimed at the well-being of the person in all its complexity.

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