

Selected forms of sport-related physical activity types in individuals with spinal cord injury

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Abstract

With the rise of industrialization and the development of the automotive industry, accidents and spinal cord injuries (SCI) occur in several situations. The complexity of the injury's repercussions forces individuals to make changes at almost all current functioning levels. Diagnosis and treatment of patients admitted immediately after the SCI is the hospitals' responsibility. These institutions have suitable equipment and qualified medical personnel for that purpose. Depending on the diagnosis, an appropriate treatment model is adopted, followed by rehabilitation. After a stable clinical condition is achieved, treatment should be continued in an outpatient clinic or inpatient treatment in a sanatorium. Physical exercises and specific sports disciplines for people after SCI have a positive impact not only on improving their physical fitness but also on their well-being, increasing their participation in social life. More often, treatment is supplemented with various forms of physical activity, including sports, which positively influences the health and quality of life of the treated individual. This study presents selected sport-related physical activities and highlights their importance in the rehabilitation process of people after SCI based on the available literature.

Key words

spinal cord injury,
physical activity,
sports activity,
rehabilitation

Introduction

Traumatic events of the spinal column and related spinal cord injuries (SCI) and their consequences are extremely challenging issues, both in treatment and rehabilitation planning. The incidence of SCI is estimated to be around 25–35 cases per 1 million people, half of which are cervical spine injuries. Their year-to-year increase is about 1000 cases, taking into account the very substantial increase in traffic accidents (33–75%), falls from heights (12–44%), or sports-related injuries (3.5–18%) [1]. Despite the recognition that sports activity contributes to the occurrence of SCI, no research has been conducted on this topic. Chan et al. [2] analyzed the available literature to identify factors influencing the occurrence of sports-related injuries. The authors conducted a literature search in MEDLINE / PubMed, CINAHL, EMBASE, PsycINFO and Sportdiscus databases. Studies have shown that the presence of SCI in a given sport and the analysis of specific characteristics regarding the occurrence of SCI in individual sports may guide appropriate preventive measures in this respect [2].

Spinal column damages with accompanying SCI require complex, multi-aspect, and specialized management. This includes ensuring spinal stability and minimizing post-traumatic lesions and providing proper nursing care, pressure ulcer prevention, preventing pulmonary and urinary complications, and many other aspects of the complex treatment process. An essential element of treatment is rehabilitation. Its continuation and support with selected forms of physical activity (including sports) prevents the occurrence of secondary lesions, resulting from inactivity, consolidates the results of treatment, and creates conditions for the compensation of disturbed psychophysical functions of the body. As demonstrated by Fu et al. [3] systematic physical training improves the functioning of people after SCI. Until recently, it was believed that ongoing physical activity compensated for resulting dysfunction only in preserved nerve and muscle functions. However, recent studies indicate that

systematic physical activity can improve function at various levels and relate to skeletal muscles and the cerebral cortex by regulating metabolic and physiological mechanisms of motor neurons in the spinal cord [3,4].

Importance of sports activities in individuals with traumatic SCI

Solving problems concerning the rehabilitation of patients after SCI must go beyond the inpatient health care and use selected forms from physical activity. Movement is the exponent of sport in the rehabilitation process, as it is a natural stimulus that accelerates and supports the processes of recovery, regeneration, and compensation of the body. Physical activity as a form of rehabilitation for people after SCI is a topic frequently discussed in the literature and many scientific discussions [5–7]. This takes on particular importance for people after SCI, for whom limb paralysis necessitates reeducation and performing daily activities. Active participation teaches systematicity, utilizes everyday hard work for dealing with one's weaknesses, and intensifies the ability to be self-sufficient, problems that create limitations in the daily functioning of people with disabilities [8]. Ponti et al. [9] demonstrated a statistically significant relationship for items in the SCI-FCS associated with fear of falling in those participating in this type of sporting activity. Moreover, most of the scales used by the authors to assess the quality of life (WHOQoL-BREF, QoL, and QUEST 2.0) showed that this form of sports activity positively affects the well-being of people who practice it and is correlated with a high level of satisfaction with skiing. Additionally, it also reduces the risk of anxiety and falls. Therefore, it can be concluded that skiing is a sport that can be recommended in rehabilitation programs [9].

Physical activity for people with disabilities is also a factor that allows them to accept themselves more quickly and thoroughly as a person with

disabilities and develop the habit of physical exercises, which enables them to maintain and use all the potential reserves the body has. The values introduced by sport are far more important, profound, and broader for such individuals than for healthy individuals. Physical activity provides the opportunity to continue active rehabilitation, provides a sense of activity and satisfaction, offers the opportunity to maintain social contact, demonstrate physical fitness, or ultimately fulfilling other life plans. Practicing sports also counteracts hypokinesia, which is a condition of not moving enough, which has a detrimental effect on the health and well-being of every individual. Finally, active practice of physical activity by people with physical disabilities is a response to the search for a specific way of being in the world, implemented - among other things - through re-designing the existing value system, searching for the lost meaning of life, in line with the assumptions of National Ability Center (NAC) [10,11]. Active participation in various sports activities makes it possible to achieve a high level of locomotor independence, and the means necessary to achieve these goals are properly conducted sports training. However, most of the competitions take place with the use of wheelchairs. Wheelchairs are the primary equipment used by people with paraplegia. Wheelchair requirements depend on the severity of the injury, body weight, and the discipline in which the wheelchair is to be used, as outlined by the British Wheelchair Sports Foundation (BWSF) [3,7].

Among people with SCI are those who see playing sports to get on with life. Undertaking training in a particular sport, they want to achieve the best results possible and set records to reach ever-higher goals. An international organization such as the International Sport Organization for the Disabled (ISOD) was also established [11]. However, sometimes the increasing competition in sport causes adverse overtraining situations that lead to health deterioration, doping, or non-physiological stimulation and behavior. Thus, the primary aim of rehabilitation through sport is not always attained. Nowadays, sports

medicine should be more involved in this process, as it involves the assessment of the condition of the disabled person in diagnosis, defining the line between norm and pathology, so that rehabilitation through sport does not contribute to the increase in the number of disabled people or increase the severity of their dysfunctions. Furthermore, the sedentary lifestyle associated with wheelchair use after SCI negatively affects most patients' ability to move freely. It is also associated with limited opportunities for participation in sports activity [5,12].

One of the most challenging tasks is to select forms of physical activity based on the type of disability, overall fitness, and efficiency. This choice also determines the level of physical exercise that can be applied, the prehensile and manual abilities of the palms, the degree of the technical difficulty of the locomotor tasks, and the commitment and participants' preferences. For disabilities affecting only the lower extremities, the forms of activity that may be applied can be of moderate to high intensity and of considerable technical difficulty. When the prehensile abilities of a person who uses a wheelchair are of lower quality and values, the forms of physical activity should be selected so that they are accessible to the person with a disability. Forms that require fast and efficient movement or maneuvering of the wheelchair are not advisable [7]. According to Holla et al., important factors influencing wheelchair users' lifestyle changes are knowledge, fatigue, habits, self-control, intrinsic motivation, risk perception, attitude, and self-efficacy. Involvement of those in the closest environment is also extremely important throughout the process and appropriate eating behaviors [13].

Selected sports activities in individuals with traumatic SCI

Sports for people with disabilities are now subject to the same rules as those without disabilities. Training loads are based on cardiovascular, respiratory, and musculoskeletal fitness. In practice, near-maximal stimuli are used (applied within

limits) because they are the most effective and efficient in triggering compensatory mechanisms that guarantee the progress of the training process. Sports training of people with disabilities naturally combines typical forms of training with elements of kinesitherapy (corrective, individual, and special exercises related to the athlete's functional state). For people with disabilities, the effort to train and counteract natural fatigue is always intensified by overcoming difficulties that result from the disease or injury [11,14].

Fencing has been one of the first sports to be adapted to the needs and abilities of people after SCI [15]. Tennis is a form of sports activity designed for people on wheelchairs. Tennis racket movements as well as wheelchair movements are active, resistive, or isometric exercises but also symmetrical for both limbs. Using a wheelchair is also a form of mobility designed to compensate for physiological gait fully. The movements made with a tennis racket to hit a ball disrupt the body's balance, making it a balance exercise (better body control and understanding of body alignment in space). The physical effort involved in playing tennis is also interval and corresponds to general fitness maintenance exercise [8]. Lim et al. assessed the effects of psychological skills training using the Test of Performance Strategies (PST) questionnaire in Korean table tennis athletes after SCI. Three male table tennis players with level II SCI participated in the study. The subjects participated in eight PST sessions over a 3-month period. It has been demonstrated that PST can be used by athletes after a SCI, taking into account the degree of disability, to provide a better rehabilitation program [16].

Team sports practiced by individuals who use wheelchairs include basketball, volleyball, and handball. Practicing them is beneficial for concentration ability to move quickly and deftly. Additionally, they learn to cooperate in a team [17].

Swimming is a sport practiced for several reasons in the rehabilitation of people after SCL. On the one hand, the aquatic environment is conducive to performing movements under re-

duced tension; on the other hand, it is an excellent training of functional skills and actions [18]. The Halliwick Concept, developed by the British Association of Swimming Therapy, is one of the approaches to exercising in water. It is a method of teaching swimming and water therapy that aims at teaching how to move and stay in the water safely and freely, which is achieved by controlling head movements, breathing, and maintaining balance. Such exercises enable disabled persons to learn how to maintain balance in an unstable environment. Once balance (stability) is achieved, controlled movement can begin, which gives independence to the disabled person, has a multilateral effect on the body, decompresses the spine, and strengthens the circulatory and respiratory systems and muscles. Such exercises are organized for people after severe spinal cord injury, those who use wheelchairs, individuals with hemiplegia or tetraplegia, and people after brain injuries [19].

Sports such as sailing, kayaking, and rowing are also popular among individuals with disabilities and can be played by those with lower-limb paralysis and/or mild lower limb paresis. These sports promote the activation of the upper limb muscles as well as the dorsal and abdominal muscles. Activities such as cruising on yachts require participants to have sailing skills and hiking, cooking, and organizational skills. They improve physical fitness, develop resourcefulness, teach self-reliance and independence, and teamwork. They enable direct contact with nature, provide perfect rest, enable integration, provide unique experiences leaving unforgettable memories [20,21].

Another water-related form of physical activity is scuba diving. It helps to experience a different world that is otherwise unattainable, be in a different physical and natural environment, and move in three dimensions. It enables individuals to overcome their disability-related complexes and forget - at least for a while - about their crutches, cane, or wheelchair. It develops a sense of responsibility, the ability to work in a group, helps improve physical fitness mental strength,

and promotes integration. According to a study conducted by Bárbara-Bataller et al. [22], diving accidents are one of the leading causes of SCI, followed by falls from heights and traffic accidents. In a retrospective study, the researchers showed that spinal cord injuries particularly affect young men. The most common clinical symptom in this group is SCI in the cervical spine. Due to the irreversible nature of these injuries, prevention is of great importance, mainly for young people [22].

Archery is a very popular sport (especially after lumbar and thoracic SCI). This type of sports activity is especially recommended for people with paraplegia, as it benefits the development of strength in upper limbs and balance. Archery also has a positive influence on concentration [8]. An attempt to combine the disciplines most beneficial to the population with paraplegia is the pentathlon, which includes swimming, archery, wheelchair racing, javelin throw, and shot put [5].

Weightlifting is especially recommended for individuals with lower-limb paralysis. An athlete must have a doctor's approval and a recent EKG result to participate in this sport. Weightlifting leads to hyper-compensatory development of muscle strength in the upper extremities dorsal and abdominal muscles. Therefore, bench pressing is the only competition for individuals with disabilities. Bourne ND et al. investigated the effects of a standard weightlifting belt on reducing discomfort and stabilizing the lumbar spine. The authors believe that its use is fully justified and confirm the hypothesis that the belt provides adequate torso stabilization [23].

Table tennis is a sport practiced by the most severely crippled patients (cervical SCI) who are sometimes barely able to hold the bat due to limited mobility and negligible upper extremity muscle strength. This sport is beneficial for upper limb muscle strength and coordination and reaction time [16].

Athletics are represented with distance and target javelin throw, discus throw, shot put, and wheelchair races. The throws exclude run-ups;

the athlete sits in the wheelchair. All competitions are separate for men and women. Walter and Krassioukov [24] showed that people suffer from sensorimotor and autonomic nervous system impairments after SCI. Alterations in the nervous system play an important role in cardiovascular problems, respiratory disorders, bladder and intestinal disorders. These complications not only deteriorate the quality of life but can also have a significant impact on athletic performance [24].

Alpine skiing is one of the winter sports practiced by people with disabilities. Due to its therapeutic, rehabilitative, and recreational qualities, it has recently become a discipline practiced even more often by individuals with disabilities. In the development of this discipline in disabled people, the same tendencies can be observed that can be seen in alpine skiing in general - the pursuit of maximizing results, regardless of the consequences [11,25].

Boccia is another sport discipline adapted for people with disabilities. Depending on the type of disability, functional abilities (mainly grasping functions, fluidity of movements), and the need for an assistant, athletes are divided into four classes: from BC1 to BC4. Competitors are classified according to the Cerebral Palsy International Sports and Recreation Association (CPiSRA) regulations. This activity is an increasingly practiced form of sport, recreation, rehabilitation, and entertainment for non-disabled and disabled people, acting as inclusive play and promoting therapeutic values [26].

Koper et al. [27] evaluated the relationship between athletic performance and psychological state in a group of 109 boccia players in four classes (BC1-BC4). The mental state analysis addressed sport identity, self-esteem, self-efficacy, hope for success, fear of failure, and expectation of success. Research has shown that only in the BC4 model do psychological variables have a potential impact on athletic performance. Moreover, the type and degree of disability should be considered in the evaluation [27].

Summary

Physical activity and sport undeniably play an important role in the rehabilitation of patients after SCL, improving the health status and ultimately improving the quality of life of this group of people with disabilities. After SCI, part of the individuals perceives sports as a way of life in the future. Active participation in selected sports activities has become evident and is an increasingly effective form of self-development for peo-

ple with disabilities, with constant medical care and proper training organization. Furthermore, practiced forms of physical activity allow getting rid of the sense of disability through contact and cooperation with others, allowing to find a new and appropriate place in the community so that the individual becomes a full member of society, which is the ultimate goal of rehabilitation and revalidation.

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