Chapter

The Interprofessional Clinical and Therapeutic Team Strategy to Manage Spinal Cord Injuries

Adele Jordaan, Mariette Swanepoel, Yvonne Paul and Terry Jeremy Ellapen

Abstract

A popular comorbidity of spinal cord injuries is physical deconditioning that frequently prejudice the person to increased risk for secondary non-communicable diseases, such as non-dependent insulin diabetes mellitus, cardiovascular diseases, respiratory diseases, cardiorespiratory diseases, obesity, osteoporosis, arthritis and osteoarthritis. Clinical literature has shown that spinal cord injured individuals have a poor cardiometabolic risk profile that amplifies the likelihood of secondary non-communicable diseases. Components of physical deconditioning include muscle atrophy, decreased aerobic capacity, inflexibility and diminished muscle and endurance. Another problem associated with spinal cord injuries is reliance or dependence on others. The combination of poor physical conditioning and dependence on others often adversely impacts on the individual's quality of life, limiting their social interaction with others. The adherence to habitual physical activity and exercises has shown to increase conditioning status, improve health and wellbeing, increase independence, and improve confidence and self-image and successful re-integration in community. Therefore it is of paramount importance to increase awareness of the benefits of habitual physical activity and exercise to spinal cord injured patients, medical and clinical practitioners, family and friends. This chapter intends to highlight the health benefits of habitual physical activity in relation to selected secondary non-communicable diseases, and, the importance of interprofessional clinical and therapeutic team strategy to improve the spinal cord injured individuals' quality of life.

Keywords: cardiovascular diseases, exercise, interprofessional healthcare strategy, non-insulin dependent diabetes mellitus, obesity, physical activity, spinal cord injury

1. Introduction

The changes in the spinal cord injured individuals' lifestyle adversely influence their physiological functioning [1, 2]. These individuals generally spend most time sitting that diminishes their physical activity levels, which consequently lowers their energy metabolism. Literature has illustrated that prolonged sitting reduces high density lipid cholesterol (HDL-C) whilst simultaneously adversely increasing the following kinanthropometric (body mass, fat mass, body mass index,

waist circumference) and metabolic risk factors (elevated systolic blood pressure, fasting insulin and triglycerides levels) [3–5]. Jordaan and Farrow et al. reported that there is an upsurge in a sub-category of metabolic syndrome among spinal cord injured individuals that being cardiometabolic diseases [2, 6]. Cardiometabolic diseases entail non-insulin dependent diabetes mellitus, renal failure, cardiovascular diseases (especially hypertension) and dyslipidaemia [2]. Considering the paucity of awareness of the clinical therapeutic benefits of habitual physical activity and exercise rehabilitation towards spinal cord injuries, this chapter intends to review empirical literature associate with this topic. A secondary aim is to demonstrate the need for an interprofessional clinical and therapeutic team strategy to enhance the wellbeing and quality of life of the spinal cord injured individuals.

2. The clinical disadvantages that spinal cord injured individuals' experience because of habitual physical inactivity

In this sub-section the authors will describe the altered metabolic profile, body composition, physical capacity, muscle strength and functional capabilities of spinal cord injured individuals. After sustaining the unfortunate occurrence of a spinal cord injury, most individuals become physical inactive (sedentary) which lowers their metabolism, which is pragmatically evident in their metamorphosis of their body composition [7, 8]. Hick *et al* reported that many spinal cord injured individuals become obese (excessive body fat content) and develop obesity-related pathologies, which include non-insulin diabetes mellitus and cardiovascular diseases [9]. Markers of obesity are increased body mass index (beyond 30kg/m^2) and waist-to-hip ratio circumferences (males beyond 0.8 and females 0.7) [10]. Physical inactivity after spinal cord injury with normal energy consumption results in an increased body fat mass and diminished lean muscle mass (muscle atrophy) from disuse [9, 11]. Fisher *et al* reported that spinal cord injured individuals who are habitually physically active and/or exercise, increase their metabolism, which expends more energy, thereby lowering body mass, fat mass and maintains lean muscle mass [11]. Resistance training has proven to be especially helpful to maintain and/or restore loss of muscle mass, as well aid with the reduction of fat mass [2].

Obese individuals muscle cells become insensitive to identify their endogenous insulin; therefore they cannot enter the cells, which prevent the insulin from converting the glucose to glycogen. Sometimes the obese person may become insulin resistant. The obese person is in a state of hyperglycemia. Rajan *et al.* postulated that 66% of spinal cord injured individuals, who are obese, find themselves susceptible to obesity-related pathologies [12]. Obese persons have increased levels of low density lipoprotein cholesterol (LDL-C), which is associated with hypertension (elevated blood pressure) and enlarged atria and ventricles. These cardiovascular morphological adaptations adversely impact the functioning of the heart, leading to various secondary cardiovascular diseases [13]. Clinical literature indicates that spinal cord injured individuals have low HDL-C and elevated LDL-C that increases the risk of atherosclerosis [2, 14, 15]. Tanhoffer *et al* reported that diminished HDL-C levels are a consequence of physical inactivity among spinal cord injured individuals, whilst physical active individuals maintain a high HDL-C and lower LDL-C levels that limit the occurrence of cardiovascular diseases [15]. De Groot *et al* suggested that habitual moderate intensity physical activity and/or exercise among spinal cord injured individuals favorably influence their cardiometabolic profiles curtailing the unfortunate incidence of cardiovascular and metabolic diseases [13].

Post spinal cord injury there is inevitably muscle mass loss due decreased physical inactivity, which consequently reduces muscle strength and endurance [16].

The loss of muscle mass and strength has being associated with decreased functional capacity; leading to greater dependence of others thereby negatively impacting on the spinal cord injured individuals' quality of life [2, 9]. Hicks *et al* and Ellapen *et al* reported that spinal cord injured individuals can prevent drastic muscle strength and mass loss (atrophy) by engaging in regular strength exercises such as arm ergometry and circuit resistance exercises [9, 17]. Hicks *et al* contend that high levels of muscle strength and endurance is positive associated with maintaining the spinal cord injured individuals physical work capacity, functional capabilities and social independence [9]. Physical capacity is the measure of the volume of physical work an individual can perform by quantifying their aerobic capacity and power output [2, 9]. Barfield *et al* emphasized that irrespective of the classification of spinal injury, individuals who are habitually physically active and/or exercise at intensities at a sufficient metabolic equivalents (METS) level are capable of increasing their aerobic fitness [18]. Martin Ginis *et al* reported that spinal cord injured individuals tend to play sport at a prolonged higher METS intensity as compared to their injured counterparts who participate only in exercise regimes [16]. Jordaan concurs with Martin Ginis *et al.* and further recommend that these findings are suggestive that participating in sport might be a more effective mode of physical activity for exploiting optimal cardiorespiratory exercise-induced physiological adaptations [2, 19].

3. The clinical advantages that spinal cord injured individuals gain from habitual physical activity and exercise

The need for regular aerobic, strength and flexibility training among spinal cord injured individuals is paramount in their daily personal pursuit to maintain a healthier quality of life.

i. The need for *regular aerobic training,* is important to increase the amount of energy expended thereby lowering the blood glucose level, which will prevent a state of hyperglycemia and non-insulin dependent diabetes mellitus. Van der Scheer *et al* reported that regular aerobic activity diminish hyperglycemia, adipose tissue, triglycerides, LDL-cholesterol while increasing HDL cholesterol levels, which favorably changes their individual's cardiometabolic profile [20]. Additional benefits include loss of excessive body mass, fat mass, body mass index and increased muscle mass (slow twitch muscle fibers) [21]. Torhaug *et al* and Tweedy *et al* concur that the use of arm cranking ergometry, circuit resistance strength training, manual wheelchair propulsion and swimming increase the spinal cord injured individuals aerobic fitness, upper body muscle strength and endurance [22, 23]. Tanhoffer *et al* has documented that spinal cord injured individuals who frequently use manual wheelchairs possess superior cardiorespiratory/aerobic fitness, which precipitates healthier cardiometabolic profiles [15]. This enriched cardiorespiratory adaptation can be viewed as being beneficial to extend upper extremity aerobic training duration, which will escalate calorie expenditure, thereby decreasing body fat. West *et al* has reported that aerobic training complimentary enhances respiratory functioning of spinal injured individual [24].

ii. Habitual circuit training improves the person's muscle strength and endurance and VO_2peak through the utilization of the short-term energy system, which chiefly stimulates fast oxidative glycolytic fibers [17, 21, 25, 26].

iii. Van Straaten *et al* have documented that habitual physical activity and exercise diminishes spinal cord injury inflammation and neuropathic pain, however the exercise-induced-physiological mechanisms are unclear [27].

iv. The need for regular flexibility training reduces stiff tight asymmetrical muscles, which allows for easier movement [17]. Many spinal injured individuals often have muscle contractures that limit their movement. Regular flexibility exercises decreases muscle contractures by increasing their muscle extensibility, joint range of motion and agonist-antagonist force couple relationship [17, 21].

4. Exercise prescription of physical activity and exercise for spinal cord injured patients

Both the World Health Organization and the American College of Sports Medicine (ACSM) have prescribed habitual physical activity and exercise for spinal cord injured individuals [10, 28]. However their frequency and intensities differ. The WHO suggests spinal cord injured individuals exercise at low to moderate intensity at least three times per week for approximately 30 min a day [28]. The exercise session can be solely strength resistance training or aerobic and/or a combination of both. Whilst Martin Ginis *et al* and the ACSM have prescribed that spinal cord injured adults should engage a minimum of 20 minutes of moderate to vigorous intensity aerobic activity at least twice a week, in addition to two strength training sessions per week [16, 28]. Jordaan disagrees with WHO, Martin Ginis *et al* and the ACSM aerobic exercise prescription because she feels that the aforementioned exercise prescription is insufficient [2, 10, 16, 28]. Jordaan rationale is based on the premise that spinal cord injured individuals are usually physically inactive; therefore, their metabolism is very low expending low amounts energy [2]. Jordaan recommends an aerobic exercise regime of 4 days a week to increase the individual's metabolism and consequently increase their energy expenditure [2]. The rationale for the aerobic exercise regime is based on the clinical fact that many spinal cord injured individuals have poor metabolic risk profiles, which increases their unfortunate campaign towards the onset of non-insulin diabetes mellitus, obesity and cardiovascular diseases [3, 4]. Therefore these individual should follow an analogous exercise rehabilitation prescription plan of cardiac patients, provided they don't have any further contra-indications. The aerobic exercise intensity should range between 11-14 on the rate of perceived effort (RPE) Borg Scale and/or 60-75% of heart reserve. Exercise duration should steadily increase from 10-40 minutes per session as per Ehrman *et al* prescription guidelines [29]. Strength training should be performed at least twice per week consisting of three sets with 8-10 repetitions per exercise for each major muscle group as per Martin Ginis *et al* strengthening exercise guidelines [16]. However the strength training should start at 40% of the incumbent's 1RM and steadily progress to 70% following Ehrman *et al* prescription [29]. Flexibility should further be included at least thrice weekly as recommended by Tweedy *et al* [23].

5. Members of an interprofessional clinical and therapeutic team strategy to manage spinal cord injuries

Spinal cord injured individuals have numerous diseases (neuro-musculoskeletal and non-communicable diseases) that are affecting their wellbeing simultaneously [2].

As such these individuals require an interprofessional team of clinical and medical practitioners to manage their health and wellbeing [30]. The medical and clinical management of a spinal cord injured individuals begins as soon as the injury occurs and persist throughout the person's life; pre-hospital immobilization, surgery and post-surgery rehabilitation and aftercare. Generally the interprofessional clinical and therapeutic team includes a physician (medical doctor), pharmacist, physiotherapist, occupational therapist, kinesiotherapist (United States of America) or biokineticist (South Africa and Namibia), rehabilitation nurse, psychologist and nutritionist [2, 31] (**Figure 1**). The medical doctor is the primary healthcare giver who serves as a referral source to the other practitioners [32]. Grogery stated that each member of the interprofessional team must acknowledge and respect each profession's scope of expertise to ensure success [33]. Due to focus of this book being on the effects of physical therapy on neurological pathology, this sub-section will concentrate on contributions of physical and exercise therapy to management of spinal cord injured individuals.

5.1 Medical doctor/physician

The speciality of the physicians involved in the management of spinal cord injured individuals depends on the time post-injury (that being phase of management and type of injury). During the surgical phase the emergency medical surgeon, anaesthesiologist, neurosurgeon, orthopaedic surgeon is needed. Post-surgery during the rehabilitation phase a pulmonologist, physiatrist, urologist

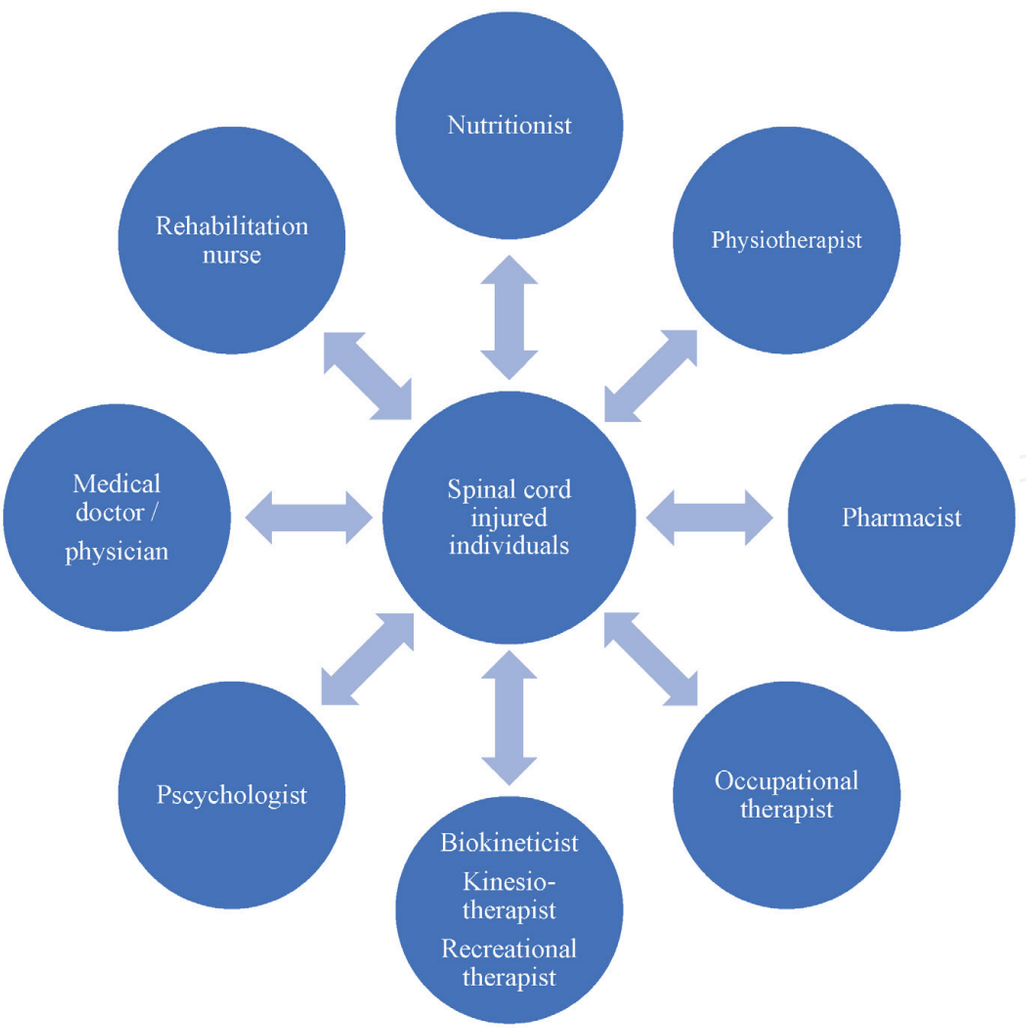

Figure 1.
The interprofessional clinical and therapeutic team supporting a spinal cord injured individual

and a rehabilitation medicine specialist is needed. The aforementioned medical doctors all have significant roles to play in the successful management of spinal cord injured individuals, who needs to comply with their directives [34]. The consulting medical doctor and/or physician general serves as the source of referrals for physiotherapy and exercise therapy (biokinetics and kinesiotherapy).

5.2 Rehabilitation nurse

The rehabilitation nurse has many responsibilities covering a range of clinical and therapeutic functions, such as patient personal hygiene care, person compliance to short; intermediate and long terms healthcare goals which overlaps with many of the therapeutic practitioners scope of professions. Many rehabilitation nurses are present 24 hours, seven days a week, thereby placing them the most admirable position to serve as the coordinators of the interprofessional clinical and therapeutic team because they interact all the clinical and rehabilitative practitioners [35].

5.3 Nutritionist

The significance of good nutritional advice is of paramount value because of the increased risks associated; both malnutrition, (during early post-injury period) and, later obesity that becomes common co-morbidity among spinal cord injured people. Good nutritional choices and habits play a fundamental role to achieve and maintain body mass control, bladder and bowel management, augment immune system function and skin integrity [36]. Collaborative regular monitoring of body mass, body mass index, lean muscle mass and percent body fat mass between the exercise therapist (biokineticist and/or kinesiotherapist) and dietary intake by the nutritionist significantly contribute to assist the spinal cord injured individual maintain optimal body, lean muscle mass and percent body fat.

5.4 Pharmacist

Pharmacist input into the management of spinal cord injured individuals involves medication review of risks that medication can produce to the health of the person and medication prescription [37].

5.5 Physiotherapist

The scope of profession of Physiotherapy spans from intensive in-hospital care, orthopedics, non-communicable diseases, neurology, obstetrics and gynecology rehabilitation [2, 38]. Physiotherapists can manage a variety of concerns of spinal cord injured individual that include diminished respiratory functioning, muscle weakness and contractures, poor somatosensation, reduced mobility, misaligned posture, and deteriorating fitness [35, 39, 40]. The physiotherapists will prescribe physical activity starting from post-surgery confirmed to bed, then bed mobility, transfers maneuvers (from bed to chair, bed to standing and return manoeuvers to bed), assisted gait movement, wheelchair mobility, and upper limb functioning and strengthening. Although a physiotherapist can perform these important tasks other specialists are requested to assist with physical activity and exercise therapy. The physiotherapist may enlist the assistance of a biokineticist (South Africa and Namibia) or kinesiotherapist (United States of America and Canada) to prescribe and monitor stretch, strengthening and aerobic exercises.

In larger spinal cord rehabilitation centers, different movement therapists such biokineticist, kinesiotherapist and recreational therapist may form part of the multi-disciplinary team. Ellapen *et al.* (2018) reported that biokineticists are rehabilitation exercise expertise because their formative tertiary education is Exercise Science and Exercise Physiology [41]. Strydom *et al* and Lawrason *et al* reported that many patients prefer recreational therapeutic physical activities such as sport, games, fishing, gardening, arts and crafts instead of clinical exercise therapy regimes, which on occasion necessitates the referral to recreational therapists [42, 43]. Harvey recommends that physiotherapists should concentrate their efforts to assist spinal cord injured individual to walk with and without assistance, push a manual wheelchair and being able to independently transfer or relocate themselves from one position to another to re-acclimatize themselves to daily living [39].

5.6 Occupational therapist

Pillanstrini *et al* describe the profession of Occupational Therapy as the skilled paramedical treatment, which helps the person to accomplish independence and success in all aspects of their daily lifestyle [44]. The occupational therapist assist spinal cord injured people to re-adjust to their social and physical living environments [44]. De Wit *et al* suggest that the fundamental focus of occupational therapist is the re-acclimatization of activities of daily living through home-based activities, sensory, perceptual and cognitive exercises [45]. Occupational therapists can also assist spinal cord injured individuals who want to return to their careers by re-acclimatizing them to their work-environments, which an aspect that warrants more emphasizes.

5.7 Kinesiotherapist

Kinesiotherapy is an American and Canadian exercise therapy profession that subscribes to the solicitation of scientific, evidence based human movement physical activity and exercise principles aimed to recover the individual's muscular strength and endurance and movement capabilities of patients with functional kinesiological limitations, and individuals who need protracted physical conditioning [46, 47]. A kinesiotherapist functions within the professional association of the American Kinesiotherapy Association. These exercise therapists can assist persons in both the pathogenic and fortogenic healthcare paradigms.

5.8 Biokineticist

A biokineticist is a specialized exercise therapist who functions within the professional association of Health Professions Council of South Africa (HPCSA) and/or the Namibian Health Professions Council (NHPC) [48, 49]. This profession is concerned with final-phase rehabilitation and preventative exercise therapy in the pathogenic healthcare paradigm and the promotion of health and wellbeing in the fortogenic healthcare paradigm [50]. Through individualized physical activity and exercise programme prescription a biokineticist is able to improve the health and wellbeing of a spinal cord injured individual. A biokineticist intends to enhance the physical and physiological status and wellbeing of a patient through an exercise regime in dual context of clinical pathology as well as performance enhancement [42]. Due to the host of non-communicable diseases co-morbidities that affect spinal cord injured individuals the expertise of biokineticists is extremely valuable to curtail their pathogenesis.

5.9 Psychologist

Clinical psychologists focus their efforts to prevent and rehabilitate a variety of psychological problems affecting individuals and families post spinal injury. The psychologist may select various psychological counseling techniques, intended to enhance their spinal cord injured individuals sense of control over these problems, as well as become acquaint with resources that they may employ to overcome their problems. The psychologist also assists the spinal cord injured individuals family to deal with the traumatic event. On occasion the attending psychologist may refer the patient to a neuropsychologist and/or psychiatrist when traditional psychological counseling is inadequate to manage the individuals' psychological problems [35]. Neuropsychologists can play a pivotal role in helping spinal cord injured individuals to address cognition dysfunction that only surface once rehabilitation begins [51].

6. The collaborative interprofessional team strategies to holistic wellbeing of spinal cord injured individuals

The efficacious healthcare management of spinal cord injured individuals necessitates a combination a clinical and therapeutic team approach [35]. Ferguson reported that there three types of interprofessional clinical and therapeutic team strategies can be adopted; multidisciplinary, interdisciplinary and transdisciplinary [52]. Although these terms are interchangeable used to highlight the collaborative nature of inter-professions within the clinical and therapeutic fraternities, there are distinct differences among them [51].

6.1 Multidisciplinary

Jefferies and Chan describe the multidisciplinary team strategy as the elementary mechanism with demarcated professional boundaries involved in holistic healthcare for patients throughout their pathological prognosis, transcending across the primary, secondary and tertiary healthcare phases [53]. The multidisciplinary team comprise of clinical and therapeutic practitioners who coordinate the contribution with little to no overlap. Each profession functions independently, but analogous towards a shared goal; acknowledging each other's contributions towards the mutual success [54]. Each profession drafts individual patient progress reports, which is shared at regular team meetings and as such does not emphasize an integrated approach to care.

6.2 Interdisciplinary

In the interdisciplinary approach, there is an overlap in practice among the practitioners towards a mutual goal within the singular unified management plan. As opposed to the multidisciplinary approach, each practitioner builds on the other's expertise to achieve mutual success. The spinal cord injured individuals progress is communicated through written reports at regular team meetings; however these reports review the overall patient goals and progress rather than individual profession goals and progress [34]. The interdisciplinary team is popular among inpatient spinal cord injury rehabilitation centers. This approach is based on respect of each profession and person and the wellbeing of the patient is of primary concern.

6.3 Transdisciplinary

Among the transdisciplinary team approach is common overlapping of responsibilities across healthcare professions, which insists on optimal communication, co-operation and interaction among practitioners. Clinical and therapeutic practitioners mutually communicate, exchange strategies and reciprocally function. In this approach, there is no hierarchy among practitioners. There is a high level of respect, co-operation and communication among practitioners [35]. The entwined nature of transdisciplinary team approach has the capacity to broaden the skill sets of each practitioner within the team because of their interaction with each. However this team has the potential to be most explosive because the overlap in responsibilities could be mistaken as disrespect for a particular discipline.

Kirshblum and Fergusson reported that the integrated nature of interdisciplinary and transdisciplinary teams is the fundamental difference between these strategic team approaches as opposed to the multidisciplinary team, which does not emphasize an assimilated approach to care [53, 54]. The interdisciplinary clinical and therapeutic team strategy towards spinal cord injured individuals has proven to be most effectiveness among the three team approaches [55].

7. Conclusion

This chapter highlights the need and importance of habitual physical activity and exercise to assist the spinal cord injured individual maintain a healthy life free from non-communicable diseases and secondary cardiorespiratory pathologies. Further the effectiveness of an interprofessional clinical and therapeutic strategy should be careful considered to help manage the lifestyle of the spinal cord injured individual.

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Conflict of interest

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