The Spinal Cord Injury-Interventions Classification System (SCI-ICS)

development and evaluation of a documentation tool to record therapy to improve mobility and self-care in people with spinal cord injury

door

Sacha van Langeveld

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De Spinal Cord Injury-Interventions Classification System (SCI-ICS)

ontwikkeling en evaluatie van een registratie systeem van paramedische behandelingen gericht op het verbeteren van mobiliteit en zelfverzorging bij personen een dwarslaesie

(met een samenvatting in het Nederlands)

Proefschrift

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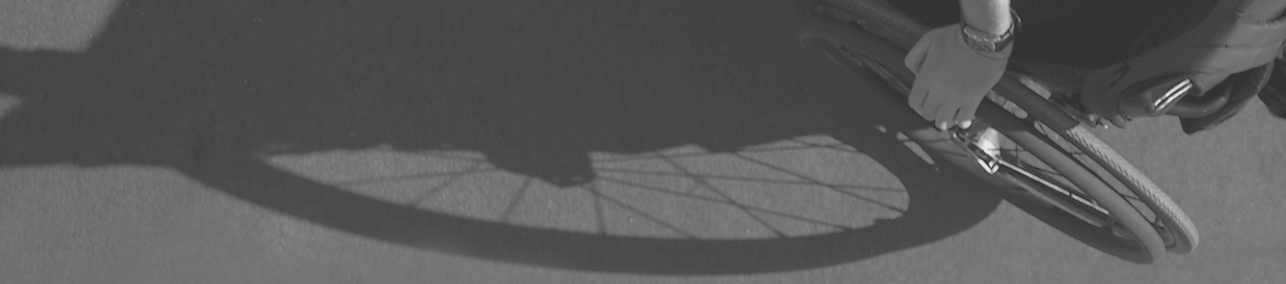

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Chapter 1

Introduction

1. Spinal cord injury rehabilitation

1.1. Rehabilitation as a multidisciplinary team effort

Since the second half of the 20th century, there has been great progress in medical care and rehabilitation for individuals who have sustained a spinal cord injury (SCI), resulting in improvements in terms of life expectancy, functional capability and integration into society.[1,2] To overcome barriers in participation, and 'to add life to years'[3], comprehensive management of the wide range of impairments and activity limitations resulting from SCI requires an interdisciplinary approach by the rehabilitation team.[1-3] Rehabilitation is a client-centerd, educational, problem-solving process that focuses on improving functionality, ultimately aiming at restoration of social participation and wellbeing.[4,5]

Rehabilitation begins at the intensive care department[5], where treating the first life-threatening impairments resulting from the lesion (e.g., by decompressing neural elements, stabilizing the spine and securing tissue perfusion) is crucial to optimize outcomes. Other essential interventions are those to prevent pressure ulcers, venous thromboembolism, stress ulceration, bowel impaction, dysphagia and pulmonary complications. In addition to these primarily medical interventions, careful assessment of neurological impairment contributes to an early prognosis of possible neurologic recovery and to designing a rehabilitation plan.[5] Early initiation of SCI-specific rehabilitation (e.g., interventions to improve mobility of the paralyzed limbs, addressing the hand function of patients with tetraplegia by applying splints) is important, as a delayed start of rehabilitation interventions may negatively influence a patient's ultimate functional capability and increase the length of stay at the rehabilitation center.[5-9]

After the acute phase, when patients are medically stable, they should preferably be rehabilitated in specialized units to address their SCI-specific needs and to optimize medical, functional, social, emotional, recreational and vocational recovery.[6,10,11] The rehabilitation team at such specialized SCI rehabilitation centers includes a physician; a rehabilitation nurse; physical, occupational, speech, recreational and vocational therapists; a psychologist and a social worker or casemanager. Other important professionals, such as rehabilitation engineers or nutritionists, may be added to the team.[1,6] At admission, the physician, who is the team leader, performs a comprehensive evaluation of the patient's medical, neurological and functional status. Based on the findings of this evaluation, the physician sets short-term and long-term goals and prepares therapy prescriptions for all team members involved in achieving these goals. Guided by the functional and medical status on admission, the center provides a customized integrated therapy programme. All disciplines play vital roles in the rehabilitation process for the patient and his or her family. Although each discipline has its own key areas, services do overlap.[1,10,12,13] For example, in the training of

transfers, which is a novel motor task for persons who have suffered an SCI, the physical therapists focus on practising the transfer skills; they start by teaching the patient to perform a transfer from a wheelchair to a treatment table, and, while adapting the pace of progress to the individual patient, they go on to practice the same task in different situations (e.g., transfer to a car). The occupational therapists visit patients' homes to evaluate how they manage transfers at home and which adaptive equipment and home modifications are needed, while nurses practice the transfers in the patient's daily routine. Overlaps between treatment areas, such as transfers, serve as a reinforcement to patients[1,10]; as repetitious practice is one of the key features of the effective training of motor tasks.[13] Well-structured team conferences with the patient and key team members are held at regular intervals to synchronize all therapy activities with the patients' short-term and long-term functional goals (e.g., mobility, self-care, domestic life). Guided by these team conferences, the therapy programme is modified over the period encompassing the admission phase, the active training phase and the discharge phase, until the goals have been achieved and the patient is discharged into the community. In the Netherlands, patients who have been discharged from inpatient rehabilitation are eligible for an additional period of day-care outpatient treatment, involving two or more disciplines from the specialized SCI team. This transitional stage provides them with the opportunity to try out their new living situation and to evaluate whether the amount and quality of care, equipment and home modifations is sufficient.[14,15]

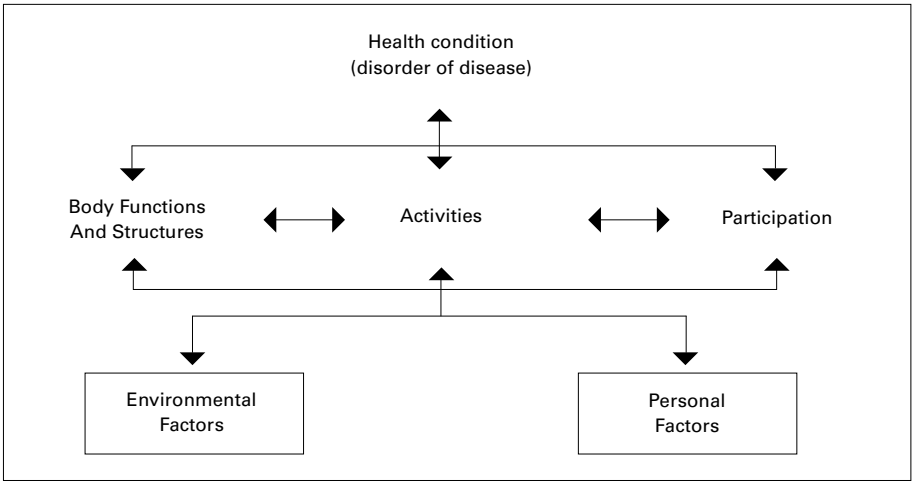
1.2. ICF as the unifying concept of rehabilitation

An important basis for the successful development of rehabilitation practice and research is a conceptually sound description of rehabilitation, interpreted as a health strategy based on a universally accepted conceptual model and taxonomy of human functioning.[16] Since the approval by the World Health Assembly (WHO) of the International Classification of Functioning, Disability and Health (ICF)[17] in 2001 and the reference to the ICF in the WHO resolution[16] on 'Disability, including prevention, management and rehabilitation' in 2005, this model has become universally accepted. (Figure 1)

The ICF[17] is a classification of health and health-related states, and is made up of two parts, each with two components. Part one consists of the components (a) Body functions and structures and (b) Activities and Participation, while part two consists of (a) Environmental factors, and (b) Personal factors. Each component, except Personal factors, consists of various domains, and within each domain, categories are defined which are the units of the classification.

Body functions are defined as the physiological functions of body systems (including psychological functions). An example of a body function is muscle function, which can be specified as power, tone and endurance. Body structures

Figure 1. The ICF model (WHO; 2001).[17]



are defined as anatomical parts of the body, such as organs and limbs. An example of a body structure is 'muscles of the upper arm'. Impairments are defined as problems of body functions and structures, such as a significant deviation or loss. Activity is defined as the execution of a task or action by an individual, while participation is defined as involvement in a life situation. An example of the Activities and Participation component is 'walking and moving' in the mobility domain. Activity limitations are difficulties an individual may have in execu-sting a task, and participation restrictions are problems an individual may experience in life situations. Although they are presented as different entities in figure 1, the Activities and Participation categories are offered in ICF[17] as one single list, and it is left to the user to consider a particular category as an activity limitation or a participation restriction. This lack of clarity has been frequently criticized in the literature.[18,19] The environmental factors make up the physical, social and attitudinal environment in which people live. The personal factors are the particular background of an individual's life and living.[17] The environmental factors and personal factors interact with the components of part one.[17]

The method used for rehabilitation medicine in the Netherlands has been derived from Bangma (1984)[20], and is referred to as the SAMPC method.[21] This approach involves lists of discipline-specific treatment areas (e.g., somatic, activities of daily living) and communication).[21] In 1980, the International Classification of Impairments, Disabilities and Handicaps (ICIDH)[22], the predecessor of the ICF[17],

which classifies consequences of diseases, was widely promoted in many countries[18,19,21], and was translated into Dutch.[23] Van Bennekom et al.[24] tried to focus rehabilitation goals on disabilities and handicaps, by developing the Rehabilitation Activities Profile in 1995 (RAP).[25] RAP enables users to document restrictions and limitations in the areas of communication, mobility, self-care and inter-relational aspects, and evaluates the extent to which these present problems to the persons involved.[26] In 2000, van Dijk[21,27] critically evaluated the SAMPC method[20], as well as the ICIDH.[22] Inspired by the above mentioned models and the Concept of Daily Living proposed by Vreede[28], van Dijk presented a model of functioning[29] which was operationalized for the educational programme used to train rehabilitation physicians in the Netherlands. This model[29] still remains in use today. The key concept in this model (referred to as 'Leerplan'[29]) is that personal and environmental characteristics predetermine an individual's functioning. The model[29] incorporates three levels of functioning: basic functions, basic activities and goal-oriented activities. The ICF[17] was translated into Dutch in 2002.[30] All the concepts described in this paragraph are used to describe the focus of rehabilitation medicine in the Netherlands.

1.3. Differences in SCI rehabilitation in different settings and countries

Worldwide, there are considerable differences in the structures, processes and outcomes of rehabilitation systems for patients with SCI.[31] Structures of care, i.e., the buildings, materials, expertise and manpower available, constitute the conditions for delivering care and are relatively stable over time.[32,33] Process of care has been defined as the 'contents of care, i.e., how the patient was moved into, through, and out of the health care system', and the services that were provided during the care episodes.[32,33]The process of care is inherently dynamic and is the most difficult to measure. Outcomes of care refers to the results of care.[32,33] These three characteristics of rehabilitation and their interconnections together define the quality of rehabilitation care.[32,33] For example, rehabilitation centers may differ in terms of the number and diversity of rehabilitation professionals, the quality of equipment (e.g., having a technology department to develop customized adaptive aids, private wheelchair stock) and facilities (e.g., fully equipped exercise rooms, swimming pool, indoor sports fields, outdoor activity equipment).[31] Differences between rehabilitation centers in terms of these 'unit characteristics' might impact on the quality of care.[31] Rehabilitation objectives and policies may also differ: rehabilitation centers might admit patients soon after SCI, or with a certain delay due to prolonged stay for acute care at a hospital, or they might be more willing to admit patients with non-traumatic SCI, or might admit patients of more advanced age.[31,34] Different health care systems may have different regulations for the length of stay (LOS) in inpatient rehabilitation, which might result in wide variations in LOS.[35] Shorter LOS may lead to undesirable

outcomes (e.g., discharge to nursing homes instead of to the community, increase in hospital readmissions, and increased long-term costs), but also to positive outcomes (earlier social reintegration, decreased short-term costs).[3,36,37] Although discharge should theoretically occur when a patient's functional and educational gains begin to plateau[36], some rehabilitation centers may discharge patients only when optimal functional goals have been achieved and home modifications have been completed, while others may discharge patients as soon as it is safe for them to be at home or at a temporary place of stay.[34] After discharge, some rehabilitation centers may offer specialized outpatient care to create a gradual transition between the safe environment of inpatient rehabilitation and the 'real life' situation in the community, while discharged patients in other centers have to rely on non-specialized primary care in the community. All these possible differences influence the contents of rehabilitation and are likely to have an effect on patient outcomes. Nevertheless, these differences and their consequences remain largely unknown.[31]
In the USA, the lack of knowledge about the influence of inpatient SCI rehabilitation on functional outcomes, such as functional independence in terms of mobility and self-care, has allowed rigorous cost-containment measures to be implemented. Although these resulted in a considerable reduction of the mean LOS to 61 days, the effects on rehabilitation outcomes have not been evaluated.[3,38] In contrast, LOS of persons with SCI in inpatient rehabilitation in the Netherlands is much longer, at a mean of 155 days.[35] Although to date, the health insurance system has exerted relatively little pressure to restrict this[35,37], there is an increasing demand for accountability regarding the long duration of rehabilitation.

2. Rationale for the present research project

Knowledge about the relationships between the needs of the patients involved, the rehabilitation interventions provided and the rehabilitation outcomes achieved is crucial. Without this knowledge, we cannot identify effective treatments or improve the quality of treatments provided, and it will be difficult to justify sufficient funding for extensive inpatient rehabilitation as financial constraints increase.

2.1. Research into SCI rehabilitation outcomes

Over the years, rehabilitation research has invested a tremendous amount of intellectual energy in identifying relevant outcome domains and developing outcome measures, including psychometric (clinimetric) research on validity,

reliability, scaling and interpretation of these measures, to provide evidence for the effectiveness and efficiency of inpatient rehabilitation.[38-41] Widely used outcome measures of SCI rehabilitation include the American Spinal Injury Association (ASIA) impairment scale (AIS) to measure neurological recovery,[31,42] the Functional Independence Measure (FIM)[41] and the Spinal Cord Independence Measure (SCIM)[43] to measure improvement in daily functioning (e.g., locomotion, transfers, dressing). Length of stay (LOS), defined as the period between first admission and final discharge from the rehabilitation center, is most commonly measured in retrospective studies. In such studies, LOS is used as a proxy measure of the rehabilitation programme, while functional gain (discharge minus admission value in scores on the FIM or SCIM) divided by LOS is used as a measure of rehabilitation efficiency.[31] Some authors[39,40,44] have characterized and criticized this as a 'black box' strategy of rehabilitation research. Such data were generated mostly for management purposes, and using them for modelling outcomes requires cautious interpretation.[38,40,45,46] Only Heinemann et al.[47], in 1995, and Johnston et al.[48], in 2003, investigated the relationship between intensity of therapy and functional status (FIM) at discharge from inpatient SCI rehabilitation. Their data were obtained in a retrospective study of billing records and medical reports. They found therapy intensity to be generally unrelated to any outcome for patients with SCI.[47,48] This might suggest that neurologic recovery (reduced impairment), rather than therapy, may be responsible for the functional improvement during inpatient rehabilitation.[47] Heinemann et al.[47] concluded that providing evidence for therapy requires monitoring improvements over shorter intervals and correlating improvement with the type and extent of therapy. Since then, no studies have been published in which therapy time or contents of SCI therapy have been measured directly. Thus, although rehabilitation professionals assume that 'more of the right kind' of therapy will result in better functional outcomes, empirical evidence for a relationship between the content and intensity of rehabilitation therapy and the functional outcome remains inadequate.[46-48]

2.2. Research into the contents of SCI rehabilitation

In contrast to the extensive research on SCI outcome measures, little effort has been invested in research into the actual process of rehabilitation, i.e., the contents of treatments. Although guidelines[49,50], books[1,10,13,51] and articles[2,52,53] giving valuable guidance on SCI treatments are available, strong scientific evidence for the effectiveness of SCI rehabilitation interventions is sparse, and much in SCI rehabilitation is still based on 'expert opinion'.[3,44,52] For example, the recently published systematic review on physical interventions by Harvey et al.[52] found only six randomized controlled trials (RCT) that reported a clear treatment effect on at least one outcome measure. These trials supported the use of fitness,

strength and gait training as well as acupuncture. Topics of recent high level evidence SCI research include functional electrical stimulation, wheelchair technologies, partial body-weight-supported ambulation, the use of robotics and the potential use of brain-control for assistive technology, robots and neuroprosthesis.[6] Although the interest in evidence-based medicine has grown, these publications fail to cover the full spectrum of therapeutic activities provided in SCI rehabilitation.[6]

In rehabilitation research, as well as in SCI rehabilitation, it has been stated that undertaking more RCTs might not be the only way to advance evidence-based practice.[44,54-57] The most important argument for this is that RCTs examine isolated interventions in optimized (standardized) circumstances to detect the unique contribution of the intervention to the outcome, whereas rehabilitation involves the simultaneous application of multiple treatments. Interventions are often not isolated but are reinforced by other interventions by other team members. Rehabilitation is an interdisciplinary process that is more than the sum of its parts, and the call for other practice-based evidence approaches, namely more rigorous observational studies, has therefore increased.[38,44,45,56]

2.3. Rationale for a classification system

A requirement for both experimental clinical trials and observational research is to describe the broad range of rehabilitation treatments in objective and operational terms.[39,40,45] A treatment can be described as any intervention that leads to a sustained change in the natural history or expected course of a patient's illness.[58] Many authors have emphasized that capturing all interventions in inpatient rehabilitation requires a classification system (also known as taxonomy), in which interventions are grouped on the basis of similarity into categories that are objective and mutually exclusive.[39,40,44,45,54,59] A classification system of interventions can guide us in comparing therapy provided during inpatient rehabilitation between patients or subgroups of patients (e.g., tetraplegia, paraplegia, traumatic or non-traumatic, younger and older patients), in identifying the interventions having the greatest impact on outcomes, and in improving effective and efficient clinical decision-making based on more than just 'expert opinion'.[39,44] Since no such classification system of treatments for patients with a SCI was available at the start of the present research project, we decided to develop a classification of interventions which could describe and compare therapy across the continuum of SCI care (acute, post-acute and chronic phases), and which would be site-neutral. In our study we used the term classification system in the sense of the ordering of entities into groups on the basis of similarity.[59]

3. Classifications available at the start of the study

There is a recognized need to address the knowledge gap regarding the contents of therapy in stroke rehabilitation, a patient population representing the most commonly treated group in acute and subacute rehabilitation settings.[33,38-40,45,60] Consequently, classification systems have been developed and used to record therapy, in terms of time and contents. These existing systems have influenced the development of our own classification system.[39,60-63] The publication by De Jong et al.[39] was the most important paper to serve as an example for our classification. In this publication, the authors describe two approaches to develop a taxonomy of rehabilitation interventions, and present the physical therapy taxonomy. Their occupational therapy taxonomy was published later, and could therefore not be used as a model in the development of our classification.[64]
The physical therapy taxonomy by De Jong et al. identified 10 so-called 'target functional activities' (pre-functional activity, bed mobility, sitting, transfers, sit-to-stand, wheelchair mobility, pre-gait, gait, advanced gait, community mobility), and two additional non-function-related activities, as the core structuring feature. As a second dimension, it identified a list of 'body systems' with four subcategories (neuromuscular, musculoskeletal, cardiopulmonary and cognitive-perceptual-sensory interventions). We argued that the use of their system was limited by their decision to label these functional activities, using terminology (e.g., 'pre-gait') that had been agreed upon by clinical experts from a limited number of specialized SCI centers, but not globally accepted; what if therapists outside these centers did not agree with the terminology used? Also, the interventions listed in the subcategories of body systems were very diverse, not meeting the basic requirements for a taxonomy in which activities should be grouped by similarity. For example, their musculoskeletal interventions subcategory covers (1) balance training, (2) postural awareness, (3) motor training, (4) proprioceptive neuromuscular facilitation (PNF), (5) neuro-developmental treatment (NDT), (6) gait training using body weight support, (7) upper extremity involved and (8) constrained induced movement therapy. NDT and PNF are specific methods as such, while balance training is the aim of a treatment and can be applied using different methods. And the involvement of a particular extremity belongs to yet another dimension. We argued that this diversity in one subcategory would create confusion, and possible misclassification (what if a therapist used a different method to improve muscle power than PNF?; what if therapists used gait training in water?
This issue was also recognized as posing a risk of misclassification in the other studies on taxonomies.[60-63] Some of the more generic descriptors from the physical therapy taxonomy, such as education, equipment, modality interventions, assessment, and group and individual therapy, proved valuable for the

development of our classification system. These descriptors were derived from guidelines[49,50] and seemed to cover all elements of therapy.[39]
To summarize, all stroke treatment taxonomies[39,60-63] that were available at the start of our research had been developed on the basis of consensus building strategies (formal or informal) with professionals from a limited number of centers (experience-driven approach). None of the publications reported the use of existing standardized classifications for the development of their own classifications. The domains of functioning on which they focused varied from one area (e.g., postural control) to a wide range of domains (e.g., mobility, self-care, domestic life, communication, leisure and work), without a clear distinction between the domains and levels or evidence of completeness. The extent of detail regarding interventions and more generic descriptions also differed between the various taxonomies. Only one taxonomy had been developed as a combined recording tool for physical therapy and occupational therapy[61], while the others were discipline-specific. Only one study had tested the reliability of the recording tool.[62] Finally, none of the taxonomies had been used to describe therapy in different countries.

4. Main issues in the development of an SCI therapy classification system

One of the reasons why the development of a classification system of therapy had not been done earlier, is that systematically grouping the therapies offered by the many disciplines involved in SCI rehabilitation is a complex matter.[38-40, 45, 60-63] For example, stretching of the calf muscle might be used because the muscle is too short and limits the patient's walking ability. However, stretching might also be used to reduce a high muscle tone, or, even more frequently, for both reasons. During this treatment, therapists might also simultaneously educate the patients about doing these stretching exercises by themselves, and assess the length of the muscle to evaluate the effect of the stretching exercise. Although stretching of the calf muscle is assumed to be a treatment provided mainly by physical therapists, stretching of hand muscles is also used by occupational therapists. Thus, the actual action performed (stretching) might be related to different goals (reducing muscle tone, increasing muscle length or both), for different target organs (calf muscle, hand muscles) and different target activities (improving walking or bicycling ability), and applied by different disciplines.
Therapists also argue that there is a distinction between the approach of practising 'movement for the sake of movement' (e.g., gait training in an exercise room, emphasizing balance, speed, coordination) and practising activities for a

specific task or in a specific environment (e.g., walking in a more realistic setting, such as on the ward to go to the bathroom, or walking while carrying shopping bags). Thus, the environment in which therapy takes place and the complexity of a particular task is believed to affect the nature of the treatment because patients learn strategies and gain experience in order to apply basic acquired skills in all kinds of situations.[13] This process of learning motor tasks can be guided by a physical therapist, by nursing staff, a recreational therapist or even a social worker who might be involved in activities addressing these motor tasks. In a sense, these ideas about learning motor tasks in SCI rehabilitation might be included in descriptions of theories about motor control and motor learning theories primarily developed for the physical rehabilitation of patients with stroke and brain impairments.[13]

To develop a classification system of interventions in SCI rehabilitation, we had to find a way to separate the different types of therapy (e.g., exercises, assessment), targets of therapy (e.g., muscle power, walking) and approaches to therapy (e.g., basic motor learning and context-specific motor learning), without ending up with too many details and a system that would be too complex to handle. In the remainder of this section, we describe the main choices underlying the development of our classification system.

4.1. Inductive or deductive approach

The two main approaches that can be used to develop a classification system (or taxonomy) for rehabilitation are the deductive and the inductive approaches.[39] The deductive approach is a theory-driven, top-down approach, guided by expert opinion and scientific evidence (where such evidence is available).[39] This approach stems from a profession's areas view of its own identity and its professional belief system. Good theory is believed to be a precondition for good science and is important for the legitimacy of an area of practice. By contrast, the inductive approach is an experience-driven, bottom-up approach, guided by frontline opinion and scientific evidence (where such evidence is available).[39] This approach starts from what therapists actually do in the clinical setting. It asks frontline clinicians to describe and characterize what they actually do and then categorize these various interventions in a meaningful way, using a common terminology. De Jong et al.[39] stated that the two approaches are not mutually exclusive, and both have their own limitations. The deductive approach may overlook important behaviours and distinctions that may not fit the theory, whilst the inductive approach may fail to see how disparate interventions fit together, and theory needs to be incorporated at some level. De Jong et al.[39] concluded that rehabilitation currently lacks a comprehensive theory encompassing the links between impairments, treatments and outcomes for all patients in all diagnostic groups, and therefore decided to use the inductive

approach. Other taxonomies of stroke treatments[60-64] also applied this inductive approach.
Since we argued that treatments by professionals in SCI rehabilitation are guided by theories, but also wanted to create a measurement tool which would reflect day-to-day clinical practice, we chose to combine the deductive and inductive approaches. Our theoretical concept (deductive approach) implied (1) that there are several conceptual levels of therapy to distinguish, (2) that categorizing an intervention by its target provides more relevant information than categorizing it by the actual intervention carried out, and (3) that this can be captured in one model for multiple disciplines. The inductive approach was included by involving clinical professionals in the development of our classification system, which was achieved by means of consensus rounds and a feasibility study.

4.2. Three levels

At the start of our research, we intended to develop a system with three levels: one level, which we called basic functions, for interventions relating to body functions and structures, one, which we called basic activities, for the teaching and training of skills, and one, which we called complex activities, for the teaching and training of skills in a specific meaningful task or context. This description of three levels of functioning deviates from the ICF[17] in that we chose not to use the term participation. As described above, the ICF defines activity and participation as different concepts, but these are combined in one list of categories in the classification. In addition, since a rehabilitation center is a setting outside the community, we chose not to use the term participation for the third level, in which we wanted to categorize the task- and context-specific interventions. In search of a more appropriate term for the third level, we also looked at other literature.[21,28,65,66] We initially considered the term 'goal-related activities', which was proposed by van Dijk[21,28] and which was already in use among clinical professionals in the Netherlands. Although the descriptions underlying this term (i.e., meaningful activities for the individual[21]) reflected our third level (task- and context-specific activities) to a large extent, we decided that 'meaningful' was a term which could be interpreted in various ways, and which appeared to be too difficult to translate into operational terms for therapy interventions. We therefore decided to use the neutral terms 'basic functions', 'basic activities' and 'complex activities' for the first version of our classification system.

4.3. Classifying targets of therapy in one classification for different disciplines

Because the ICF[17] is a classification of health and health-related states, rather than of therapeutic activities, it guided us in categorizing interventions (in other words the actual interventions that take place) using the target of therapy as the

key organizing principle of the classification, whereas the actual interventions provided were regarded as the means. For example, muscle power training can be achieved in many ways; using weights, gym machines or using manual resistance applied by a therapist. These interventions are regarded as the actual therapy provided. The aim of all these interventions is similar: improving the patient's muscle power. Regardless of which discipline provides the actual therapy, the use of functions and activities as the key organizing feature of the classification enabled us to capture relevant information on treatments provided to the patient in one model for multiple disciplines. In contrast, discipline-specific classification systems would increase the risk of missing interventions, since we know there is some overlap between disciplines, but the level of overlap also varies between facilities. Also, if we were to miss a particular intervention, such as an intervention newly implemented in the course of the research, we would only have to insert this intervention according to its targeted domains and categories, without needing to change the structure of our classification.

4.4. Two domains

We wanted to develop a comprehensive classification of SCI therapy interventions, which had to reflect clinical practice, but we also realized the magnitude of this task. Hence, we restricted ourselves to interventions to improve the two assumed main domains of inpatient SCI rehabilitation, mobility and self-care.[1-3,13] Our classification therefore comprised categories of the ICF[17] at the level of Body functions and structures, i.e., categories that are conditional to mobility and self-care (e.g., muscle power), and the mobility and self-care categories (e.g., walking, dressing) at the level of Activity and Participation. Based on clinical experience, we estimated that these two domains would cover a large majority of the interventions in inpatient SCI rehabilitation. Other important areas of functioning described in the ICF[17], such as communication and domestic life, were therefore excluded from this first version.

4.5. Three disciplines

Mobility and self-care are both believed to be key treatment areas for physical therapists, occupational therapists and nurses.[1,13,49,50] The nursing staff plays a vital role in guiding patients to carry over to what they have learned in therapy, and experienced nurses might even be the first to teach patients motor tasks such as dressing or transfers. However, unlike interventions provided by occupational therapists and physical therapists, those provided by nurses are difficult to describe as separate entities. Nurses provide a mixture of 'care-focused' activities and 'rehabilitation-focused' (e.g., educational, training) activities, and their rehabilitation-focused activities are often provided ad hoc and fragmented throughout the day.[67,68] Since the practical problem of classifying the numerous

contacts between nurses and patients throughout the day, versus the clearly scheduled treatment sessions of therapists, would be very difficult to solve, we excluded the nursing staff from this first version.
For a similar reason, we excluded exercise undertaken by the patients themselves outside scheduled therapy time.
In the Netherlands, sports therapists provide interventions to improve patients' physical capacity, wheelchair skills, walking ability, etc. To cover all therapeutic activities focusing on mobility and self-care, we therefore included interventions provided by sports therapists, in addition to those provided by physical therapists and occupational therapists.

4.6. Level of detail

Two main questions guided us in determining the level of detail of our classification system: how detailed do we have to make it to capture relevant information which would enable us to relate the therapy provided to outcomes, and how do we make it feasible for therapists to classify their treatment sessions in the limited amount of time available in their busy schedule? We therefore decided to restrict the classification system to a limited number of different interventions.

4.7. Only direct patient care

We decided to focus the classification system on interventions which would take place in the actual presence of the patient, and not to incorporate other, indirect, activities such as documentation. Since we wanted to keep our classification as simple as possible, and since its primary use would be to study relationships between treatments and rehabilitation outcomes, indirect activities were deemed less important. Generic descriptors[39], such as assessment, education and equipment, were included in the classification and allocated to the targeted categories, and were only recorded if time spent on these subjects was spent in direct contact with the patients. We argued that this would provide us with relevant information such as the time spent on education to prevent skin problems. We also decided to distinguish between individual therapy and group therapy, as structured SCI inpatient rehabilitation programmes in the Netherlands include group therapy. Although such group therapy may originally have been used to reduce demands on therapy time[69], it became apparent over the years that group therapy, in which patients of similar functional ability exercise together, is a useful strategy to maximize motivation[13,70] and to learn motor task strategies from peers.[13] Other benefits of group therapy include peer support and social interaction.[69,70]

5. Aims and contents of this thesis

In view of the lack of knowledge about the contents of actual therapy provided in inpatient SCI rehabilitation, the main aims of the studies reported on in the present thesis were:

- To develop a classification system representing all clinical interventions provided by physical therapists, occupational therapists and sports therapists and aiming at the improvement of mobility and self-care.
- To develop a classification system which can be used in a valid and reliable way for research and clinical practice, and which is site-neutral and cross-cultural.
- To describe the contents of treatments in different rehabilitation centers and countries.
- To compare these treatment contents between different rehabilitation centers and countries.

6. Outline of the present thesis

The present thesis describes the development and evaluation of a classification system of physical therapy, occupational therapy and sports therapy to improve mobility and self-care in SCI rehabilitation. Chapter 2 reports on the development of the classification system, which was later named the Spinal Cord Injury–Interventions Classification System (SCI-ICS). The content of the first version of the SCI-ICS, which was based on the ICF, existing guidelines and international spinal cord injury literature, was evaluated by means of a modified Delphi consensus procedure involving Dutch and Flemish therapists of ten SCI rehabilitation centers. Chapter 3 evaluates the feasibility of the SCI–ICS to record treatments provided to inpatients and outpatients in three Dutch SCI rehabilitation facilities. Chapter 4 describes the testing of the intra- and interrater reliability of scoring treatments with the SCI–ICS. In chapter 5, treatments provided to inpatients with a recently acquired SCI are compared between three Dutch SCI rehabilitation centers. Chapter 6 outlines differences and similarities of treatments provided to inpatients with a recently acquired SCI between three Dutch SCI rehabilitation centers, one center in Australia and one in Norway. Finally, chapter 7 presents a general discussion of the findings and the conclusions of this thesis.

References

1. Kirshblum S, Campagnolo DI, DeLisa JA (eds). Spinal cord medicine. Philadelphia: Lippincott Williams & Wilkins; 2002.
2. Noreau L, Shepard RJ. Spinal cord injury, exercise and quality of life. Sports Med. 1995;20: 227-250.
3. DeVivo MJ, Krause JS, Lammertse DP. Recent trends in mortality and causes od death among persons with spinal cord injury. Arch Phys Med Rehabil. 1999;80:1411-19.
4. Sipski ML, Richards J. Spinal cord injury rehabilitation: state of science. Am J Phys Med Rehabil. 2006;85:310-342.
5. Wuermser L, Ho CH, Chiodo AE, Priebe MM, Kischblum SC, Scelza WM. Spinal cord injury medicine. 2. Acute care management of traumatic and non-traumatic injury. Arch Phys Med Rehabil. 2007;88:55-61.
6. Kirschblum SC, Priebe MM, HO CH, Scelza WM, Chiodo AE, Wuermser LA. Spinal cord injury medicine. 3. Rehabilitation phase after acute spinal cord injury. Arch Phys Med Rehabil. 2007;88:62-70.
7. Scivoletto B, Morganti B, Molinan M. Early versus delayed inpatient spinal cord injury rehabilitation: an Italian study. Arch Phys Med Rehabil. 2005;86:512-516.
8. Sumida M, Fujimoto M, Tokushiro A, Tominga A, Uchida R. Early rehabilitation effect for traumatic spinal cord injury. Arch Phys Med Rehabil. 2001;82:391-395.
9. van der Putten JJ, Stevenson VL, Playford ED, Thomson AJ. Factors affecting functional outcome in patients with nontraumatic spinal cord lesions after inpatient rehabilitation. Neurorehabil Neural Repair. 2001;15:99-104.
10. Sisto SA, Druin E, Sliwinski MM. Spinal cord injuries. Management and rehabilitation. St. Louis, Missouri: Mosbey Elsevier; 2009.
11. Yarkony GM, Bass LM, Keeman V, Meyer PR. Contractures complicating spinal cord injury: incidence and comparison between spinal cord center and general hospital acute care. Paraplegia. 1985;23:265-71.
12. Gasaway J, Whiteneck G, Dijkers D. Classification of SCI rehabilitation treatments. Clinical taxonomy development and application in spinal cord injury rehabilitation research: The SCIRehab project. Journal of Spinal Cord Medicine. 2009;32:260-269.
13. Harvey L. Management of spinal cord injuries. Sydney: Butterworth Heinemann Elsevier; 2008.
14. Bloemen-Vrencken J. Health problems after spinal cord injury rehabilitation: who cares? (Thesis). Amsterdam: Free University of Amsterdam; 2009.
15. Schonherr MC. Functional outcome after spinal cord injury: Activities and Participation (Thesis). Groningen: Rijksuniversiteit Groningen; 2003.
16. Stucki G, Cieza A, Melvin J. The international classification of functioning, disability and health: a unifying model for the conceptual description of the rehabilitation strategy. J Rehabil Med. 2007;39:279-285.
17. World Health Organization. International classification of functioning, disability and health: ICF. Geneva: WHO; 2001.

18. Jette AM, Tao W, Haley SM. Blending activity and participation sub-domains of the ICF. Disabil Rehabil. 2007;29:1742-1750.
19. Whiteneck G, Dijkers MP. Difficult to measure constructs: conceptual and methodological issues concerning participation and environmental factors. Arch Phys Med Rehabil. 2009;90:22-35.
20. Bangma BD. Revalidatie Geneeskunde. Methodologie en praktische uitvoering (Rehabilitation Medicine: Methodology and practical implementation). Rotterdam: Erasmus University, Medical Faculty, Post Graduate Training Institute (PAOG); 1984.
21. van Dijk AJ. On rehabilitation medicine. A theory-oriented contribution to assessment of functioning and individual experience (Thesis). Amsterdam: Free University of Amsterdam; 2001.
22. (WHO) World Health Organisation. International classification of impairments, disabilities, and handicaps. Geneva: WHO; 1980.
23. Raad voor gezondheidszorg research 1980. Vertaling van de International Classification of Impairments, Disabilities, and Handicaps. A manual of classification relating to the consequences of disease. WHO; 1980.
24. van Bennekom CAM, Jelles F. Rehabilitation activities Profile: the ICDH as a framework for a problem-oriented assessment method in rehabilitation medicine (Thesis). Amsterdam: Free university of Amsterdam; 1995.
25. van Bennekom CAM, Jelles F. Rehabilitation Activities Profile. Haarlem; 1995.
26. van Asbeck FWA (ed). Handboek dwarslaesie revalidatie. Houten/Diegem: Bohn Stafleu Van Loghum; 1998.
27. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-110.
28. Vreede CF. A guide to ADL. Delft: Eburon; 1993.
29. van Dijk AJ, Dekkers JHM, Pijlman CP, Steinmijer NAM, Kuipers AN, Slootman JR. Leerplan Syllabus Incompany training; 2006.
30. Nederlands WHO-FIC Collaborating Centre. ICF, Nederlandse vertaling van de 'International classification of functioning, disability and health'.Geneva, 2002. Houten Diegem: Bohn Stafleu Van Loghum; 2002.
31. Fromovich-Amit Y, Biering Sørensen F, Baskov V, Juocevicius, Hansen HV, Gelernter I, Hart J, Baskov A, Dreval O, Terese P, Catz A. Properties and outcomes of spinal rehabilitation units in four countries. Spinal cord. 2009;47:597-603.
32. Wade DT.Editorial. A framework for considering rehabilitation interventions. Clin Rehabil. 1998;12:363-368.
33. Hoenig H, Sloane R, Horner RD, zolkewitz M, Duncan P, Hamilton B. Taxonomy for classification of stroke rehabilitation services. Arch Phys Med Rehabil. 2000;81:853-862.
34. de Groot S, Dallmeijer AJ, Post MWM, van Asbeck FWA, Nene AV, Angenot ELD. Demographics of the Dutch multicenter prospective cohort study 'Restoration of mobility in spinal cord injury rehabilitation'. Spinal Cord. 2006;44:668-675.
35. Osterthun R, Post M, van Asbeck F, on behalf of the Dutch-Flemish Spinal Cord Society. Characteristics, length of stay and functional outcomes of patients with spinal cord injury in Dutch and Flemish rehabilitation centers. Spinal Cord. 2009;47:339-344.

36. Eastwood EA, Hagglund K, Ragnarsson K, Gordon w, Marino R. Medical rehabilitation length of stay and outcomes for persons with traumatic spinal cord injury 1990-1997. Arch Phys Med Rehabil. 1999;80:1457-1463.
37. Post MWM, Dallmeijer AJ, Angenot E, van Asbeck FWA, van der Woude LH. Duration and functional outcome of spinal cord injury rehabilitation in the Netherlands. J Rehabil Res Dev. 2005;42:75-86.
38. Keith RA. Treatment strength in rehabilitation. Arch Phys Med Rehabil. 1997;78:1298-1304.
39. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "Black Box"of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-686.
40. White J, Hart T. It's more than a black box; It's a Russian Doll. Defining rehabilitation treatments. Am J Phys Med Rehabil. 2003;82:639-652.
41. Alexander MS, Anderson KD, Biering-Sørensen F, Blight AR, Brannon R, Bryce TN et al.Outcome measures in spinal cord injury: recent assessments and recommendations for future directions. Spinal Cord. 2009;47:582-591.
42. Marino RJ, Barros T, Biering-sørensen F, Burns SP, Donovan WH, Graved DE. International standards for neurological classification of spinal cord injury. J Spinal Cord Med. 2003;26:50-56.
43. Itzkovich M, Gelernter I, Biring-Sørensen F, Weeks C, Lamaree MT, Craven BC et al. The spinal cord injury indepence measure (SCIM) version III: reliability and validity in a multi-center study. Disabil Rehabil. 2007;29:1926-1933.
44. Whiteneck G, Gassaway MS, Dijkers M, Jha A. Classification of SCI rehabilitation treatments. New approach to study the content and outcomes of spinal cord injury rehabilitation: the SCIRehab project. J Spinal Cord Med. 2009;32:251-259.
45. Chen CC, Heinemann AW, Granger CV, Linn RT. Functional gains and therapy intensity during subacute rehabilitation: A study of 20 facilities. Arch Phys Med Rehabil. 2002;83:1514-1523.
46. Jette DU, Warren RL, Wirtalla C. Rehabilitation in skilled nursing facilities. Am J Phys Med Rehabil. 2004;83:704-711.
47. Heinemann AW, Hamilton B, Linacre JM, Wright BD, Granger C. Functional status and therapeutic intensity during inpatient rehabilitation. Am J Phys Med Rehabil. 1995;74:315-326.
48. Johnston MV, Wood KD, Fiedler R. Characteristics of effective and efficient rehabilitation programs. Arch Phys Med Rehabil. 2003;84:410-418.
49. American Physical Therapy Association. Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-27, 223-39, 437-53.
50. Occupational Therapy Practice Framework: domain and process. Am J Occup Ther. 2002;56: 609-39.
51. Figoni SF. Spinal cord injury. In: Durstine JL (ed). Exercise management for persons with chronic disease and disabilities. Champaign (IL): Human kinetics; 1997.
52. Harvey L. The effectiveness of physical interventions for people with spinal cord injuries: a systematic review. Spinal Cord. 2008; 1-12.
53. Jacobs PL, Nash MS. Exercise recommendations for individuals with spinal cord injury. Sports Med. 2004;34:727-751.

54. Heinemann AW. State-of-the-science on postacute rehabilitation: setting a research agenda and developing an evidence base for practice and public policy. An introduction. Arch Phys Med Rehabil. 2007;88:1478-1481.
55. Clohan DB, Durkin EM, Hammel J, Murray P, Whyte J, Dijkers M, Gans B, Graves DE, Heinemann AW, Worsowicz G. Postacute rehabilitation research and policy recommendations. Arch Phys Med Rehabil. 2007;88;1535-1541.
56. Horn SD, De Jong G, Ryser DK, Veazie PJ, Teraoka J. Another look at observational studies in rehabilitation research: going beyond the holy grail of the randomized controlled trial. Arch Phys Med Rehabil. 2005;86:8-15.
57. Biering-Sørensen F. Evidence-based medicine in treatment and rehabilitation of spinal cord injured. Spinal Cord. 2005;43:587-592.
58. Wade DT. Describing rehabilitation interventions. Clin Rehabil. 2005;19: 811-818.
59. Bailey, KD. Typologies and taxonomies. An introduction to classification techniques. London New Delhi: Sage publications; 1994. p. 1-6.
60. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the 'black box' of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-1908.
61. Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box therapy- a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. Clin Rehabil. 1999;13:301-309.
62. van Vliet PM, Lincoln B, Robinson E. Comparison of the contents of two physiotherapy approaches for stroke. Clin Rehabil. 2001;15:398-414.
63. Tyson SF, Selley A. The development of the stroke physiotherapy intervention recording tool (SPIRIT). Disabil Rehabil. 2004;26:1184-1188.
64. Richards LG, Latham NK, Jette DU, Rosenberg L, Smout RJ, De Jong G. Characterizing occupational therapy practice in stroke rehabilitation. Arch Phys Med Rehabil. 2005;86:51-60.
65. Marino RJ, Stineman MG. Functional assessment in spinal cord injury. Top Spinal Cord Inj Rehabil. 1996;1:32-45.
66. Nagi S. Some conceptual issues in disability and rehabilitation, in: Sussman M (ed). Sociology and Rehabiltation, American Sociological Association. Washington DC; 1965: p. 100-113.
67. Heinemann AW, Kirk P, Hastie BA, Semik P, Hamilton BB, Linacre JM, Wright, D, Granger C. Relationships between disability measures and nursing effort during medical rehabilitation for patients with traumatic brain injury and spinal cord injury. Arch Phys Med Rehabil. 1997;78:143-149.
68. Jette DU, Warren RL, Wirtalla C. Rehabilitation in skilled nursing facilities. AM J Phys Med Rehabil. 2004;83:704-711.
69. English CK, Hillier SL, Stiller KR, Warden-Flood A. Circuit class therapy versus individual physiotherapy sessions during inpatient stroke rehabilitation: a controlled trial. Arch Phys Med Rehabil. 2007;88:955-963.
70. Dean CM, Richards C, Malouin F. Task-related circuit training improves performance of locomotor tasks in chronic stroke: a randomized controlled trial. Arch Phys Med Rehabil. 2000;81:409-17.

Chapter 2

Development of a classification system of physical, occupational and sports therapy interventions to document mobility and self-care in spinal cord injury rehabilitation

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Abstract

Objective. To describe the development of a classification system for therapeutic activities in clinical spinal cord injury (SCI) rehabilitation.
Design. Descriptive study including a modified Delphi consensus method.
Setting. Specialized SCI units of 10 rehabilitation facilities.
Participants. Thirty physical therapists, occupational therapists and sports therapists from 10 Dutch and Flemish SCI centers.
Main outcome measures. Identification of the levels, categories and interventions; level of agreement among experts with (1) definitions, (2) terminology, (3) relevance, and (4) completeness of the classification (consensus considered sufficient if 80% or more agree).
Results. The classification comprises 3 levels of functioning: basic functions, basic activities, and complex activities. The 3 levels comprise 28 categories within which interventions are listed. Sufficient consensus was obtained for the definitions of the 3 levels (range 87% - 100%). Percentages of consensus for the terminology used and the completeness of the categories ranged from 75% to 100%. The perceived relevance of the categories for everyday work varied per discipline.
Conclusions. A potentially useful classification system was developed to record clinical treatment sessions in physical therapy, occupational therapy and sports therapy for persons with SCI. The classification system is currently being tested in ongoing research.

Introduction

Many rehabilitation researchers have emphasized the need to examine the actual contents of rehabilitation programmes, to allow the rehabilitation input to be correlated with functional outcome measures.[1-3] One key component of these contents is the therapy provided. Research on spinal cord injury (SCI) rehabilitation has emphasized the contributions made by therapeutic activities involving physical therapy, occupational therapy, and sports therapy to the improvement of physical performance and capacity regarding mobility and self-care by SCI patients.[4,5] However, the least developed area in this type of research is outcomes research or effectiveness research for these treatments.[6-9] To correlate the complex and broad range of rehabilitation interventions with outcomes, most studies have used only the length of stay[10,11] or the total number of hours of therapy[12,13] as a rough proxy of the amount of therapy provided. At a more specific level, research into rehabilitation interventions has examined the methods and effects of some stand-alone interventions. At the level of body structures and functions, methods that have been examined include those involving muscle stretching and passive range of motion of the joints[14,15], cardiovascular training[16], and exercises for the respiratory system.[17] At the level of activities, research has concentrated on functional electrical stimulation in cycling[18], training on a treadmill[19,20], and training with robotic devices.[21] So far, however, these publications have failed to cover the full spectrum of therapeutic activities provided in SCI rehabilitation.

Research into treatment efficacy and effectiveness requires specification of the many treatments. Describing and characterizing treatments, by means of uniform concepts and language would enable us to create a basis to correlate interventions with rehabilitation outcomes.[6] In stroke rehabilitation, several studies[6,9,22-24] have focused on therapeutic activities, and their authors have introduced systems of concept categories or classes, into which treatments can be systematically grouped. De Jong et al.[6] defined their system as a 'taxonomy of treatments', while Bode et al.[9] used the term 'classification of therapy activities'.

Although some of the interventions described in these stroke studies[6,9] can also be used in SCI rehabilitation, others[6] are specifically aimed at impairments resulting from stroke (e.g., cognitive training). Another difference between SCI and stroke rehabilitation is the greater role of sports therapy in SCI and the less likely use of cognitive and speech therapy.

As far as we know, no classification or taxonomy of treatments has been developed for SCI rehabilitation. We therefore decided to develop a classification of well-defined treatments, with the aim of using it as a tool to collect data on the contents of SCI rehabilitation interventions in different systems and settings in

order to open up the 'black box' of SCI rehabilitation. Defining treatments in a systematic way forces researchers and clinicians to articulate their underlying hypotheses and beliefs about the mechanisms of treatment effects.[7] Moreover, defining treatments in objective and operational terms is a requirement for any research.[7] The use of clear definitions allows the active ingredients of different treatments that contribute to rehabilitation outcomes to be identified and compared. The aim of this study was (1) to develop the classification described above and (2) to examine the level of agreement on its definitions, terminology, relevance, and completeness among representatives of 10 Dutch and Flemish SCI rehabilitation centers.

Methods

The classification was developed in three stages, combining quantitative and qualitative data.[25] We first performed a literature search to identify relevant models and elements for our classification.[4,26-32]

In developing our classification, we made two basic choices. First, we decided that the classification should be structured according to aspects of human functioning. Second, the classification should be focused primarily on the mobility and self-care domains rather than on all possible domains of functioning at once. The concept of mobility covers sitting, standing, transfers, arm and hand use, walking, wheelchair mobility, and transportation. Self-care covers eating, drinking, washing, caring for body parts, dressing and toileting. The decision to develop these domains first was mainly based on the consideration that mobility and self-care are key issues in independent living and quality of life for individuals with SCI.[4,5] In addition, most outcome measures of rehabilitation (e.g., motor Funktional Independence Measure) address mobility and self-care.[11-13]

In our study, we used the term classification in the sense of the ordering of entities into groups (in this case 3 levels and 28 categories) based on similarity.[33] The ordering of the 3 levels is based on the concept of human functioning[27], while the ordering of the various categories is based on the targeted area of the interventions. The levels and categories are mutually exclusive.

After the literature search, the first draft of the classification was used in an exploratory study in 3 Dutch rehabilitation centers with a specialized SCI unit. Subsequently, a modified Delphi consensus procedure[34] consisting of an invitational conference followed by a two-round postal questionnaire survey, was used to test the second draft of the classification.

Exploratory study

To pretest and refine the first draft of our classification, the first author (SvL) visited 3 SCI centers in the Netherlands for one week each to collect data by means of interviews and observations of daily therapeutic activities. Based on this qualitative evaluation of the first draft of the classification by the research team a second draft was developed.

Delphi rounds

Since approval of the classification by relevant clinicians was considered a crucial test of its validity, a Delphi consensus method was used.[34] The Delphi technique is a formal method for generating group consensus without the need for prolonged face-to-face interaction.[34-36] First, an invitational conference was organized, to which all 11 Dutch and Flemish rehabilitation centers with a specialized SCI unit were invited to send representatives. During the morning session, the classification was explained and examples were given of how to categorize interventions with the classification. In the afternoon, the Delphi technique was explained.

Six weeks after the invitational conference, the first postal consensus round took place. All participants to the conference received the classification of interventions with instructions and a questionnaire. They were first asked whether the definitions of the 3 levels were clear. Second, they were asked to indicate (by choosing yes or no) for each intervention, whether (1) the terminology used to describe the intervention was acceptable, (2) the intervention was relevant to their discipline, and (3) the lists of interventions were complete. Acceptable terminology was defined as using language that was familiar to the respondents, and relevant intervention was defined as an intervention that was performed regularly or occasionally in the respondents' clinical practice. If the respondents thought that the lists were incomplete, they were asked to suggest additions. The required pretest level of agreement with the terminology used and relevance of each intervention was set at 80%[36] for each of the 3 disciplines. If the level of agreement with a particular intervention within a particular discipline was less than 80% acceptance, the intervention was omitted, clarified, or adapted for the second round.

A second postal consensus round was held 6 weeks later and included only adapted or clarified items about which insufficient agreement existed in the first round, as well as the additional items suggested by participants in the first round. The participants were asked whether the revised version was an improvement and whether they thought the adapted or additional items should indeed be included in the classification. The required level of agreement was again set at 80% within the discipline. The first author collected all the responses and computed percentages of agreement using Excel.

Results

Models of human functioning

Various models of human functioning have been proposed.[26-30] Since the International Classification of Functioning, Disability and Health (ICF)[27] is the most widely used classification and is internationally agreed upon, we decided to use the ICF model and terminology and to add a distinction between basic and complex activities, as suggested by Van Dijk[28,29] and Post et al.[37]

The 3 levels used in our classification were defined as follows: (1) basic functions: interventions aimed at the physiological functions of body systems and/or anatomical parts of the body; (2) basic activities: interventions aimed at exercising and/or training techniques and skills for positions and movements; and (3) complex activities: interventions aimed at training activities taking place in a relevant environmental context with a meaningful goal for the individual. These definitions imply that several therapeutic activities (e.g., walking and wheelchair driving) can be categorized at the level of either basic activities or complex activities, depending on the context and environment in which these therapeutic activities take place.

Invitational conference

At the invitational conference, 10 of the 11 SCI centers were represented (14 physical therapists, 13 occupational therapists and 5 sports therapists). All 8 Dutch and 2 out of 3 Flemish SCI centers were represented by at least 1 physical therapist (range per center, 1-2) and at least 1 occupational therapist (range per center, 1-2). The 5 sports therapists represented 5 Dutch centers. One Dutch sports therapist was on vacation, and the other Dutch and all 3 Flemish centers did not have specialized SCI sports therapists. The mean number of years of experience in SCI rehabilitation was 12.2 years for the physical therapists, 5.2 years for the occupational therapists, and 4.7 years for the sports therapists. The participants unanimously agreed that the proposed classification was useful, and all were willing to participate in its further development.

Postal Delphi rounds

Of the 32 participants of the invitational conference, 30 completed the first and second Delphi rounds (13 physical therapists, 12 occupational therapists and 5 sports therapists). All 10 centers represented at the invitational conference were also represented in the postal Delphi rounds.

As shown in Table 1, there was a high level of consensus among the participants about the contents of the classification.

Table 1. Percentages of agreement with aspects of the classification in the first Delphi round.

	Interventions	PTs (n=13)	OTs (n=12)	Sports (n=5)
Acceptable terminology				
Basic functions categories	n = 14	92.3%	96.7%	94.4%
Basic functions subcategories	n = 26	95.7%	95.2%	86.7%
Basic activities categories	n = 11	84.6%	75.0%	100.0%
Basic activities subcategories	n = 31	98.6%	89.0%	100.0%
Complex activities:	n = 7	100.0%	100.0%	100.0%
Complex activities subcategories	n = 23	100.0%	100.0%	100.0%
Agreement on relevance				
Basic functions categories	n = 14	80.1%	65.6%	30.7%
Basic functions subcategories	n = 26	83.5%	57.2%	34.1%
Basic activities categories	n = 11	72.7%	67.2%	74.5%
Basic activities subcategories	n = 31	81.6%	72.0%	62.0%
Complex activities categories	n = 7			
Complex activities mobility	n = 2	80.1%	100.0%	100.0%
Complex activities self-care	n = 5	7.7%	95.0%	0.0%
Complex activities subcategories	n = 23			
Complex activities mobility	n = 11	58.0%	96.2%	61.8%
Complex activities self-care	n = 12	99.1%	99.1%	0.0%
Agreement on completeness				
Basic functions categories	n = 14	92.3%	84.4%	92.3%
Basic functions subcategories	n = 26	53.9%	90.0%	90.0%
Basic activities categories	n = 11	100.0%	75.0%	80.0%
Basic activities subcategories	n = 31	92.9%	75.0%	100.0%
Complex activities categories	n = 7	100.0%	92.6%	100.0%
Complex activities subcategories	n = 14	100.0%	92.6%	100.0%

Percentages of agreement within each discipline on (1) acceptability (recognizability) of the terminology used; (2) relevance of the interventions listed; and (3) completeness of the list of interventions. The percentages of agreement on the relevance of the mobility and self-care domains of complex activities are presented separately to highlight the differences between disciplines.

Abbreviations: PTs, physical therapists; OTs, occupational therapists; Sports, sports therapists.

Consensus on basic functions level

In the first Delphi round, the definition of the basic functions level was accepted by all participants. There was also sufficient consensus about the terminology used for the 10 categories and the interventions listed at the level of basic functions. Only the 'pain treatment' category was frequently commented on, with participants stressing the need for separate categories for neuropathic pain and musculoskeletal pain. Consequently, the categories of 'neuropathic pain treatment' and 'musculoskeletal pain treatment' were introduced in the second Delphi round. This adaptation was accepted and approved by all participants as a useful addition to the classification. Regarding relevance, all categories and interventions at the level of basic functions were rated as relevant by at least 80% of the representatives of one or more disciplines. Finally, the classification (categories and intervention lists) was considered complete by all 3 disciplines, except for the list of interventions at the level of basic functions, which was considered incomplete by the physical therapists (53.8%). Since comments were mainly directed at the interventions in the muscle power category, we adapted the terminology for muscle power training interventions in the second Delphi round to broaden the coverage of these interventions. These adaptations were accepted and approved as a useful addition to the classification by 93.3% of the participants. Table 2 lists the final 11 categories, with some examples of interventions at the basic functions level. (Page 35)

Consensus on basic activities

In the first Delphi round, the proposed definition of the level of basic activities was accepted by 87% of the participants. There were no major comments on the terminology used for the categories and interventions. All categories were rated relevant (> 80 %) by 1 or more disciplines. As regards the completeness of the basic activities list, agreement was only insufficient among the occupational therapists, with 75% agreement for both the categories and interventions. Additions mentioned by the occupational therapists were presented in the second Delphi round. Only 1 of these, fall skills, received sufficient consensus to be added to the basic activities interventions. Table 3 lists the final 9 categories, with some examples of interventions at the basic activities level. (Page 36)

Consensus on complex activities

In the first Delphi round, the definition of the complex activities level was accepted by 90% of the participants. The participants had no major comments on the terminology used for the complex activities level. The mobility categories were rated by all 3 disciplines as relevant to their discipline in the first Delphi round, whereas the self-care categories were rated as highly relevant only by the occupational therapists. Finally, the agreement about the completeness of the

categories and interventions at this level was sufficient. Table 4 shows the final 8 categories, with some examples of interventions at the complex activities level. (Page 37)

Table 2. Basic functions: categories and examples of exercises, training and appliances for physiological functions and structures of the body.

Basic functions categories	Examples of interventions
(1) Muscle power	Active exercises with assistance by therapist Active exercises with training equipment Appliances, e.g., electrical stimulation
(2) Muscle tone	Stretching exercises Relaxation techniques Appliances, e.g., hot and cold packs
(3) Muscle length	Stretching exercises Passive movements
(4) Joint mobility	Manual mobilization techniques
(5) Sensory system	Sensitize/ desensitize Appliances, e.g., electrical stimulation
(6) Neuropathic pain	Pain coaching strategies Appliances, e.g., hot packs
(7) Musculoskeletal pain	Manual techniques
(8) Skin and related structures (I) general aspects	Manual techniques, e.g., connective tissue massage Appliances, e.g., compression, bandaging
(9) Skin and related structures (II) (ulcer prevention)	Appliances, e.g., ultrasound
(10) Cardiovascular system	Cardiovascular training equipment Sports activities
(11) Respiratory system	Breathing pattern strategies Appliances, e.g., suctioning

Table 3. Basic activities: categories and examples of exercising and training skills and techniques.

Basic activities categories	Examples of interventions
(1) Hand and arm use	Picking up, grabbing, manipulating, releasing Lifting, carrying, putting down Reaching, positioning Sports activities
(2) Tasks and subtasks in self-care	Washing oneself and caring for body parts Toileting; bladder Toileting; bowel Dressing Eating, drinking
(3) Basic body positions and movements	Prone, supine, lying on side and turning Sitting Positions and movements, mainly using arms Positions and movements, using arms and legs Sitting in sports activities
(4) Transfers	From/to wheelchair - exercise table From/to wheelchair - different heights/forms From/to Wheelchair - toilet/shower - chair - wheelchair From/to wheelchair - bed From/to wheelchair - car From/to wheelchair - lift, lifting techniques
(5) Standing	Standing Getting up/ sitting down Falls skills Standing in sports activities
(6) Walking	Walking on treadmill (+support system) Walking in water (hydrotherapy) Walking indoors Walking outdoors Walking in sports activities
(7) Manual wheelchair propulsion and (hand)cycling	Hand rim wheelchair propulsion indoors Hand rim wheelchair propulsion outdoors Hand rim wheelchair propulsion in sports activities Hand cycling or bicycling indoors Hand cycling or bicycling outdoors
(8) Use of and/or driving human-powered and/or motorized transportation	Power wheelchair propulsion indoors Power wheelchair propulsion outdoors Using transportation indoors Using transportation outdoors
(9) Swimming skills training	Exercising and training for swimming

Table 4. Complex activities: categories and examples of interventions in a meaningful context or environment.

Complex activities categories	Examples of interventions
(1) Walking and moving around indoors	From nursing ward to exercise locations On the nursing ward At one's own home In other home/building/store
(2) Walking and moving around outdoors	In immediate area of RC In immediate area of one's own home To go to stores/buildings in the neighbourhood of RC <1km To go to stores/buildings >1km To be outdoors, to go to recreational areas
(3) Transfers inside/outside the RC	As a part of ADL tasks inside the RC As a part of other complex activities inside the RC At locations outside the RC To a car, including wheelchair in/out to go elsewhere.
(4) Washing oneself and caring for body parts	Being in bed on the ward in the RC At the sink, in the shower on the ward in the RC At locations outside the RC
(5) Toileting; bladder	On the ward in the RC At locations outside the RC
(6) Toileting; bowel	On the ward in the RC At locations outside the RC
(7) Dressing	Being in bed on the ward in the RC In the wheelchair on the ward in the RC At locations outside the RC
(8) Eating and drinking	Being in bed on the ward in the RC Sitting at the table on the ward in the RC Sitting at the table in the restaurant, or elsewhere in the RC At locations outside the RC

Abbreviations: ADL, activities of daily living; RC, rehabilitation center.

Discussion

The aim of the present study was to develop a classification for physical therapy, occupational therapy, and sports therapy interventions to improve self-care and mobility among persons with SCI. The proposed classification met with high levels of consensus among Dutch experts in the field as regards the definitions and terminology used and the relevance and completeness of the classification. The classification therefore appears to be a relevant and comprehensive tool to record therapeutic activities in SCI rehabilitation. It is the first in which specific treatment components of physical therapy, occupational therapy and sports therapy in SCI rehabilitation can be identified. The detailed taxonomy of treatments might enable the detection of meaningful differences and changes in therapeutic activities provided during various periods of rehabilitation and in different types of patients as previous studies[6,10,13,19] concluded that such comparisons require more detailed descriptions of interventions than the systems used in these studies allowed for. To improve the reliability of our classification, we have developed a detailed manual and classification instructions.
Since we used the ICF[27] terminology as the basis for our classification, the majority of the categories and interventions can easily be linked to items in the ICF. A few specifications were added to the ICF terminology to make it more appropriate for therapeutic treatment sessions in SCI rehabilitation. Neuropathic pain, for example, was added as a separate category next to musculoskeletal pain, since these types of pain require different therapeutic interventions, as was confirmed by the participants in our consensus rounds. Furthermore, the labels walking and moving around and moving around with transportation from the ICF[27] were divided into several subcategories within the levels of basic and complex activities, depending on the context and environment in which these therapeutic activities take place. Just as has been reported in publications on stroke[23,24], the approach in SCI rehabilitation involves emphasizing not only the need to address the underlying impairments but also task-oriented therapy (relating to a specific context or environment).[38-40] By making a distinction between basic and complex activities, we aimed to capture the basic therapeutic activities as well as the more advanced ones.

Study limitations

This study was subject to several limitations. First, at this stage of development, no actual data from treatment sessions were collected. Hence, we cannot conclude that the proposed categories and interventions reflect actual clinical practice. These data are collected in an ongoing study. Furthermore, the interobserver and intraobserver reliability of the classification and sensitive to different types of SCI patients (tetraplegia, paraplegia, complete, incomplete) and

settings (post-acute, outpatient) will be tested in a subsequent study. Finally, this study involved only a Dutch-language version of the classification. Nonetheless, we want to emphasize that this classification was developed from an international point of view. Not only did we consult international literature[4] and guidelines[31,32] on therapeutic activities in SCI rehabilitation, but the use of the ICF[26,27] to structure the classification also ensures a cross-cultural perspective. An English-language version of the classification will be tested in future research.

Conclusions

The results of this study indicate that the recently developed classification is a promising tool to record day-to-day treatment sessions in SCI rehabilitation. After its validation has been completed, the classification enables description of clinically relevant therapeutic interventions in SCI rehabilitation in a globally accepted language. Both type and duration of specific interventions can be described. With the classification, improvement in, for example, locomotion, can be related to the type and duration of training at different levels of functioning. It can reveal which form of locomotor training , for example, training on a treadmill versus over ground walking exercises, account for the improvement in walking performance of patients with SCI. In this way, comparisons can be made between SCI rehabilitation programmes in different centers or countries. In the future, such studies may identify succesful treatments in the real world of SCI rehabilitation.

References

1. Heinemann AW, Hamilton B, Linacre JM, Wright BD, Granger C. Functional status and therapeutic intensity during inpatient rehabilitation. Am J Phys Med Rehabil. 1995;74:315-326.
2. Johnston MV, Wood KD, Fiedler R. Characteristics of effective and efficient rehabilitation programs. Arch Phys Med Rehabil. 2003;84:410-418.
3. Stineman MG, Hamiliton BB, Goin JE, Granger CV and Fiedler RC. Functional gain and length of stay for major rehabilitation impairment categories. Am J Phys Med Rehabil. 1996;1:68-78.
4. Kirschblum S, Ho CH, House JG, Druin E, Nead C, Drastal S: Rehabilitation of spinal cord injury. In: Kirschblum S, Campagnolo DI, Delisa JA, (eds.) Spinal cord medicine. Philadelphia: PA Lippincott Williams & Wilkins; 2002.
5. Noreau L, Shepard RJ. Spinal cord injury, exercise and quality of life. Sports Med. 1995;20:227-250.
6. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "Black Box"of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-686.
7. White J, Hart T. It's more than a black box; It's a Russian Doll. Defining rehabilitation treatments. Am J Phys Med Rehabil. 2003;82:639-652.
8. Keith RA. Treatment strength in rehabilitation. Arch Phys Med Rehabil. 1997;78:1298-1304.
9. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the 'black box' of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-1908.
10. Post MWM, Dallmeijer AJ, Angenot E, Asbeck FWA van, Woude LH van der. Duration and functional outcome of spinal cord injury rehabilitation in the Netherlands. J Rehabil Res Dev. 2005;42:75-86.
11. Heinemann AW, Linacre JM, Wright BD, Hamilton BB, Granger C. Prediction of rehabilitation outcomes with disability measures. Arch Phys Med Rehabil. 1994;75:133-143.
12. Ditunno JF, Ditunno PL, Graziani V, Scivoletto G, Bernardi M, Castellano V, Marchetti M, Barbeau H, Frankel HL, D'Andrea Greve Jm, Y- Ko H, Marshall R and Nance P. Walking index for spinal cord injury (WISCI): an international multicenterr validity and reliability study.
Spinal cord. 2000;38:234-243.
13. Chen CC, Heinemann AW, Granger CV, Linn RT. Functional gains and therapy intensity during subacute rehabilitation: A study of 20 facilities. Arch Phys Med Rehabil. 2002;83:1514-1523.
14. Harvey LA, Byak AJ, Ostrovskaya M, Glinsky J, Katte L, Herbert RD. Randomised trial of the effects of four weeks of daily stretch on extensibility of hamstring muscles in people with spinal cord injuries. Aust J Physiother. 2003;49:176-81.
15. Harvey LA, Herbert R, Crosbie J. Does stretching induce lasting increases in joint ROM? A systematic review. Physiother Res Int. 2002;7:1-13.
16. Jacobs PL, Nash MS. Exercise recommendations for individuals with spinal cord inujry.. Sports Med. 2004;34:727-751.
17. Mueller G, Perret C, Spengler CM. Optimal intensity for respiratory muscle endurance training in patients with spinal cord injury. J Rehabil Med. 2006;38:381-6.

18. Mutton DL, Scremin AM, Barstow TJ, Scott MD, Kunkel CF, Cagle TG. Physiologic responses during functional electrical stimulation leg cycling and hybrid exercise in spinal cord injured subjects. Arch Phys Med Rehabil. 1997;78:712-718.
19. Dobkin.B, Apple D, Barbeau H, Basso M, Behrman A, DeForge D, Ditunno J, Dudley G, Elashoff R, Fugate L, Harkema S, Saulino M, Scott M, Spinal cord Injury Locomotor Trial Group. Weight-supported treadmill vs over-ground training for walking after acute incomplete SCI. Neurology. 2006; 28:484-93.
20. Field- Fote EC, Lindley SD, Sherman AL. Locomotor training approaches for individuals with spinal cord injury: a preliminary report of walking-related outcomes. J Neurol Phys Ther. 2005;29:127-137.
21. Bouyer LJ. Animal models for studying potential training strategies in persons with spinal cord injury. J Neurol Phys Ther. 2005;29:117-125.
22. Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box therapy- a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. Clin Rehabil. 1999;13:301-309.
23. Latham NK, Jette DU, Slavin M, Richards LG, Procino A, Smout RJ, Horn SD. Physical Therapy during stroke rehabilitation for people with different walking abilities. Arch Phys Med Rehab. 2005;86:41-50.
24. Richards LG, Latham NK, Jette DU, Rosenberg L, Smout RJ, De Jong G. Characterizing Occupational therapy practice in stroke rehabilitation. Arch Phys Med Rehab. 2005;86:51-60.
25. Creswell JW. Research design. Qualitative, quantitative, and mixed methods approaches. 2nd ed. Thousand oaks, California: Sage publications; 2003.
26. WHO-FIC Collaborating Center. ICF, Nederlandse vertaling van de 'International Classification of Functioning, Disability and Health'. Geneva: Houten Diegem: Bohn Stafleu Van Loghum; 2002.
27. World Health Organisation. International Classification of functioning, disability and health: ICF. Geneva: WHO; 2001.
28. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-110.
29. van Dijk AJ. On rehabilitation medicine. A theory-oriented contribution to assessment of functioning and individual experience [Thesis]. Amsterdam: Free University of Amsterdam; 2001.
30. Marino RJ. Stineman MG Functional assessment in spinal cord injury. Top Spinal Cord Inj Rehabil. 1996;1:32-45.
31. American Physical Therapy Association.Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-127/223- 239/437-453.
32. Occupational therapy practice framework: Domain and process. Am J Occup Ther. 2002;56,609-639.
33. Bailey, KD. Typologies and taxonomies. An introduction to classification techniques. London: Sage publications;1994. p. 1-6.
34. Jones J, Hunter D. Using the Delphi and nominal group technique in health services research. In: Pope C, Mays N, eds. Qualitative research in health care. 2nd ed. London: BMJ Books;2000. p. 40-49.
35. Weigl M, Cieza A, Andersen C, Kollerits B, Amann E, Stucki G.Identification of relevant ICF categories in patients with chronic health conditions: a Delphi exercise.
J Rehabil Med. 2004;44(Suppl):12-21.

36. Stucky G and Grimby G. ICF core sets for chronic conditions. J Rehabil Med. 2004;44(Suppl):5-6.
37. Post MW, van Lieshout G, Seelen HA, Snoek GJ, IJzerman M, Pons C. Measurement properties of the short version of the Van Lieshout Test (VLT-SV) for arm/hand function of persons with tetraplegia after spinal cord injury. Spinal Cord. 2006;44:763-771.
38. Beekhuizen KS, Field-Fote EC. Massed practice versus massed practice with stimulation: effects on upper extremity function and cortical plasticity in individuals with incomplete cervical spinal cord injury. Neurorehabil Neural Repair. 2005;19:33-45.
39. Hoffman LR, Field-Fote EC. Cortical reorganization following bimanual training and somatosensory stimulation in cervical spinal cord injury: a case report. Phys Ther. 2007;87:208-23.
40. Dobkin BH. Confounders in rehabilitation trials of task-oriented training: lessons from the designs of the EXCITE and SCILT multicenter trials. 2007;21:3-13. Erratum in: Neurorehabil Neural Repair. 2007;21:195.

Chapter 3

Feasibility of a classification system for physical therapy, occupational therapy, and sports therapy interventions for mobility and self-care in spinal cord injury rehabilitation

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Abstract

Objective. To test the feasibility of a classification system developed to record the contents of treatment sessions intended to improve mobility and self-care by persons with a spinal cord injury (SCI) in clinical rehabilitation.
Design. Descriptive study.
Setting. Three Dutch SCI facilities.
Participants. Participants (n=36) as well as physical therapists (n=20), occupational therapists (n=14), and sports therapists (n=2).
Interventions. Not applicable.
Main outcome measures. Questionnaires to assess the clarity of the classification system, time needed to record 1 treatment session, and the distribution of categories and interventions. The classification system consisted of 28 categories at 3 levels of functioning: basic functions (e.g., muscle power), basic activities (e.g., transfers) and complex activities (e.g., walking and moving around outdoors).
Results. Therapists used 1625 codes to record 856 treatment sessions of 142 patients. For 93% of the treatment sessions, the coding caused little or no doubt. The therapists were able to classify 86.3% of the treatment sessions within 3 minutes. The classification system was rated as useful and easy to use.
Conclusions. The findings support the suitability of our classification system as a tool to record the contents of SCI treatment sessions in different settings and by different therapists.

Introduction

Physical therapy, occupational therapy, and sports therapy are thought to contribute to the improvement of mobility and self-care among patients with Spinal Cord Injury (SCI).[1-3] However, evidence for interventions for mobility and self-care is sparse.[4] Spinal Cord Injury rehabilitation research has mostly focused on isolated and easy-to-define interventions[5-8] and new technological developments.[9-11] To be able to determine and compare the effectiveness and efficiency of comprehensive SCI rehabilitation programmes, it is necessary to describe the contents of these programmes in a standardized and unambiguous way.[12]

To date, however, no classification system is available for therapeutic interventions in SCI rehabilitation. We have therefore developed a classification system based on the main domains of SCI rehabilitation, mobility and self-care.[13]
The classification system consists of 28 categories at 3 levels of functioning. (Appendix 1) The levels of the classification system and the selection of the categories were derived from the International Classification of Functioning, Disability and Health (ICF)[14,15] and the Van Dijk model.[16,17] The interventions were identified from clinical practice, general SCI literature[1-3], the Guide to Physical Therapy Practice[18], and the Occupational Therapy Practice Framework[19], as well as classification systems developed for stroke rehabilitation.[20-22]

The levels used in our classification system are defined as follows: (1) basic functions, i.e. interventions aimed at the physiological functions of body systems and/or anatomical parts of the body (comparable with the components body functions and structures of the ICF)[14], (2) basic activities, i.e. interventions aimed at skills and techniques for positions and movements (comparable with the component activity of the ICF)[14], and (3) complex activities, i.e. interventions aimed at task-oriented activities with a meaningful goal for the person (more advanced activities). The difference between the last two levels is the difference in context and/or the environment in which the activities take place. For example, walking exercises between parallel bars are aimed at practising components (e.g., muscle power and/or endurance) of the movement itself. Walking with the goal of moving from room to room is primarily aimed at the goal of being able to walk in a task related context. The rationale for a distinction between basic and complex activities has been described elsewhere.[23-26] According to the definition of the ICF[14,15], participation encompasses involvement in a life situation. Because our rehabilitation setting does not provide interventions in life situations, a classification for participation interventions was not developed.

Each of the 28 categories includes several types of interventions. Examples of interventions within certain categories are provided in appendix 2. Exercises and/or training interventions consist of 3 to 6 specific methods and techniques of therapeutic exercises or functional training. Modalities include electrotherapeutic modalities (e.g., electrical stimulation) and physical agents (e.g., cryotherapy). Assessment involves examination and evaluation. Education involves all kinds of patient-related instructions. Equipment includes the prescription, application and production of devices and other equipment. The unspecified code was added to record therapeutic activities not listed in the classification system as presented.

The first version of the classification system was tested in a modified Delphi procedure[27] to achieve consensus about the categories and interventions and to refine them if necessary.[13] A total of 30 therapists from 10 rehabilitation centers participated. Sufficient consensus was obtained for the definitions of the 3 levels (range, 87% - 100%). Percentages of consensus for the terminology used and the completeness of the categories ranged from 75% to 100%. The perceived relevance of the categories for everyday work varied per discipline.[13]
To confirm the feasibility of the classification system, however, its actual use needed to be evaluated in practice.
This article presents the results of a multicenter study into the feasibility of the classification system for use by therapists, in various settings and various disciplines. Feasibility was evaluated by the following criteria:

1. Completeness: therapists should be able to classify all clinical activities into 1 or more interventions listed in the categories.[28]
2. Mutually exclusiveness: therapists should be able to choose without doubt between the levels, categories, and interventions in the classification system.[28]
3. Speed: therapists should be able to record the contents of a treatment session within 3 minutes.
4. Ease: the classification system had to be easy to use as assessed by the clarity of the general and the detailed information in the manual.

Methods

Sample

The study included all physical therapists, occupational therapists, and sports therapists (n=36) working with patients with SCI at 3 specialized Dutch rehabilitation centers. Therapists who were expected to be off-duty for more than half of the time during the study (e.g., because they went on holiday) were excluded.

Treatment selection
All treatment sessions of patients with SCI at the inpatient and outpatient departments were included if (1) the patient was physically present, (2) the treatment session was an individual treatment, and (3) the treatment session was aimed at the domains of mobility and self-care.

Procedure
After approval of the study by the scientific and ethical board of each center, the study was introduced during a special staff meeting, and therapists were asked to participate on a voluntary basis. All participating therapists (n=36) gave verbal consent to participate in the project. The therapists then received the classification system and a manual consisting of three parts: (1) general information on the structure of the classification system, (2) detailed descriptions of all coded interventions, and (3) a one-page summary with coding instructions. The contents of and procedures for the use of the classification system were discussed with all therapists at a further instructional meeting. The therapists were then asked to practise recording their sessions with the classification system for a period of 1 week.
After this first week, a second instructional meeting was held at each center. Next, the participants were asked to record all relevant treatment sessions over a period of 2 to 4 weeks. After this period, the participants were sent a questionnaire on the feasibility of the classification system.

Measures
To obtain data for evidence of completeness, the participants had to record their treatment sessions with codes. The form used to record treatment sessions allowed users to record a maximum of 5 different interventions a session and to indicate the amount of time spent on each intervention in 5-minute increments. If the therapists were unable to record an intervention in one of the listed categories, they could record it as unspecified. To obtain data for evidence of completeness, mutually exclusiveness, speed and ease of use, each recording form also included 5 questions (Questionnaire A) relating to

- the difficulty users had when classifying interventions (7-point scale ranging from no doubt to too much doubt about which level, category and intervention to choose);
- (if therapists had been in doubt about which code to use) an open-ended question to describe what caused the doubt;
- the time they needed to classify the activities in a treatment session (less than 1 minute, between 1 and 3 minutes or more than 3 minutes);
- (if the manual had been consulted) the clarity of the general information in the manual and the detailed descriptions of interventions (7-point scale ranging from very clear to very unclear).

To obtain information related to the opinion of the therapists on completeness, mutually exclusiveness, speed and ease of use, a questionnaire (Questionnaire B) with 13 questions was administered at the end of the recording period. These questions related to the therapist's opinion on the instructional meeting, the various sections of the manual (7-point scale from very good to very poor), and whether they felt the average time needed to classify the activities in a treatment session was acceptable for research purposes and for daily use (7-point scale from very acceptable to very unacceptable).

Statisticical analysis

Because the practice week did not reveal major problems, the data collected in this week were merged with the data collected in the other weeks. Descriptive statistics were used for the distribution of classification system codes and the time spent on each therapeutic activity. The percentage of unspecified codes was used as an indicator of the completeness of the classification system. Sufficient user satisfaction was defined as 80% or more of the therapists having a positive opinion on the feasibility of the classification system. To assess this, the 1 through 7 scales were dichotomized into positive opinions (scores 1-3) and neutral or negative opinions (scores 4-7).

Results

Therapists

A total of 20 physical therapists, 14 occupational therapists, and 2 sports the-rapists participated on a voluntary basis. The distribution of the 3 disciplines varied by center: in center A, 8 physical therapists and 5 occupational therapists participated, in center B, 8 physical therapists, 5 occupational therapists and 1 sports therapist participated, and in center C, 4 physical therapists, 4 occupational therapists and 1 sports therapist participated. One sports therapist of center A and 1 occupational therapist and physical therapist of center C were excluded according to the criteria. The participating physical therapists had been working with patients with SCI for a mean of 10.4 years (SD 5.6; range 3-20) and the OT for a mean of 4.8 years (SD 3.4; range 1-10). The sports therapists in centers B and C had been working with SCI patients for 5 years and 1 year, respectively.

Treatment characteristics

The number of recorded treatment sessions varied in each center (257 in center A, 357 in center B, 242 in center C), by discipline (521 for physical therapy, 283 for occupational therapy, 52 for sports therapy) and by therapist (7-51). A total of

272 treatment sessions were recorded during the practice week, and 584 were recorded during the recording weeks. Treatment sessions of 142 different inpatients and outpatients with SCI were recorded. The number of patients did not differ significantly per center (45 in center A, 48 in center B, 49 in center C). The mean age of the patients was 49 years; they included 88 men and 54 women. The types of SCI included motor-complete tetraplegia (n=21), motor-complete paraplegia (n=26), motor-incomplete tetraplegia (n=42), and motor-incomplete paraplegia (n=53).

Codes and time by treatment session

The participants recorded a total of 1625 codes. Thirty-nine percent (335/ 856) of all treatment sessions required only 1 code to describe the therapeutic activities during the session, 32% (273) required 2 codes, 23% (199) required 3 codes, 5% (42) required 4 codes and only 1% (7) required 5 codes. The mean time spent on the first coded activity varied from 15.8 minutes (SD 8.9) for physical therapists to 22.5 minutes (SD 15.0) for occupational therapists and 22.2 minutes (SD 10.2) for sports therapists. The largest amount of time spent on therapeutic activities by code was 60 minutes for physical therapists, 90 minutes for occupational therapists and 45 minutes for the sports therapists.

Completeness

The participants used interventions from all 3 levels. The physical and occupational therapists recorded at 3 levels of functioning, whereas the sports therapists recorded only at the level of basic functions and basic activities. Table 1 shows the numbers of codes in the various categories of the classification system. The therapists used 27 of the 28 categories. Only the category of bowel interventions at the level of complex activities was not used. Of the 27 categories used, 23 (85.1%) were used by at least 2 disciplines. The largest number of recordings occurred in the categories of muscle power, muscle length, walking, wheelchair propulsion and hand cycling. The physical therapists made most of their recordings in the categories of muscle power, muscle length, joint mobility, and walking. The occupational therapists made most of their recordings in the categories of manual wheelchair propulsion and hand cycling, maintaining and changing body positions and movements, partial tasks of self-care, and arm and hand use. The largest numbers of recordings by the sports therapists were made in the categories of manual wheelchair propulsion and hand cycling, swimming, arm and hand use, and muscle length.

All types of interventions, exercises and training, modalities, assessment, education, and equipment were used at all 3 levels. Of the 1625 codes, only 24 (1.9%) were recorded as unspecified. Another 42 codes (2.9%) were recorded for exercises and training without further specification.

Table 1. Distribution of the recordings of various therapeutic activities in treatment sessions in the feasibility study.

Category	Code	N[1]	%[2]	Total time[3]
Basic functions				
Muscle power	101	224	13.8	4220
Muscle length	102	157	9.7	2755
Muscle tone	103	80	4.9	1080
Joint mobility	104	129	7.9	1910
Sensory functions	105	7	0.4	125
Neuropathic pain	106	5	0.3	45
Musculoskeletal pain	107	23	1.4	445
Skin and related structures (1)[4]	108	3	0.2	35
Skin and related structures(2)	109	42	2.6	965
Cardiovascular system	110	34	2.1	655
Respiratory system	111	20	1.2	210
Total	NA	724	44.5	12444
Basic activities				
Hand and arm use	201	74	4.6	1215
Sub-tasks of self-care	202	59	3.6	1270
Basic body positions and movements	203	127	7.8	2110
Transfers	204	84	5.2	1670
Standing	205	89	5.5	1360
Walking	206	150	9.2	2400
Manual wheelchair propulsion and (hand)cycling	207	140	8.6	3095
Use of / driving transportation	208	29	1.8	670
Swimming	209	19	1.2	360
Total	NA	771	47.5	14150
Complex activities				
Walking and moving around indoors	301	51	3.1	900
Walking and moving around outdoors	302	24	1.5	465
Transfers	303	20	1.2	240
Washing and caring for body parts	304	12	0.7	260
Toileting: bladder	305	1	0.1	45
Toileting: bowel	306	0	NA	NA
Dressing	307	16	1.0	500
Eating and drinking	308	6	0.4	95
Total	NA	130	8	2505
Total of all recordings	NA	1625	100	29099

[1]Total number of recorded codes per category, [2]Percentage of the total number of recorded codes, [3]Total time spent (in minutes) on therapeutic activities, per category, [4]There were 2 categories for skin and related structures: (1) general and (2) pressure ulcers.

Mutually exclusiveness

The therapists were able to classify the activities in most of the treatment sessions, with 767 (89.6%) of 856 involving little or no doubt. There was no significant difference in the level of doubt between the practice week and the recording weeks. A reason for doubt about the right classification was given in 140 cases. In only 27 of these 140 cases did the doubt concern the choice between the 3 levels of the classification system. Other comments concerned where to classify equipment , the difficulty in finding the category for the intervention (e.g., walking the stairs, cycling), and difficulty in separating simultaneously performed interventions.

Speed

The therapists recorded 756 (88.3%) of the 856 treatment sessions within 3 minutes and 388 (45.4%) of 856 within 1 minute. The time needed to record a treatment session was slightly longer in the practice week than in the recording weeks. The percentage of recordings taking more than 3 minutes was similar for the two periods (12.5% and 11.3%, respectively), but the percentage of recordings taking 1-3 minutes decreased (56.6% and 36.5%, respectively), while the percentage of recordings taking less than 1 minute was higher in the recording weeks (30.9% and 52.1%, respectively).

The therapists recorded the majority of treatment sessions immediately after the session or later that same day. All therapists considered the time needed to classify a treatment session acceptable for recording for research purposes. Twenty-two of 36 therapists rated the time needed to classify a treatment session for daily use acceptable or neutral.

Ease of use

The therapists consulted the general information about the structure of the classification system in the manual in 251 (29.3%) of 856 of the recorded treatment sessions. If consulted, this information was rated by 193 (76.9%) of 251 as clear to very clear. The detailed descriptions of interventions in the manual were consulted in 405 (47.3%) of 856 of the recorded treatment sessions. If consulted, this information was rated by 363 (89.4%) of 405 as clear to very clear. Over 80% of the therapists had a favorable opinion on the general information, the detailed descriptions of the interventions, the recording instructions, and the recording form.

Comments

The therapists were finally invited to mention possible improvements to the classification system. In most cases, the therapists suggested including more examples in the detailed descriptions of the interventions. The occupational therapists

mentioned the difficulty in distinguishing self-care interventions at the level of basic activities from self-care interventions at the level of complex activities. The occupational therapists also mentioned the difficulty in classifying interventions involving equipment.

Discussion

The primary aim of this study was to test the feasibility of our recently developed classification system to record the contents of SCI rehabilitation sessions by physical therapists, occupational therapists and sports therapists. This study confirmed that the classification system was complete and that the categories and interventions were mutually exclusive to record treatment sessions of a wide range of patients with SCI in 3 post-acute rehabilitation settings in the Netherlands. The general instructions and coding guidelines were sufficiently clear, and the amount of time needed to classify was within reasonable limits. Second, this study demonstrated that it is possible to record the contents of SCI rehabilitation to assess the interventions provided, as has been found previously in stroke research.[21,23-25] The experience gained in earlier studies on taxonomies and/ or classification systems shows that the validity and reproducibility of such classifications can be improved by providing accurate and detailed descriptions of interventions.[12,21,22,29] Our classification system aimed at capturing the details to be able to differentiate between therapeutic activities for the various types of SCI patients during different phases of rehabilitation.

Almost all categories and all types of interventions listed in the classification system (exercises and training, modalities, assessment, education, and equipment) were used. There were only a few cases in which the therapists were unable to classify their treatment sessions. For the few categories which were rarely used, therapists indicated that this was due to the short period of recording. Hence, we may conclude that the interventions listed are fairly complete and are relevant to clinical practice.

The results show that therapists considered the time needed to classify a treatment session acceptable for research purposes, and most indicated that it was feasible for clinical use.

Although the primary aim of this study was not to examine the distribution of interventions in SCI rehabilitation, we were able to show differences between disciplines in terms of the focus by level (for example, occupational therapists and sports therapists were more activity-oriented than physical therapists) as well as differences in the focus on categories (for example, physical therapists were more focused on muscle power than on muscle length). Furthermore, our

data reveal differences in the time spent on activities per discipline and per patient, and describe the type of intervention, for example, exercise or assessment.

Study limitations

Although the data provide evidence for the feasibility of our recently developed classification system, this study was subject to certain limitations. Our results may not be generalized to other settings, because the classification system was developed for use in the Dutch SCI rehabilitation system, which might differ from that in other countries with respect to patient population and type of interventions applied. However, since we included a wide range of patients with SCI, from early admission to outpatient treatment, the sample might be considered representative of the whole spectrum of patients with SCI in post-acute care. Further, international literature was used to identify relevant physical[18] and occupational[19] therapist interventions and our terminology was as much as possible derived from the ICF.[14,15]

A second limitation is that the study included only two sports therapists, so we cannot conclude that the treatment sessions recorded in this study by the sports therapists were representative of the Dutch situation.

There were several comments from therapists that will be used to refine the classification system. Ongoing research includes more sports therapists and an investigation of interrater and intrarater reliability.

Conclusions

This study revealed that the recently developed classification system of SCI rehabilitation interventions can be used to record the contents of treatment sessions intended to improve mobility and self-care among patients with SCI by different therapists from different disciplines in different post-acute rehabilitation settings. The classification system allows us to describe and compare the nature and quantity of therapeutic activities in SCI rehabilitation.

References

1. Kirsblum S, Campagnolo DI, DeLisa JA, eds. Spinal Cord Medicine. Philidelphia: Lippincott Williams & Wilkins; 2002.
2. Beckers DML, Buck MJI, Pons C. De revalidatie van dwarslaesiepatiënten. Lochem: De tijdstroom; 1992.
3. Nash MS, Horton III, JA. Recreational and therapeutic exercise after spinal cord injury. In: Kirschblum S, Campagnolo DI, Delisa JA, (eds.) Spinal Cord Medicine. Philidelphia: Lippincott Williams & Wilkins; 2002. p. 331-48.
4. Biering-Sorensen F. Evidence-based medicine in treatment and rehabilitation of spinal cord injured. Spinal Cord. 2005;43:587-592.
5. Harvey LA, Byak AJ, Ostrovskaya M, Glinsky J, Katte L, Herbert RD. Randomised trial of the effects of four weeks of daily stretch on extensibility of hamstring muscles in people with spinal cord injuries. Aust J Physiother. 2003;49:176-81.
6. Harvey LA, Herbert R, Crosbie J. Does stretching induce lasting increases in joint ROM? A systematic review. Physiother Res Int. 2002;7:1-13.
7. Jacobs PL, Nash MS. Exercise recommendations for individuals with spinal cord injury. Sports Med. 2004;34:727-751.
8. Mueller G, Perret C, Spengler CM. Optimal intensity for respiratory muscle endurance training in patients with spinal cord injury. J Rehabil Med. 2006;38:381-6.
9. Dobkin.B, Apple D, Barbeau H, Basso M, Behrman A, DeForge D, Ditunno J, Dudley G, Elashoff R, Fugate L, Harkema S, Saulino M, Scott M. Weight-supported treadmill vs over-ground training for walking after acute incomplete SCI. Neurology. 2006;28:484-93.
10. Dallmeijer AJ, Zentgraaff ID, Zijp NI, Woude LH van der. Submaximal physical strain and peak performance in handcycling versus handrim wheelchair propulsion. Spinal Cord. 2004;42:91-8.
11. Mutton DL, Scremin AM, Barstow TJ, Scott MD, Kunkel CF, Cagle TG. Physiologic responses during functional electrical stimulation leg cycling and hybrid exercise in spinal cord injured subjects. Arch Phys Med Rehabil 1997;78:712-718.
12. Tyson SF, Selley A. The development of the stroke physiotherapy intervention record tool (SPIRIT). Disabil Rehabil. 2004;26:1184-1188.
13. van Langeveld SA, Post MW, Asbeck FW van, Postma K, Dam D ten, Pons C. Development of a classification of physical, occupational, and sports therapy interventions to document mobility and self-care in spinal cord injury rehabilitation. J Neurol Phys Ther. 2008;32:2-7.
14. World Health Organisation. International Classification of functioning, disability and health: ICF. Geneva: WHO; 2001.
15. WHO-FIC Collaborating Centre. ICF: Nederlandse vertaling van de "International Classification of Functioning, Disability and Health". Geneva: Houten Diegem: Bohn Stafleu Van Loghum; 2002.
16. van Dijk AJ. On rehabilitation medicine. A theory-oriented contribution to assessment of functioning and individual experience (Thesis). Amsterdam. Free Univ of Amsterdam; 2001.
17. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-110.

18. American Physical Therapy Association. Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-127, 223- 239, 437-453.
19. Occupational Therapy Practice Framework: domain and process. Am J Occup Ther. 2002;56: 609-639.
20. Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box therapy: a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. Clin Rehabil. 1999;13:301-309.
21. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the "black box" of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-1908.
22. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "black box" of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-686.
23. Richards LG, Latham NK, Jette DU, Rosenberg L, Smout RJ, De Jong G. Characterizing occupational therapy practice in stroke rehabilitation. Arch Phys Med Rehab 2005;86(Suppl 2):51-60.
24. Latham NK, Jette DU, Slavin M, Richards LG, Procino A, Smout RJ, Horn SD. Physical therapy during stroke rehabilitation for people with different walking abilities. Arch Phys Med Rehab. 2005;86(Suppl 2):41-50.
25. De Wit L, Putman K, Lincoln N, Baert I, Berman P, Beyens H, et al. Stroke rehabilitation in Europe. what do physiotherapists and occupational therapists actually do? Stroke. 2006;37:1483-1489.
26. Post MW, Lieshout G van, Seelen HA, Snoek GJ, Ijzerman M, Pons C. Measurement properties of the short version of the Van Lieshout Test (VLT-SV) for arm/hand function of persons with tetraplegia after spinal cord injury. Spinal Cord. 2006;44:763-771.
27. Jones J, Hunter D. Using the Delphi and nominal group technique in health services research. In: Pope C, Mays N, eds. Qualitative research in health care. Bristol: BMJ Books; 2000.
28. Bailey KD. Typologies and taxonomies: an introduction to classification techniques. London: Sage Publications; 1994. p. 1-6.
29. Jette DU, Latham NK, Smouth RJ, Gassaway J, slavin MD, Horn SD. Physical therapy interventions for patients with stroke in inpatient rehabilitation facilities. Phys Ther. 2005;85:238-248.

APPENDIX 1
Classification of therapeutic activities into categories

Basic functions
101 Muscle power
102 Muscle length
103 Muscle tone
104 Joint mobility
105 Sensory functions
106 Neuropathic pain
107 Musculoskeletal pain
108 Skin and related structures I
109 Skin and related structures II
110 Cardiovascular system
111 Respiratory system

Basic activities
201 Hand and arm use
202 Subtasks of self-care
203 Maintaining and changing body positions and movements
204 Transfers[1]
205 Standing
206 Walking[2]
207 Manual wheelchair propulsion and (hand) cycling
208 Use and/or driving of human-powered and/or motorized transportation
209 Swimming

Complex activities
301 Walking and moving around indoors[3]
302 Walking and moving around outdoors[3]
303 Transfers[4]
304 Washing oneself and caring for body parts
305 Toileting: bladder
306 Toileting: bowel
307 Dressing
308 Eating and drinking

[1] Transfers at the level of basic activities (204) are directed primarily at the training of skills and techniques of transfers, e.g., learning how to transfer from the wheelchair to the floor and back.
[2] Walking at the level of basic activities (206) is directed primarily at the training of skills and techniques of walking, e.g., walking to improve the coordination, step frequency, etc.
[3] Walking at the level of complex activities (301, 302) is directed primarily at the location and the circumstances (goal of action) in which it takes place, e.g., walking to go to the toilet.
[4] Transfers at the level of complex activities (303) are directed primarily at the location and the circumstances (goal of action) in which they take place, e.g., transfers to a car seat with the goal of being transported in the car.

APPENDIX 2
Examples of categories at the 3 different levels of the classification system, with the coded types of interventions

CATEGORIES	TYPES OF INTERVENTIONS	
101 Muscle power	101.1	Exercising, training, and modalities
	101.1.1	(Assisted) active exercises with adaptive exercise aids
	101.1.2	Active exercises; with/without physical aid by therapist
	101.1.3	Active exercises with fitness equipment
	101.1.4	Active exercises with specific hand-function equipment
	101.1.5	Modalities
	101.2	Assessment
	101.3	Education
	101.4	Equipment
	101.5	Unspecified
206 Walking	206.1	Exercising and training skills and techniques
	206.1.1	Walking on treadmill (+ support system)
	206.1.2	Walking in water (hydrotherapy)
	206.1.3	Walking indoors
	206.1.4	Walking outdoors
	206.1.5	Walking in sports activities
	206.2	Assessment
	206.3	Education
	206.4	Equipment
	206.5	Unspecified
302 Walking and moving around outdoors	302.1	Exercising and training skills and tecniques in meaningful context and/or environment
	302.1.1	In immediate area of rehabilitation center
	302.1.2	In immediate area of one's own home
	302.1.3	To go to stores/buildings in the immediate area of RC
	301.1.4	To go to stores/buildings > 1 km from rehabilitation center
	302.1.5	To be outdoors/in recreational areas
	302.2	Assessment
	302.3	Education
	302.4	Equipment
	302.5	Unspecified

Chapter 4

Reliability of a new classification system for mobility and self-care in spinal cord injury rehabilitation: the Spinal Cord Injury-Interventions Classification System

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Abstract

Objective. To investigate the reliability of the Dutch-language version of the Spinal Cord Injury- Interventions Classification System.
Design. Descriptive study.
Setting. Three Dutch spinal cord injury facilities.
Participants. Six physical therapists, 6 occupational therapists, and 3 sports therapists.
Interventions. Not applicable.
Main outcome measures. A 4 or 5-digit code was used to score videotaped interventions on 2 occasions in terms of level, category, and type of intervention. We examined the percentage of correctly assigned interventions (agreement between the researcher and the participants), agreement between the first and second measurements (intrarater reliability), and agreement between the therapists of the same discipline (interrater reliability).
Results. A total of 252 interventions were assigned. The agreement between the researcher and the participants was good: the percentage of correct interventions was high at both measurements (91.7% and 94.4%). Intrarater agreement was also good (90.9%). The interrater agreement within the physical therapists and the occupational therapists was high at both occasions (mean 92.3% and 87.3%, respectively), but lower within the sports therapists (mean 69.3%).
Conclusions. The study provided first evidence for reliability of the SCI-ICS. Further research is needed to confirm these results and to test reliability of other language versions.

Introduction

Physical therapists, occupational therapists, and sports therapists play an important role in the interdisciplinary team approach in postacute spinal cord injury (SCI) rehabilitation.[1,2] Although guidelines[3,4] and books[2,5], that provide descriptions of therapeutic activities exist, evidence on the complex and broad range of rehabilitation interventions is sparse. To be able to determine and compare the effectiveness of comprehensive SCI rehabilitation programmes, it is necessary to describe the contents of these programmes in a standardized and unambiguous way.[6-8] Describing and characterizing treatments by means of uniform concepts and language would enable us to correlate the therapeutic interventions with rehabilitation outcomes.[8] Because no such classification system was available for therapeutic interventions in SCI rehabilitation, we developed the Spinal Cord Injury-Interventions Classification System (SCI-ICS) for the main domains of SCI rehabilitation, mobility, and self-care.[9,10]

The SCI-ICS comprises 3 levels, covering 25 categories with a total of 139 different interventions. (Appendices 1-3) The levels and categories of the SCI-ICS were derived from the International Classification of Functioning, Disability and Health (ICF)[11] and the Van Dijk[12] model. The interventions were identified from clinical practice, general SCI literature[2,6], clinical practice guidelines[3,4], and classification systems developed for stroke rehabilitation.[8,13]

The levels used in the SCI-ICS are defined as follows: (1) body functions, i.e. interventions aimed at influencing body functions and structures, (2) basic activities, i.e. interventions aimed at practising skills and techniques for positions and movements, and (3) complex activities, i.e. interventions aimed at practising skills and techniques for positions and movements in task-oriented and context-specific activities. Each category represents the target of the intervention and includes several types of interventions: exercises, assessment, education, equipment, and unspecified. (Appendices 1-3) Exercises interventions are further subdivided in 1 to 6 specific methods and techniques and moda-lities. (Appendices 1-3) Modalities include electrotherapeutic modalities (e.g., electrical stimulation) and physical agents (e.g., cryotherapy). Assessment includes examination and evaluation. Education includes all kinds of patient-related instructions. Equipment includes the prescription, application and production of devices and other equipment. Unspecified was added to allow recording of therapeutic activities not listed in the classification system. The inclusion and exclusion criteria and examples from clinical practise of each type of intervention are described in the manual.

To achieve consensus amongst therapists about the SCI-ICS, a Delphi consensus procedure[9] was used. This procedure is commonly used to reach consensus among medical practitioners.[14-16] A total of thirty therapists from ten Dutch rehabilitation centers participated.[9] The SCI-ICS met with high levels of consensus among the therapists in terms of definitions of the 3 levels (range, 87%-100%),

terminology used, and completeness (range, 75%-100%). The perceived relevance of the categories for everyday work varied per discipline. In a subsequent feasibility study[10] 36 physical, occupational, and sports therapists of 3 Dutch SCI rehabilitation centers used the SCI-ICS to record 856 treatment sessions with 1625 interventions. This study[10] confirmed that the SCI-ICS was complete, that only 24 interventions (1.9%) were recorded as unspecified, and that the categories and interventions were mutually exclusive. For 93% of the treatment sessions, the recording raised little or no doubt.[10] The therapists were able to record 86.3% of the treatment sessions within 3 minutes. The classification system was rated as useful and easy to use.[10]
The feasibility study yielded several suggestions for improvement, which we used to refine the SCI-ICS: we described the distinction between self-care interventions at the level of basic and complex activities more clearly, we assigned the equipment interventions to the corresponding categories at the level of basic activities, and we restructured and omitted some categories. The total number of categories was reduced from 28 to 25 categories, and the total number of interventions from 177 to 139 different interventions.
The aim of the present study was to test the agreement between the researcher (first author) and the participants, and the intra-and interrater reliability of the final version of the SCI-ICS.

Methods

Design

Therapists used the SCI-ICS to score a series of videotaped interventions twice, with an interval of 3 weeks between the 2 measurements.

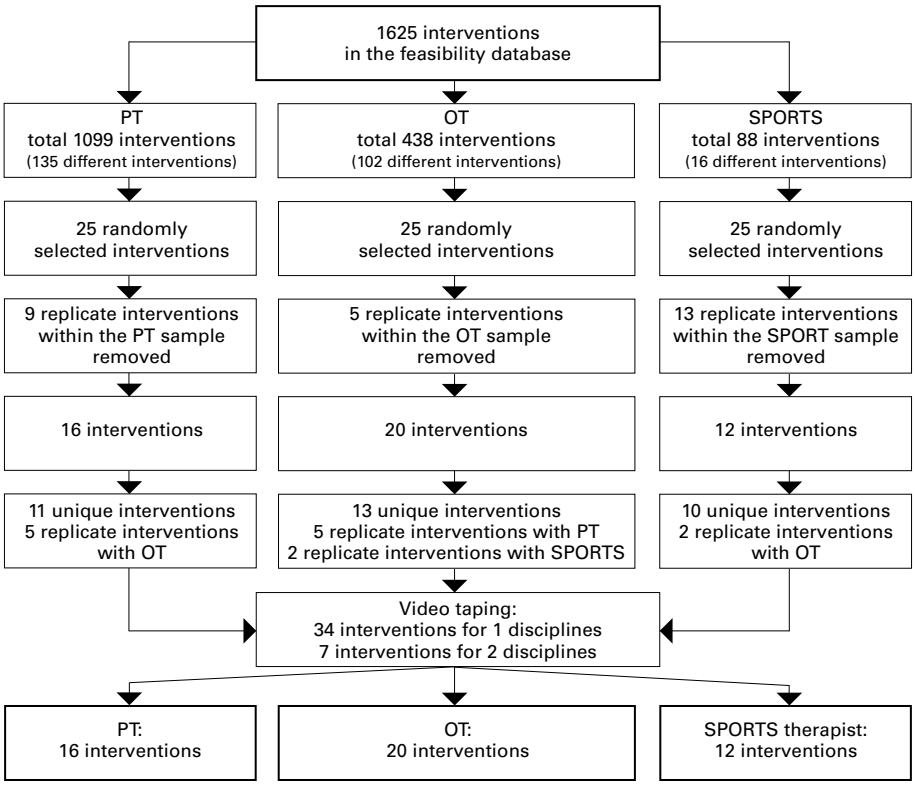
Participants

Therapists. The study was conducted in 3 Dutch rehabilitation centers: Rehabilitation centre De Hoogstraat, Utrecht; Sint Maartenskliniek, Nijmegen; and Rijndam rehabilitation centre, Rotterdam. Each center provided 2 physical therapists, 2 occupational therapists, and 1 sports therapist (total n=15). The physical therapists had been working with SCI patients for a mean of 12.9 years (range, 6-22), the occupational therapists for a mean of 8.5 years (range, 4-12), and the sports therapists for a mean of 10 years (range, 7-15). For 8 participants (4 physical therapists, 2 occupational therapists, and 2 sports therapists) the SCI-ICS was new; the other 7 were involved in the earlier Delphi consensus procedure.[9] The therapists participated on a voluntary basis.
Patients on video. The mean age of the 24 patients who appeared in the video clips was 47 years; they included 18 men and 6 women admitted to the inpatient

or outpatient departments at the De Hoogstraat. The types of SCI included motor-complete tetraplegia (ASIA grade A,B, n= 4), motor-complete paraplegia (ASIA grade C,D, n=9), motor-incomplete tetraplegia (ASIA grade A,B, n=6), and motor-incomplete paraplegia (ASIA grade C,D, n= 5).

Intervention selection for videotaping. A representative selection of physical, occupational, and sports therapy interventions was ensured by drawing a computerized random selection of 25 interventions per discipline using the database from the earlier feasibility study.[10] This database contains a total of 1625 interventions. Physical therapists recorded 1099 interventions (into 135 different codes), occupational therapists recorded 438 interventions (into 102 different codes), and sports therapists recorded 88 interventions (into 16 different codes). This random selection ensured that the most commonly performed interventions had the highest chance of being selected. The selection procedure is illustrated in Figure 1.

Figure 1. Selection procedure of interventions for videotaping.



Of the 75 selected interventions, 27 occurred more than once in the sample, e.g., walking exercises in water occurred 4 times. Removing these replicates resulted in 20 interventions for occupational therapy, 16 for physical therapy, and 12 for sports therapy. This selection contained 8 of the 10 most often recorded physical therapy interventions, 9 of the 10 most often recorded occupational therapy interventions, and 10 of the 10 most often recorded sports therapy interventions. The selection also represented 50.8% of all interventions recorded by physical therapists, 33.8% of all interventions recorded by occupational therapists and 89.7% of all interventions recorded by sports therapists in the feasibility study.[10] Seven of the 48 interventions occurred in the selection for 2 disciplines. For example, improving joint range of motion by using mobilization techniques occurred in the random selection of both physical therapy and occupational therapy so that 41 different interventions, were videotaped during regular treatment sessions at the De Hoogstraat. From the 15 therapists who participated in the study, only 2 were featured in 2 video clips. They knew that the videos would be used for this study, but they did not know the code that these videos represented.
The video clips included interventions in 18 of the 25 categories from the SC-ICS. All types of interventions (e.g., exercises, assessment) occurred on the video. The video clips for the physical therapists contained 11 exercise, 4 assessment, and 1 equipment intervention; for the occupational therapists 13 exercise, 2 assessment, 2 education, and 3 equipment interventions; and the for the sports therapists 10 exercise, 1 education, and 1 equipment intervention. Each videotaped intervention was edited by the researcher into a 30-second clip. If knowledge of the goal of an intervention was necessary to assign it to the right category, we asked the therapist to verbally describe the goal of the treatment on the video, e.g., muscle stretching should be scored in category 103 if its goal is to influence tone, but in category 102 if its goal is to improve length. A pilot study in which one physical therapist and one occupational therapist (from Rijndam rehabilitation center and from De Hoogstraat rehabilitation center, respectively) scored all 41 videotaped interventions, showed that 30 seconds was sufficient to show the action that took place and capture the goal of the treatment. Only in 2 video clips did we have to add, in writing, an identification of the location at which the treatment sessions took place (e.g., exercise room, bedroom).
The medical ethics committees of all participating centers approved the study. All patients with SCI on the videos (n=24) provided written consent for the use of the video and for the use of information from their medical charts.

Procedure

A DVD with the video clips and the classification manual were sent to the participants. They were instructed to read the manual thoroughly before scoring the

videotaped interventions. The therapists only had to score the clips regarding their discipline: physical therapy scored 16, occupational therapy scored 20, and the sports therapists scored 12 videotaped interventions. They were allowed to watch each video clip repeatedly and to consult the manual if desired. After scoring, they had to send the DVD and the completed forms back to the researcher without keeping notes of the codes assigned. This procedure was repeated three weeks later. They were also instructed not to discuss any items of the test with colleagues during the study period, and they were not given any feedback about their results until the data of both measurements were complete.

Instrumentation

The reliability data were collected using the final version of the SCI-ICS. (Appendices 1-3) Participating therapists were asked to assign to each video clip an intervention (complete 4- or 5-digit code) from the SCI-ICS. Additionally, they were asked to rate the level of doubt they experienced on a 7-point scale (1=no doubt at all; 7= too much doubt).[17] If participants hesitated between certain interventions, they were asked to indicate the intervention they had chosen and all interventions they had considered. The first intervention provided was used for analysis.

Finally, therapists were asked to document the time needed to read the manual, and the time needed to observe and score the video clips.

Statistics

The percentage of correctly assigned interventions (agreement between the researcher and the participants on complete identical code), percentage agreement between the first and second measurements (intrarater reliability), and percentage agreement between the therapists of the same discipline (interrater reliability) were calculated.[18] The desired level of agreement was set in advance at 80%.[19] It was not possible to compute the Cohen Kappa for chance-corrected agreement. In the case of very unevenly distributed data, the kappa value becomes highly sensitive to small departures from perfect concordance.[20]

After the percentage of correct interventions (complete identical code), we calculated the percentages of interventions whose level (first digit of the code) was correct, interventions whose category (second and third digit of the code) was correct, interventions whose type of intervention, e.g., exercise, education (fourth digit of the code) was correct, and interventions whose, if applicable, type of exercise intervention (fifth digit of the code) was correct. (Appendices 1-3). These percentages of agreement were also computed for each individual discipline.

The level of doubt was described by dichotomizing the 1 to 7 scale into little or no doubt (scores 1-3) and considerable doubt (scores 4-7).[17]

Data were analyzed using SPSS version 15.0.a

Results

Data were complete, so that a total of 252 interventions were assigned at each measurement session: 96 (6 x 16) by physical therapists, 120 (6 x 20) by occupational therapists and 36 (3 x 12) by sports therapists. For the first measurement session the therapists spent an average of 76 minutes (range, 30-180min) reading the manual, and a mean of 70 minutes (range, 30-120min) observing and scoring the video clips. At the second measurement session, 46 minutes (range, 30-90min) were spent reading and a mean of 54 minutes (range, 30-90min) observing and scoring.
Agreement between the researcher and the participants was calculated as the percentage of correctly assigned interventions (complete code identical).
The percentage of correctly assigned interventions was 91.7% (231 of 252) at the first measurement and 94.4% (238 of 252) at the second measurement. Table 1 lists the percentages of agreement for each of the disciplines.

The physical therapists had the highest percentages of correctly assigned interventions (complete code identical), although the results of the occupational therapists were also above the desired level of 80%. The percentage of interventions correctly assigned by the sports therapists (77.8%) was below the desired level at the first measurement. This low percentage of agreement was mainly caused by incorrectly assigned exercise intervention (fifth digit of the code identical; see table 1). At the second measurement, the percentage of interventions correctly assigned by the sports therapists was above the desired level (91.7%).
At the first measurement, the number of incorrectly assigned interventions per therapist varied from 0 to 5. Four therapists made no errors, 7 scored 1 incorrect, 2 scored 2 incorrect, and 2 scored 5 incorrect. At the second measurement this varied from 0 to 3; 7 therapists made no errors, 3 scored 1 incorrect; 4 scored 2 incorrect, and 1 scored 3 video clips incorrect. Five video clips were scored incorrectly at both measurements, but not by more than 1 therapist.
Five other video clips were scored incorrectly at 1 of the 2 measurements by 2 therapists and 1 video clip was scored incorrectly by more than 2 occupational therapists, namely 4. All the alternative interventions mentioned were different. Agreement between therapists who were or were not involved in the earlier performed Delphi consensus procedure did not differ significantly from each other.

Intrarater agreement

The percentage of agreement between the interventions (complete identical codes) on the first and second measurements was high (90.9%; 229 of 252). Agreement was 91.7% for physical therapists and occupational therapists and 86.1% for sports therapists. (Table 1)

Table 1. Percentage of agreement of video clip scoring.

	PT n=6	OT n=6	Sports n=3
Total number of video clips	**6 x 16 = 96**	**6 x 20 = 120**	**3 x 12 = 36**
Agreement between the researcher and the participants: percentage of correct interventions (complete identical codes) at 1st measurement:	95.8%(92)	92.5%(111)	77.8%(28)
level[1]	100.0%(96)	98.3%(118)	97.2%(35)
category[2]	97.9%(94)	95.0%(114)	94.4%(34)
types of intervention[3]	100.0%(96)	96.7%(116)	88.9%(32)
exercise intervention[4]	97.9%(94)	94.2%(113)	80.6%(29)
Agreement between the researcher and the participants: percentage of correct interventions (complete identical codes) at 2nd measurement:	95.8%(92)	94.2%(113)	91.7%(33)
level	100.0%(96)	98.3%(118)	97.2%(35)
category	97.9%(94)	96.7%(116)	97.2%(35)
types of intervention	99.0%(95)	97.5%(117)	97.2%(35)
exercise intervention	99.0%(95)	97.7%(116)	91.7%(33)
Intrarater reliability: percentage complete identical codes (therapists with themselves, 1st with 2nd measurement):	91.7%(88)	91.7%(110)	86.1%(31)
level	100.0%(96)	98.3%(118)	100.0%(36)
category	94.8%(91)	96.7%(116)	97.2%(35)
types of intervention	99.0%(95)	96.7%(116)	91.7%(33)
exercise intervention	96.9%(93)	95.0%(114)	86.1%(31)
Interrater reliability: percentage complete identical codes (therapist with therapist (paired), 1st and 2nd measurement combined)[5]:	92.3%(443)	87.3%(525)	69.4%(50)
level	100.0%(480)	96.0%(576)	94.4%(68)
category	93.3%(448)	92.3%(554)	91.6%(66)
types of intervention	97.9%(470)	94.0%(565)	88.9%(64)
exercise intervention	93.5%(449)	95.6%(573)	81.9%(59)

[1] The 1st digit of the code was identical; agreement on the level (body functions, basic activities or complex activities).
[2] The 2nd and 3rd digit of the code were identical; agreement on the category.
[3] The 4th digit of the code was identical; agreement on the type of intervention (whether the video clip is showing an exercise, assessment, education or equipment intervention).
[4] The 5th digit of the code was identical; agreement on the exercise intervention (which specific exercise intervention is shown in the video clip).
[5] Interrater reliability: percentage of identical codes of therapist with therapist (paired) were calculated. Six PT gave 30 comparisons for the 1st and 2nd measurement combined; 30 x 16 video clips = total 480 calculations. Six 6 OT gave 30 comparisons; 30 x 20 video clips = total 600 calculations; and 3 sports therapists gave 6 comparisons; 6 x12 video clips = total 72 calculations.

Abbreviations: PT=physical therapists, OT=Occupational therapists.

Interrater agreement

The percentage of agreement between the complete codes between the therapists of the same discipline on the first and second measurement was high for the 6 physical therapists (mean, 92.0% and 92.5%, respectively) and the 6 occupational therapists (mean, 86.0% and 88.5%). The percentage of agreement between the 3 sports therapists was low on the first measurement (mean, 55.5%), but high on the second measurement (mean, 83.3%).

Level of doubt

At the first measurement, the participants were able to score 231 (91.7%) of the 252 interventions with little or no doubt. The physical therapists felt most confident (99.0%), followed by the sports therapist (88.9%) and occupational therapists (86.7%). At the second measurement, 235 (93.3%) of 252 interventions were scored with little or no doubt. Of the interventions scored with considerable amount of doubt, 28.6% were incorrect at both measurements. Of the interventions scored with little or no doubt, 93.5% was correct at the first, and 94.5% at the second measurements.

Alternative interventions

Among the 35 (of 504) incorrectly assigned interventions by 1 or more therapists at both measurements, there were 25 for which no alternative codes were registered, 6 for which the correct intevention as an alternative, and 4 for which other interventions were provided as an alternative. None of the provided alternative interventions was duplicated.

Discussion

This study showed that therapists from different rehabilitation facilities were able to use the SCI-ICS to score videotaped interventions in a reliable and consistent way. Most interventions were scored with little or no doubt. The number of alternative interventions was small, and there were no duplicates.
The percentage of correct interventions (complete identical codes) of the sports therapists was slightly below the desired level of 80% at the first measurement, but well above this threshold (91.7%) at the second measurement. This was caused by one therapist who scored only 58% correct at the first measurement, although he did score all videotaped interventions correctly with regards to level and category. After the study, he mentioned he did read the manual more thoroughly in between the 2 measurement sessions. This finding underlines the importance of training to accomplish proper use of the SCI-ICS.

Study limitations

First, we used a random selection of interventions from an existing database.[7] Although only 41 of the 139 interventions described in the final version of the SCI-ICS were represented in the sample, the random selection ensured that the selection was representative of normal practice routine.

Secondly, we investigated the agreement between the reseacher and the participants by using the researcher as the criterion standard[21], whereas the researcher herself could be incorrect. However, none of the videotaped interventions were scored differently from the researcher by more than 1 therapist at both measurements, and none of the alternative interventions provided were identified by more than 1 therapist.

Third, we used videotapes and did not ask for scoring of interventions performed live. This allowed us to standardize the observational material for research; each observer, as well as the same observer at each measurement, had the opportunity to see and hear exactly the same videotaped action.[22] By videotaping the interventions for this study during treatments with different patients with an SCI that occurred in a real clinical setting, we tried to ensure that this would not jeopardize reliability.

A final limitation is that the study involved only 3 sports therapists. This number is small, but it is comparable with the total number of raters in the other reliability studies on recording tools of therapy activities.[22,23]. Moreover, we used therapists from different rehabilitation centers, instead of researchers[22,23], to test classification accuracy in clinical practice. Nevertheless further research into reliability with the SCI-ICS with larger numbers of therapists is desirable.

Our classification system can be used to record treatment sessions by different therapists within different disciplines at different specialized SCI rehabilitation units in the Netherlands. The manual has been translated into English and is available on request. Research into the reliability of the English-language version of the SCI-ICS will be addressed in ongoing studies.

Previous studies[8,13,22-25] concluded that detailed descriptions of treatment not only enhance reliability but might also enable the detection of meaningful differences and changes in therapeutic activities provided during various periods of rehabilitation and in different types of patients.

Conclusions

The results of this study provide evidence that the SCI-ICS is a reliable tool to record routine treatment sessions intended to improve mobility and self-care in SCI rehabilitation. Further studies using larger groups of therapists and different language versions of the SCI-ICS are necessary to confirm these results.

References

1. Kirshblum SC, Priebe MM, Ho CH, Scelza WM, Chiodo AE, Wuermser L. Spinal cord medicine. 3. Rehabilitation phase after acute spinal cord injury. Arch Phys Med Rehabil. 2007;88:62-70.
2. Harvey L. Management of spinal cord injuries. Sydney: Butterworth Heinemann Elsevier; 2008.
3. American Physical Therapy Association. Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-27, 223-39, 437-53.
4. Occupational Therapy Practice Framework: domain and process. Am J Occup Ther. 2002;56:609-39.
5. Sisto SA, Druin E, Sliwinski MM. Spinal cord injuries. Management and rehabilitation. St. Louis: Mosbey Elsevier; 2009.
6. Kirshblum S, Campagnolo DI, DeLisa JA, eds. Spinal cord medicine. Philadelphia: Lippincott Williams & Wilkins; 2002.
7. Heinemann AW. State-of-the-science on post-acute rehabilitation: setting a research agenda on developing an evidence base for practice and public policy. An introduction. Arch Phys Med Rehabil. 2007;88:1478-1481.
8. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "black box" of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-86.
9. van Langeveld SA, Post MW, van Asbeck FW, Postma K, ten Dam D, Pons C. Development of a classification of physical, occupational, and sports therapy interventions to document mobility and self-care in spinal cord injury rehabilitation. J Neurol Phys Ther. 2008;32:2-7.
10. van Langeveld SA, Post MW, van Asbeck FW, Postma K, Leenders J, Pons C. Feasibility of a classification system for physical therapy, occupational therapy, and sports therapy Interventions for mobility and self-Care in spinal cord injury rehabilitation. Arch Phys Med Rehabil. 2008;89:1454-1459.
11. World Health Organization. International classification of functioning, disability and health: ICF. Geneva: WHO; 2001.
12. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-10.
13. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the "black box" of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-8.
14. Jones J, Hunter D. Using the Delphi and nominal group technique in health services research. In: Pope C, Mays N. (eds.) Qualitative research in health care. 2nd ed. London: BMJ Books; 2000. p 40-49.
15. Weigl M, Cieza A, Andersen C, Kollerits B, Amann E, Stucki G. Identification of relevant ICF categories in patients with chronic health conditions: a Delphi exercise. J Rehabil Med. 2004; (Suppl 44):12-21.
16. Finger ME, Cieza A, Stoll J, Stucki G, Huber EO. Identification of intervention categories for physical therapy, based on the international classification of functioning, disability and health: A Delphi exercise. Phys Ther. 2006;86:1203-1220.

17. Streiner DL, Norman GR. Health measurement scales. Oxford (NY): Oxford University Pr; 2006. p. 34-42.
18. Post MW, de Witte LP. Good inter-rater reliability of the Frenchay Activities Index in stroke patients. Clin Rehabil. 2003;17:548-52.
19. Post MW, Festen H, van de Port G, Visser-Meily JMA. Reproducibility of the Caregiver Strain Index and the Caregiver Reaction Assessment in partners of stroke patients living in the Dutch community. Clin Rehabil. 2007;21:1050-5.
20. Feinstein AR, Cicchetti DV. High agreement but low kappa: 1. the problem of two paradoxes. J Clin Epidemiol. 1990;43:543-549.
21. Reijman M, Hazes MW, Koes BW, Verhagen AP, Bierma-Zeinstra SM. Validity, reliability, and applicability of seven definitions of hip osteoarthritis used in epidemiological studies: a systematic appraisal. Ann Rheam Dis. 2004;63:226-232.
22. De Wit L, Kamsteegt H, Yadav B, Verheyden G, Feys H, De Weerdt W. Defining the content of individual physiotherapy and occupational therapy sessions for stroke patients in an inpatient rehabilitation setting. Development, validation and inter-rater reliability of a scoring list. Clin Rehabil. 2007;21:450-459.
23. van Vliet PM, Lincoln NB, Robinson E. Comparison of the content of two physiotherapy approaches for stroke. Clin Rehabil. 2001;15:398- 414.
24. De Wit L, Putman K, Lincoln N, Baert I, Berman P, Beyens H, Bogaerts K, Brinkman N, Connell L, Dejaeger E, De Weerdt W, Jenni W, Lesaffre E, Leys M, Louckx F, Schuback B, Schupp W, Smith B, Feys H. Stroke rehabilitation in Europe. What do physiotherapists and occupational therapists actually do? Stroke. 2006;37:1483-9.
25. Post MW, Dallmeijer AJ, Angenot E, van Asbeck FW, van der Woude LH. Duration and functional outcome of spinal cord injury rehabilitation in the Netherlands. J Rehabil Res Dev. 2005;42:75-86.

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a. SPSS Inc, 233 S Wacker Dr, 11th FL, Chicago, IL 60606.

APPENDIX 1
Level body functions with 10 categories and 46 interventions

BODY FUNCTIONS CATEGORIES	BODY FUNCTIONS INTERVENTIONS[1]
101 Muscle power	101.1 Exercises and modalities 101.1.1 Active-assisted exercises 101.1.2 Active exercises 101.1.3 Resisted active exercises 101.1.4 Modalities 101.2 Assessment 101.3 Education
102 Muscle length	102.1 Exercises and modalities 102.1.1 Passive or active-assisted range of motion exercises or stretches administered by a therapist 102.1.2 Stretching performed by the patient himself/ herself 102.1.3 Modalities 102.2 Assessment 102.3 Education
103 Muscle tone	103.1 Exercises and modalities 103.1.1 Passive or active-assisted range of motion exercises or stretches administered by a therapist 103.1.2 Stretching performed by the patient himself/ herself 103.1.3 Relaxation therapy 103.1.4 Modalities 103.2 Assessment 103.3 Education
104 Joint mobility	104.1 Exercises and modalities 104.1.1 Manual mobilization techniques 104.1.2 Modalities 104.2 Assessment 104.3 Education
105 Sensory functions	105.1 Exercises and modalities 105.1.1 Practising of sensory functions 105.1.2 Modalities 105.2 Assessment 105.3 Education

BODY FUNCTIONS CATEGORIES	BODY FUNCTIONS INTERVENTIONS[1]
106 Neuropathic pain	106.1 Exercises and modalities 106.1.1 Neuropathic pain treatment 106.1.2 Modalities 106.2 Assessment 106.3 Education
107 Musculoskeletal pain	107.1 Exercises and modalities 107.1.1 Manual techniques 107.1.2 Modalities 107.2 Assessment 107.3 Education
108 Skin and related structures	108.1 Exercises and modalities 108.1.1 Manual techniques 108.1.2 Modalities 108.2 Assessment 108.3 Education
109 Cardiovascular system	109.1 Exercises 109.1.1 Cardiovascular fitness training without equipment 109.1.2 Cardiovascular fitness training with equipment 109.2 Assessment 109.3 Education
110 Respiratory system	110.1 Exercises and modalities 110.1.1 Exercises for breathing strategies without devices 110.1.2 Exercises for breathing strategies with devices 110.1.3 Modalities 110.2 Assessment 110.3 Education

[1]Not presented here is the code (100.8) for unspecified interventions in each category.

APPENDIX 2
Level basic activities with 8 categories and 56 interventions

BASIC ACTIVITIES CATEGORIES	BASIC ACTIVITIES INTERVENTIONS[1]
201 Hand and arm use	201.1 Exercises: Practising: 201.1.1 picking up, grasping, manipulating, releasing, and reaching 201.1.2 lifting, carrying, putting down, pulling, and pushing 201.1.3 the use of arm and hand skills in self-care in an exercise room 201.1.4 the use of arm and hand skills in sports activities 201.2 Assessment 201.3 Education 201.4 Equipment
202 Changing and maintaining body positions and movements	202.1 Exercises: Practising of body positions and movements: 202.1.1 in/ to prone, supine, and sidelying position 202.1.2 with the use of arms and legs (e.g., crawling, kneeling) 202.1.3 sitting and moving in a sitting position, mainly with the use of the arms 202.1.4 in sports activities while sitting 202.2 Assessment 202.3 Education 202.4 Equipment
203 Transfers	203.1 Exercises: Practising transfer: 203.1.1 wheelchair to/ from treatment table (equal height) 203.1.2 wheelchair to/ from objects with different heights and forms 203.1.3 wheelchair to/ from toilet, shower/ commode chair, tubseat 203.1.4 wheelchair to/ from bed 203.1.5 wheelchair to/ from car 203.1.6 lifting by persons and/ or lifts/ hoists 203.2 Assessment 203.3 Education 203.4 Equipment

[1]Not presented here is the code (200.8) for unspecified interventions in each category.

BASIC ACTIVITIES CATEGORIES	BASIC ACTIVITIES INTERVENTIONS[1]
204 Standing	204.1 Exercises: Practising: 204.1.1 standing and standing balance 204.1.2 getting up and sitting down 204.1.3 sports activities, while standing 204.2 Assessment 204.3 Education 204.4 Equipment
205 Walking	205.1 Exercises: Practising: 205.1.1 walking on a treadmill with or without suspension equipment 205.1.2 walking in water (hydrotherapie) 205.1.3 walking indoors (including climbing the stairs) 205.1.4 walking outdoors 205.1.5 sport activities, while walking 205.2 Assessment 205.3 Education 205.4 Equipment
206 Using/ driving a manual wheelchair and/ or a (hand)cycle and/ or a bicycle	206.1 Exercises: Practising: 206.1.1 hand rim wheelchair propulsion indoors 206.1.2 hand rim wheelchair propulsion outdoors 206.1.3 hand rim wheelchair propulsion in sports activities 206.1.4 hand cycling or bicycling indoors 206.1.5 hand cycling or bicycling outdoors 206.2 Assessment 206.3 Education 206.4 Equipment
207 Using/ driving a powered wheelchair and/ or transportation	207.1 Exercises: Practising: 207.1.1 powered wheelchair propulsion indoors 207.1.2 powered wheelchair propulsion outdoors 207.1.3 other transportation propulsion indoors 207.1.4 other transportation propulsion outdoors 207.2 Assessment 207.3 Education 207.4 Equipment
208 Swimming	208.1 Exercises: Practising: 208.1.1 swimming 208.2 Assessment 208.3 Education 208.4 Equipment

APPENDIX 3
Level complex activities with 7 categories and 37 interventions

COMPLEX ACTIVITIES CATEGORIES	COMPLEX ACTIVITIES INTERVENTIONS[1]
301 Moving around indoors	301.1 Exercises: Practising moving around indoors: 301.1.1 to and from the ward to other rooms in the rehabilitation center 301.1.2 on the ward in the rehabilitation center 301.1.3 in one's home 301.1.4 in buildings 301.2 Assessment 301.3 Education
302 Moving around outdoors	302.1 Exercises: Practising moving around outdoors: 302.1.1 in the neighborhood of the rehabilitation center 302.1.2 in the neighborhood of one's home 302.1.3 to and from buildings 301.1.4 in recreational areas 302.2 Assessment 302.3 Education
303 Washing oneself	303.1 Exercises: Practising washing and drying oneself: 303.1.1 while being in one's bed in the rehabilitation center 303.1.2 while sitting on the ward in the rehabilitation center 303.1.3 in different locations other than the rehabilitation center 303.2 Assessment 303.3 Education
304 Caring for body parts	304.1 Exercises: Practising caring for body parts: 304.1.1 while being in one's bed in the rehabilitation center 304.1.2 while sitting on the ward in the rehabilitation center 304.1.3 in different locations other than the rehabilitation center 304.2 Assessment 304.3 Education

COMPLEX ACIVITIES CATEGORIES	COMPLEX ACTIVITIES INTERVENTIONS[1]
305 Toileting	305.1 Exercises: Practising toileting: 305.1.1 while being in one's bed in the rehabilitation center 305.1.2 while sitting on the ward in the rehabilitation center 305.1.3 in different locations other than the rehabilitation center 305.2 Assessment 305.3 Education
306 Dressing	306.1 Exercises: Practising dressing: 306.1.1 while being in one's bed in the rehabilitation center 306.1.2 while sitting on the ward in the rehabilitation center 306.1.3 in different locations other than the rehabilitation center 306.2 Assessment 306.3 Education
307 Eating and drinking	307.1 Exercises: Practising eating and drinking: 307.1.1 while being in one's bed in the rehabilitation center 307.1.2 while sitting on the ward in the rehabilitation center 307.1.3 in different locations other than the rehabilitation center 307.2 Assessment 307.3 Education

[1]Not presented here is the code (300.8) for unspecified interventions in each category.

Chapter 5

Contents of physical therapy, occupational therapy, and sports therapy sessions for patients with a spinal cord injury in 3 Dutch rehabilitation centers

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Submitted.

Abstract

Purpose. To describe the contents of interventions to improve mobility and self-care for patients with spinal cord injury (SCI) in early post-acute rehabilitation, using the Spinal Cord Injury-Interventions Classification System (SCI-ICS), and to compare these interventions between rehabilitation centers. The SCI-ICS describes therapy to improve mobility and self-care at 3 levels of functioning and consists of 25 categories with a total of 139 different interventions.
Methods. Fifty-three physical therapists, occupational therapists and sports therapists of 3 Dutch SCI rehabilitation centers recorded interventions with the SCI-ICS for patients with SCI in early post-acute rehabilitation during 4 consecutive weeks.
Results. Therapists recorded 1640 treatment sessions of 48 patients with a SCI. The mean number of treatment sessions per patient per week (8.9 overall) differed between centers (p=0.02), unlike the mean therapy time in minutes per patient per week (259 overall; p=0.44). Highest frequencies for individual categories were found for 'Muscle Power', 'Walking', and 'Hand rim wheelchair propulsion'.
Conclusions. We described the specific contents of therapy of patients with a SCI in 3 Dutch rehabilitation centers. The largest proportion of time was spent on interventions to improve muscle power, walking, and hand rim wheelchair propulsion.

Introduction

Physical therapy, occupational therapy and sports therapy contribute to the improvement of physical performance and capacity in terms of mobility and self-care in patients with spinal cord injury (SCI).[1,2] Although guidelines[3-5] and books[1,6,7] on therapeutic activities are available, evidence for the effectiveness of rehabilitation interventions is sparse.[2] Correlating therapeutic interventions with rehabilitation outcomes requires treatments to be described and characterized by means of uniform concepts and language.[8] Previous studies[8-10] on classification systems in stroke rehabilitation concluded that detailed descriptions of treatment not only enhance reliability, but might also enable the detection of meaningful differences and changes in therapeutic activities provided during various stages of rehabilitation and to different types of patients. There was therefore need for a detailed classification system. Since no such classification system was available for therapeutic interventions in SCI rehabilitation, we developed the Spinal Cord Injury-Interventions Classification System (SCI-ICS) for the main domains of SCI rehabilitation, namely mobility and self-care.[11-13]

The SCI-ICS comprises 3 levels of functioning, covering 25 categories with a total of 139 different interventions. (Appendices 1-3) The levels and categories of the SCI-ICS were derived from the International Classification of Functioning, Disability and Health (ICF)[14] and the Van Dijk model.[15] The interventions were identified from clinical practice[16], general SCI literature[1,7], clinical practice guidelines[3,4], and classification systems developed for stroke rehabilitation.[8-10]

The levels used in the SCI-ICS are defined as: (1) body functions, i.e. interventions aimed at influencing body functions and structures, (2) basic activities, i.e. interventions aimed at practising skills and techniques for positions and movements, and (3) complex activities, i.e. interventions aimed at practising skills and techniques for positions and movements in task-oriented and context-specific activities (defined as: activities at a specific location outside the exercise room relating to specific tasks). Each category describes the target of the intervention and includes several types of intervention: exercises, assessment, education and unspecified. (Appendices 1-3). Equipment is only listed in the categories at basic activity level. Exercise interventions are further subdivided in 1 to 6 specific methods and techniques and modalities. Modalities include electrotherapeutic applications (e.g., electrical stimulation) and physical agents (e.g., cryotherapy). Assessment includes examination and evaluation. Education includes all types of patient-related instructions. Equipment includes the prescription, application and production of devices and other equipment and is only categorized at the level of basic activities. Unspecified was added to each category to allow therapeutic activities not listed in the classification system to be recorded. The definitions of all interventions, with inclusion and exclusion criteria and examples from clinical practice, are presented in a 52-page manual.[16]

Consensus amongst therapists about the SCI-ICS was achieved by means of a Delphi consensus procedure.[11] The results of a feasibility[12] and a reliability[13] study on the SCI-ICS have been published. These three studies[11-13] provided evidence for (1) high levels of consensus on the SCI-ICS amongst Dutch therapists, (2) the completeness, and mutually exclusiveness of the categories, (3) the feasibility of the system for use by therapists of different disciplines and in different centers, and (4) good intrarater and interrater agreement.
The primary aim of the present study was to describe treatment provided to inpatients with SCI in 3 different Dutch rehabilitation centers, using the final version of the SCI-ICS. In contrast to the earlier feasibility study[12], we now included all therapists (staff, assistants and trainees) to describe all treatments (not only individual[12], but also group) for inpatients with a recently acquired SCI during a pre-set period. In the Netherlands group treatment sessions are common in SCI rehabilitation programmes. Group therapy is provided not only because it creates the possibility to increase the amount of time spent on therapy, but in particular it is seen as a useful strategy for maximizing motivation, offering peer support, social interaction and peer learning.[1,17] Thus to compare in future Dutch SCI rehabilitation programmes with other settings it is important to include group treatment sessions, and therapy provided by assistants and trainees to examine the whole package of provided therapy. In the study, we restricted ourselves to inpatients with a recently acquired SCI in 3 specialized SCI centers from the same Health care system. The 3 centers are members of the Dutch-Flemish SCI Association (N.V.D.G. Nederlands Vlaams Dwarslaesie Genootschap). We hypothesized that overall we would find similarities between centers in the time spent on the various levels, categories and types of intervention (e.g., time per week on exercises, assessment), and differences between the centers in the way therapy is delivered (e.g., frequency and time per week, group or individual). In discussions in meetings of the N.V.D.G., and from the results of the Delphi consensus procedure[11] we had reason to believe we would find differences in contents of therapy.

Methods

Design

Therapists from 3 Dutch inpatient rehabilitation centers used the SCI-ICS to record interventions provided to patients with SCI during 4 weeks (20 therapy days). The study was approved by the scientific and ethical review boards of the 3 rehabilitation centers.

Patients
Patients were included if they had been admitted for initial inpatient rehabilitation after onset of SCI. Patients received written information on the research project and were asked to provide written consent for the use of information from their medical records.

Therapists
The study included all staff, assistants and trainees of the physical therapy, occupational therapy, and sports therapy (n=53) departments working with SCI patients at the participating rehabilitation centers. At the start of this study 19 of them were unfamiliar with the SCI-ICS, while the other 34 had been involved in 1 or more of the earlier SCI-ICS studies.

Procedure
Three weeks before the start of data acquisition, the therapists received the SCI-ICS manual and were asked to study it thoroughly. An instruction meeting was held to discuss the SCI-ICS with all therapists. Next, all therapists were instructed to practise recording their treatment sessions with the SCI-ICS for 2 days, during which they could discuss with the researcher any difficulties they might have using the instrument. After this, the therapists were instructed to start recording all treatment sessions of the included patients for the set period of 4 weeks.

Instrumentation
Therapists were asked to record each treatment session in which both patient and therapist were physically present on a separate recording form. Therapists were asked to check a box for individual treatment or group treatment. An individual treatment was defined as a treatment in which the number of therapists was equal to or larger than the number of patients. A group treatment was defined as a treatment in which the number of patients was larger than the number of therapists. If more than 1 therapist was actively involved In the treatment session (individual or group), only 1 therapist completed a recording form for each patient. The number of other actively involved therapists could be indicated by checking a box. The recording form allowed users to record 1 treatment session with a maximum of 5 different interventions using 4- or 5-digit codes from the SCI-ICS and to record the number of minutes spent on each intervention, in 5-minute increments.
We also explored therapy activities directed at other domains than mobility and self-care by asking the therapists to record the frequency of interventions and the duration of therapy time spent on the domains of ‘communication’,

'domestic life', 'major life areas' and 'community, social and civic life'. These domains were defined according to the ICF[14] and were not sub-divided any further. Patient characteristics and medical information were retrieved from the medical records.

Statistical analysis

Descriptive statistics were used for the distribution and time spent on the SCI-ICS interventions. The distribution of total therapy time over different interventions was used to compare contents of treatment between the 3 centers. One-way analysis of variance (ANOVA) and Chi-square were used to detect significant differences between centers ($p<0.05$).

Results

Patients

Forty-eight patients were included in the study. Eleven patients had motor complete paraplegia (Asia Impairment Scale (AIS) A, B), 15 had motor incomplete paraplegia (AIS C, D), 8 had motor complete tetraplegia, and 14 had motor incomplete tetraplegia. Table 1 lists the characteristics of patients and therapists. Center B had a relatively high number of patients with tetraplegia, while patients of center A had a relatively recent SCI that was more likely to be of non-traumatic origin. (Table 1) The median number of days between onset and admission to the rehabilitation center did not differ significantly between centers ($p=0.05$).

Therapists

All therapists (n=53) participated on a voluntary basis and gave written consent. The total group included 20 physical therapists, 16 occupational therapists, 4 sports therapists, 9 physical therapy assistants, 3 trainee physical therapists and 1 trainee sports therapist. The therapists of center C had more experience in working with SCI than those at the other centers. (Table 1)

Recorded treatment sessions

A total of 1647 treatment sessions were recorded. Seven forms were excluded due to incomplete documentation. Table 2 provides general information on the treatment sessions.

Ninety-three percent of all treatment sessions (1524/1640) consisted entirely of mobility and self-care interventions, while 3% (51/1640) consisted partly of mobility and self-care interventions and partly of interventions not included in the

Table 1. Patient and therapist characteristics.

Patient characteristics	Center A (N=14)	Center B (N=20)	Center C (N=14)
Age (years; mean (SD))	53.2 (17.1)	54.6 (17.0)	54.9 (14.9)
Sex (% men)	57.1	70.0	42.9
Cause of SCI (% traumatic)	21.4	65.0	50.0
Type of SCI			
motor-complete paraplegia	3	5	3
motor-incomplete paraplegia	7	2	6
motor-complete tetraplegia	1	6	1
motor-incomplete tetraplegia	3	7	4
Time between onset of SCI and admission (days; median (range))	24.5 (15.8-65.0)	52.0 (32.0-141.0))	61.5 (25.5-182.8)
Time between onset of SCI and start of the study (days; median (range))	95.0 (57.3-188.0)	175.0 (125.0-347.0))	202.5. (92.3-311.0)
Therapist characteristics	**Center A (N=19)**	**Center B (N=16)**	**Center C (N=18)**
Discipline			
Physical therapist (N)	8	6	6
Physical therapy assistant (N)	4	2	3
Physical therapy trainee (N)	1	1	1
Occupational therapist (N)	5	5	6
Sports therapist (N)	1	2	1
Sports therapy assistant (N)	0	0	1
Experience in SCI rehabilitation (years; mean (SD))	6.5 (4.9)	6.3 (5.7)	9.9 (7.6)

SCI-ICS, and 3.9% (65/1640) consisted entirely of interventions not included in the SCI-ICS. In 56.6% of the treatment sessions (928/1640), therapists described the therapeutic activities during the session as comprising only 1 intervention, while 28.5% involved 2 interventions, 11.7% involved 3 interventions, 2.4% involved 4 interventions, and only 0.8% involved 5 interventions. The mean number of interventions per treatment session differed between centers (p=0.00).
Ninety-four percent (45925 minutes) of the total recorded therapy time (48970 minutes) was spent on mobility and self-care interventions, and 6 percent on interventions for the other domains of the ICF.[14] As shown in Table 2, the mean number of treatment sessions per patient per week and the duration of treatment sessions differed significantly between the centers, unlike the total

Table 2. Treatment characteristics by center.

Treatment characteristics	Center A (N=14)	Center B (N=20)	Center C (N=14)	Sig[1].
Total number of recorded treatment sessions (n=1640)	441	862	337	0.02
Total therapy time in minutes				
For mobility and self-care	12340	22420	11165	0.26
For other domains of the ICF	470	1585	990	0.57
Number of treatment sessions per patient per week (mean (range))	8.1 (SD 3.5)	11.3 (SD 5.5)	7.3 (SD 2.9)	0.02
Total therapy time per patient per week in minutes (mean (SD))	228.1(SD 94.7)	291.3 (SD 174.9)	248.1(139.6)	0.44
Duration of treatment sessions in minutes (mean (SD))	28.9 (SD 4.7))	24.6 (SD 3.4)	32.3 (SD 11.6)	0.01
Treatment sessions by discipline				0.00
Physical therapy[2] (%)	78.7	66.6	54.6	NA
Occupational therapy (%)	17.7	22.5	34.1	NA
Sports therapy[3] (%)	3.6	10.9	11.3	NA
Proportion of individual treatment sessions for each discipline				0.00
Physical therapy (% individual)	73.7	62.5	62.5	NA
Occupational therapy (% individual)	62.8	81.5	68.7	NA
Sports therapy (% individual)	87.5	28.7	57.9	NA

[1] Significant difference ($p<0.05$) was calculated with ANOVA and Chi-square analysis.
[2] Staff members of the physical therapy department recorded 77% of the treatment sessions, physical therapy assistants 18%, and physical therapy trainees 5%.
[3] Staff members of the sports department recorded 88% of the treatment sessions, while the sports therapy trainee recorded 12%.

Abbreviation NA=Not applicable.

therapy time per patient per week. The proportion of therapy provided by the different disciplines as well as the ratio of individual to group treatment sessions differed significantly between centers. (Table 2)
All disciplines in all centers recorded the largest percentage of the time as exercise interventions. Table 3 shows the distribution of therapy time over the different types of interventions.
The percentage of time spent on assessment, education and equipment differed significantly between centers. (Table 3)

Table 3. Therapy time by type of intervention.

Type of intervention	Center A		Center B		Center C		All
Therapy time spent	**%[1]**	**Mean[2], SD**	**%**	**Mean, SD**	**%**	**Mean, SD**	**Sig[3]**
Exercises	93.9	214.4(92.6)	83.8	239.2(168.6))	74.4	183.4(168.6)	0.52
Assessment	1.9	4.3(5.7)	5.5	17.5(17.2)	4.0	11.4(14.7)	0.03
Education	1.4	3.2(2.3)	4.2	13.1(10.8)	11.1	26.7(19.1)	0.00
Equipment	2.5	5.5(10.8)	6.0	20.2(17.6)	10.2	25.8(17.2)	0.04
Unspecified	0.3	7.1(1.8)	0.5	1.3(2.7)	0.3	0.6(2.0)	0.63

[1] Percentage of time spent per type of intervention was calculated for each center.
[2] Mean time in minutes was calculated per patient per week.
[3] Significant difference ($p<0.05$) was calculated with ANOVA analysis.

Therapy time by level and category

In all centers, the largest proportion of the therapy time was spent at the level of basic activities and body functions, and the smallest proportion at the level of complex activities. The time spent on each level did not differ significantly between centers. Table 4 shows the percentage of therapy time spent on the various levels and on each of the 25 categories.

Twenty-four of the 25 categories were used in the descriptions of the contents of therapy (provided in group or as individual treatment) for mobility and self-care; only the category of 'Neuropathic pain' was not used at all. To describe the contents of group therapy 20 categories were used; 'Neuropathic pain', 'Skin and related structure', 'Washing oneself', 'Dressing', and 'Eating and drinking' were not used. Most therapy time was spent on interventions in the categories of 'Muscle power', 'Walking', and 'Manual wheelchair propulsion'. Center A spent most of the therapy time on 'Walking' and 'Muscle power', center B on 'Muscle power', 'Walking', Joint mobility', and 'Manual wheelchair wheelchair propulsion', and center C on 'Muscle power' and 'Manual wheelchair wheelchair propulsion'. (Table 4) The distribution of time spent over the various interventions only differed significantly between the centers for the categories of 'Joint mobility'($p=0.01$), 'Manual wheelchair propulsion' ($p=0.02$), and 'Toileting' ($p=0.03$).
Twenty-two categories were used by at least 2 disciplines. Seven of the 8 categories at basic activity level were used by all 3 disciplines.

Table 4. Distribution of therapy time over all 25 categories of the SCI-ICS by center.

Centers	Center A		Center B		Center C		Sig[1]
	%[2]	Mean[3], SD	%	Mean, SD	%	Mean, SD	
Levels							
Body functions	47.3	111.2 (55.8)	48.9	139.3(114.1)	36.0	79.7(78.9)	0.18
Basic activities	50.7	112.6(85.1)	46.8	139.7(82.9)	50.1	124.5(45.2)	0.58
Complex activities	2.0	4.3(6.9)	4.3	12.3(14.9)	13.9	43.8(87.6)	0.07
Categories							
Muscle power	18.0	43.3(23.8)	19.7	56.1(58.9)	20.6	47.6(50.9)	0.74
Muscle length	5.0	12.0(13.3)	4.3	12.3(20.1)	2.7	5.4(11.7)	0.42
Muscle tone	3.1	7.7(10.2)	5.9	16.8(42.1)	2.0	3.9(7.5)	0.41
Joint mobility	7.2	16.0(29.8)	10.6	30.2(28.3)	1.5	2.9(10.3)	0.01
Sensory functions	0.4	0.98(2.3)	0.3	1.0(2.7)	2.1	4.3(15.3)	0.48
Neuropathic pain	0.0	0(0)	0.0	0(0)	0.0	0(0)	NA
Musculoskeletal pain	9.5	21.8(43.5)	0.5	1.5(3.5)	1.0	2.6(3.9)	0.05
Skin and related structures	0.0	0(0)	0.3	0.94(2.7)	0.4	1.0(2.4)	0.36
Cardiovascular system	4.1	10.2(17.8)	6.3	17.8(28.6)	5.6	11.7(17.6)	0.59
Respiratory system	0.0	0(0)	0.9	2.7(7.8)	0.1	0.2(0.67)	0.27
Hand and arm use	6.5	14.3(29.2)	6.3	19.9(23.2)	8.1	17.5(22.1)	0.81
Body positions and movements	3.5	8.2(11.7)	5.1	15.9(16.6)	3.6	8.0(7.7)	0.14
Transfers	2.0	4.6(6.3)	6.3	19.7(29.4)	3.3	11.1(18.6)	0.15
Standing	5.2	11.6(15.1)	1.6	4.4(11.5)	3.0	6.4(7.1)	0.21
Walking	24.5	53.9(57.3)	10.8	31.0(59.8)	7.6	20.2(21.9)	0.21
Manual wheelchair propulsion	5.0	10.9(11.1)	10.1	30.4(36.1)	17.9	45.5(33.7)	0.02
Transportation	0.3	0.6(2.3)	2.5	7.2(12.6)	3.3	7.8(12.6)	0.14
Swimming	3.7	8.4(7.3)	4.0	11.3(16.1)	3.2	7.9(14.4)	0.73
Moving around indoors	1.8	3.9(5.8)	0.6	1.6(2.7)	8.1	26.8(70.7)	0.14
Moving around outdoors	0.0	0(0)	1.2	3.3(4.7)	2.8	8.2(15.3)	0.06
Washing oneself	0.0	0(0)	0.3	0.9(2.90	0.4	0.7(2.0)	0.47
Caring for body parts	0.2	0.4(1.3)	0.3	0.9(3.4)	0.4	1.1(1.9)	0.75
Toileting	0.0	0(0)	0.1	0.4(0.9)	0.7	2.6(5.2)	0.03
Dressing	0.0	0(0)	1.6	4.6(10.7)	1.4	4.1(6.2)	0.22
Eating and drinking	0.0	0(0)	0.2	0.6(2.1)	0.1	0.4(1.7)	0.52

[1] Significant difference ($p<0.05$) was calculated with ANOVA analysis.
[2] Percentage of time spent per level and per category was calculated for each center.
[3] Mean no. minutes per week per patient.

Discussion

The primary aim of this study was to compare the contents of physical therapy, occupational therapy and sports therapy to improve mobility and self-care by patients with a spinal cord injury in 3 Dutch inpatient rehabilitation centers. The findings demonstrate that the SCI-ICS can be used to describe the contents of therapy in a routine rehabilitation setting in much greater detail than just length of stay[18,19] and total hours of therapy.[20]

The results show several similarities in terms of therapy content between the 3 Dutch centers. Comparable amounts of therapy time were spent at the levels of body functions and basic activities, while little time was spent practising skills in task-oriented and context-specific activities (complex activity level). The category of 'Muscle power' was frequently recorded in all centers, while in all centers the categories like 'Neuropathic pain' and 'Eating and Drinking' showed low frequences. Overlap between disciplines in the use of categories was found for the majority of categories. By far the largest proportion of time was spent on exercise interventions, and this proportion was comparable between the 3 centers. The mean time spent per patient per week did not differ significantly between the centers either.

This study also found differences between centers. Therapy time for assessment, education and equipment differed between the centers. The mean number of treatment sessions per patient per week, and the mean time per patient per treatment session also differed significantly between the centers, as did the proportions of individual and group treatment sessions. On only 3 out of 24 categories, significant differences between centers were seen. The significant difference between centers for 'Manual wheelchair propulsion' could not be explained by differences in the proportion of persons with motor complete injuries in each center.

Although the patients in center A had a relatively recent SCI, and the patients in center B had a relatively higher number of patients with a tetraplegia therapy contents recorded at category level were more or less the same. We assume, the low number of significant differences on the categories between centers could be explained by the known fact that therapists from these centers share theoretical and practical knowledge on the treatment of patients with SCI in meetings and workshops organized by the Dutch-Flemish SCI Association. Thus, although therapists might believe they provide different therapy, this study showed the provided therapy programmes in these centers are more or less similar.

Although the mean number of treatment sessions per patient per week differed significantly between the centers, the mean time per patient per week did not differ significantly. This may have been caused by the differences in the number

of group treatment sessions. Although 1 group treatment session is recorded as 1 treatment session, the duration of group treatment sessions is longer than that of individual sessions. This underlines the importance of recording not only numbers but also durations of treatment sessions.
The findings that the amount of time spent per patient per week was comparable between centers could be explained by the fact that the 3 centers are part of the same Health care system guided by the same financial constraints.
The findings of the present study resemble those of our previous study on the feasibility of the SCI-ICS[12], in which 36 therapists recorded 856 treatment sessions, in that most therapy time was spent at the body function and basic activity levels, while the smallest proportion of time was spent practising skills in task-oriented and context-specific activities (complex activities). These findings show that the 3 Dutch centers provide therapy mainly in an exercise room, rather than in the patient's bedroom or bathroom (self-care), or outside the rehabilitation center (outdoor mobility). Nonetheless, at least 2 centers recorded task-oriented and context-specific activities in the present study. A reason why therapists provide less task-oriented or context-specific activities could be that it takes extra effort and time to practise self-care or mobility at other locations within the tight schedules of exercise room-based therapists.
Several authors have described the importance for patients with SCI of learning motor tasks in a specific context[1,21], making it desirable to practise mobility and self-care at the level of complex activities.

Study limitations

This study had some limitations. First, the small number of patients included in the study meant that it was not useful to compare the contents of therapy between the different types of SCI (e.g., complete paraplegia, incomplete tetraplegia). However, since we included a wide range of patients with SCI, from early admission to discharge, traumatic and non-traumatic, the sample might be considered representative of the whole spectrum of SCI patients in post-acute care. Also, due to the small number of patients, we were only able to analyse the contents of therapy at the 3 levels (e.g., body functions), the 25 categories (e.g., walking), and the 4 types of interventions (e.g., exercises, assessment); it was not useful to compare the contents of therapy at the level of exercise interventions. (See 5 digit codes Appendices) Further research with larger numbers of patients will enable us to compare treatment between types of SCI and stages of rehabilitation.
The second limitation was that this study only described the contents of therapy which took place in the presence of the therapists who recorded it. Thus, we cannot report on other mobility and self-care focused therapy (e.g., independent

exercises performed by the patients themselves) or the contributions by the nursing staff or other members of the multidisciplinary team.
Finally, our results apply to the Dutch patient population, that may differ from that in other countries. However, we do emphasize the SCI-ICS was developed from an international point of view. Not only did we consult international literature[1,3-5,7], to identify relevant interventions, the use of the ICF[14], to structure the classification also ensures a cross-cultural perspective. Ongoing research abroad with the English-language version of the SCI-ICS, will enable us to study the feasibility of the SCI-ICS in various other countries and to report on similarities and differences in the contents of therapy for persons with SCI between different countries.

Conclusions

Using the SCI-ICS, we found more similarities than differences between 3 Dutch rehabilitation centers in the therapy provided to their inpatients with SCI. The largest proportion of time was spent on interventions to improve muscle power, walking, and manual wheelchair propulsion.

References

1. Harvey L. Management of spinal cord injuries. Sydney: Butterworth Heinemann Elsevier; 2008.
2. Harvey L. The effectiveness of physical interventions for people with spinal cord injuries: a systematic review. Spinal Cord. 2008;1-12.
3. American Physical Therapy Association. Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-27, 223-39, 437-53.
4. Occupational Therapy Practice Framework: domain and process. Am J Occup Ther. 2002;56: 609-39.
5. Jacobs PL, Nash MS. Exercise recommendations for individuals with spinal cord injury. Sports Med. 2004;34:727-51.
6. Sisto SA, Druin E, Sliwinski MM. Spinal cord injuries. Management and rehabilitation. St. Louis: Mosbey Elsevier; 2009.
7. Kirshblum S, Campagnolo DI, DeLisa JA, editors. Spinal cord medicine. Philadelphia: Lippincott Williams & Wilkins; 2002.
8. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "black box" of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-86.
9. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the "black box" of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-8.
10. De Wit L, Kamsteegt H, Yadav B, Verheyden G, Feys H, De Weerdt W. Defining the content of individual physiotherapy and occupational therapy sessions for stroke patients in an inpatient rehabilitation setting. Development, validation and inter-rater reliability of a scoring list. Clin rehabil. 2007;21:450-459.
11. van Langeveld Sacha AHB, Marcel W.M. Post, Floris W.A. van Asbeck, Karin Postma, Dominique ten Dam, Kees Pons. Development of a classification of physical, occupational, and sports therapy interventions to document mobility and self-care in spinal cord injury rehabilitation. J Neurol Phys Ther. 2008;32:2-7.
12. van Langeveld Sacha A, Marcel W. Post, Floris W. van Asbeck, Karin Postma, Jacqueline Leenders, Kees Pons. Feasibility of a classification system for physical therapy, occupational therapy, and sports therapy interventions for mobility and self-care in spinal cord injury rehabilitation. Arch Phys Med Rehabil. 2008; 89:1454-1459.
13. van Langeveld Sacha A, Marcel W. Post, Floris W. van Asbeck, Paul ter Horst, Jacqueline Leenders, Karin Postma, Eline Lindeman. Reliability of a new classification system for mobility and self-care in spinal cord injury rehabilitation: the Spinal Cord Injury- Interventions Classification System. Arch Phys Med Rehabil. 2009;90:1229-1236.
14. World Health Organization. International classification of functioning, disability and health: ICF. Geneva: WHO; 2001.
15. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-10.

16. van Langeveld AHB. The Spinal Cord Injury-Interventions Classification System manual. 2008.
17. Dean CM, Richards C, Malouin F. Task-related circuit training improves performance of locomotor tasksin chronic stroke: a randomized controled pilot trial. Arch Phys Med Rehabil. 2000;81:409-17.
18. Post MW, Dallmeijer AJ, Angenot E, van Asbeck FW, van der Woude LH. Duration and functional outcome of spinal cord injury rehabilitation in the Netherlands. J Rehabil Res Dev. 2005;42:75-86.
19. Heinemann AW, Linacre JM, Wright BD, Hamilton BB, Granger C. Prediction of rehabilitation outcomes with disability measures. Arch Phys Med Rehabil. 1994;75:133-143.
20. Chen CC, Heinemann AW, Granger CV, Linn RT. Functional gains and therapy intensity during subacute rehabilitation: A study of 20 facilities. Arch Phys Med Rehabil. 2002;83:1514-1523.
21. Spooren AI, Janssen-Potten YJ, Kerckhofs E, Seelen HA. Outcome of motor training programmes on arm and hand functioning in patients with cervical spinal cord injury according to different levels of the ICF: a systematic review. J Rehab Med. 2009;41:497-505.

APPENDIX 1
Level body functions with 10 categories and 46 interventions

BODY FUNCTIONS CATEGORIES	BODY FUNCTIONS INTERVENTIONS[1]
101 Muscle power	101.1 Exercises and modalities 101.1.1 Active-assisted exercises 101.1.2 Active exercises 101.1.3 Resisted active exercises 101.1.4 Modalities 101.2 Assessment 101.3 Education
102 Muscle length	102.1 Exercises and modalities 102.1.1 Passive or active-assisted range of motion exercises or stretches administered by a therapist 102.1.2 Stretching performed by the patient himself/ herself 102.1.3 Modalities 102.2 Assessment 102.3 Education
103 Muscle tone	103.1 Exercises and modalities 103.1.1 Passive or active-assisted range of motion exercises or stretches administered by a therapist 103.1.2 Stretching performed by the patient himself/ herself 103.1.3 Relaxation therapy 103.1.4 Modalities 103.2 Assessment 103.3 Education
104 Joint mobility	104.1 Exercises and modalities 104.1.1 Manual mobilization techniques 104.1.2 Modalities 104.2 Assessment 104.3 Education
105 Sensory functions	105.1 Exercises and modalities 105.1.1 Practising of sensory functions 105.1.2 Modalities 105.2 Assessment 105.3 Education

BODY FUNCTIONS CATEGORIES	BODY FUNCTIONS INTERVENTIONS[1]
106 Neuropathic pain	106.1 Exercises and modalities 106.1.1 Neuropathic pain treatment 106.1.2 Modalities 106.2 Assessment 106.3 Education
107 Musculoskeletal pain	107.1 Exercises and modalities 107.1.1 Manual techniques 107.1.2 Modalities 107.2 Assessment 107.3 Education
108 Skin and related structures	108.1 Exercises and modalities 108.1.1 Manual techniques 108.1.2 Modalities 108.2 Assessment 108.3 Education
109 Cardiovascular system	109.1 Exercises 109.1.1 Cardiovascular fitness training without equipment 109.1.2 Cardiovascular fitness training with equipment 109.2 Assessment 109.3 Education
110 Respiratory system	110.1 Exercises and modalities 110.1.1 Exercises for breathing strategies without devices 110.1.2 Exercises for breathing strategies with devices 110.1.3 Modalities 110.2 Assessment 110.3 Education

[1]Not presented here is the code (100.8) for unspecified interventions in each category.

APPENDIX 2
Level basic activities with 8 categories and 56 interventions

BASIC ACTIVITIES CATEGORIES	BASIC ACTIVITIES INTERVENTIONS[1]
201 Hand and arm use	201.1 Exercises: Practising: 201.1.1 picking up, grasping, manipulating, releasing, and reaching 201.1.2 lifting, carrying, putting down, pulling, and pushing 201.1.3 the use of arm and hand skills in self-care in an exercise room 201.1.4 the use of arm and hand skills in sports activities 201.2 Assessment 201.3 Education 201.4 Equipment
202 Changing and maintaining body positions and movements	202.1 Exercises: Practising body positions and movements: 202.1.1 in/ to prone, supine and sidelying position 202.1.2 with the use of arms and legs (e.g., crawling, kneeling) 202.1.3 sitting and moving in a sitting position, mainly with the use of the arms 202.1.4 in sports activities while sitting 202.2 Assessment 202.3 Education 202.4 Equipment
203 Transfers	203.1 Exercises: Practising transfer: 203.1.1 wheelchair to/ from treatment table (equal height) 203.1.2 wheelchair to/ from objects with different heights and forms 203.1.3 wheelchair to/ from toilet, shower/ commode chair, tubseat 203.1.4 wheelchair to/ from bed 203.1.5 wheelchair to/ from car 203.1.6 lifting by persons and/ or lifts/ hoists 203.2 Assessment 203.3 Education 203.4 Equipment

BASIC ACTIVITIES CATEGORIES	BASIC ACTIVITIES INTERVENTIONS[1]
204 Standing	204.1 Exercises: Practising: 204.1.1 standing and standing balance 204.1.2 getting up and sitting down 204.1.3 sports activities, while standing 204.2 Assessment 204.3 Education 204.4 Equipment
205 Walking	205.1 Exercises: Practising: 205.1.1 walking on a treadmill with or without suspension equipment 205.1.2 walking in water (hydrotherapie) 205.1.3 walking indoors (including climbing the stairs) 205.1.4 walking outdoors 205.1.5 sport activities, while walking 205.2 Assessment 205.3 Education 205.4 Equipment
206 Using/ driving a manual wheelchair and/ or (hand)cycle and/ or bicycle	206.1 Exercises: Practising: 206.1.1 hand rim wheelchair propulsion indoors 206.1.2 hand rim wheelchair propulsion outdoors 206.1.3 hand rim wheelchair propulsion in sports activities 206.1.4 hand cycling or bicycling indoors 206.1.5 hand cycling or bicycling outdoors 206.2 Assessment 206.3 Education 206.4 Equipment
207 Using/ driving a powered wheelchair and/ or transportation	207.1 Exercises: Practising: 207.1.1 powered wheelchair propulsion indoors 207.1.2 powered wheelchair propulsion outdoors 207.1.3 other transportation propulsion indoors 207.1.4 other transportation propulsion outdoors 207.2 Assessment 207.3 Education 207.4 Equipment
208 Swimming	208.1 Exercises: Practising: 208.1.1 swimming 208.2 Assessment 208.3 Education 208.4 Equipment

[1]Not presented here is the code (200.8) for unspecified interventions in each category.

APPENDIX 3
Level complex activities with 7 categories and 37 interventions

COMPLEX ACTIVITIES CATEGORIES	COMPLEX ACTIVITIES INTERVENTIONS[1]
301 Moving around indoors	301.1 Exercises: Practising moving around indoors: 301.1.1 to and from the ward to other rooms in the rehabilitation center 301.1.2 on the ward in the rehabilitation center 301.1.3 in one's home 301.1.4 in buildings 301.2 Assessment 301.3 Education
302 Moving around outdoors	302.1 Exercises: Practising moving around outdoors: 302.1.1 in the neighbourhood of the rehabilitation center 302.1.2 in the neighbourhood of one's home 302.1.3 to and from buildings 301.1.4 in recreational areas 302.2 Assessment 302.3 Education
303 Washing oneself	303.1 Exercises: Practising of washing and drying oneself 303.1.1 while being in one's bed in the rehabilitation center 303.1.2 while sitting on the ward in the rehabilitation center 303.1.3 in different locations other than the rehabilitation center 303.2 Assessment 303.3 Education
304 Caring for body parts	304.1 Exercises: Practising of caring for body parts: 304.1.1 while being in one's bed in the rehabilitation center 304.1.2 while sitting on the ward in the rehabilitation center 304.1.3 in different locations other than the rehabilitation center 304.2 Assessment 304.3 Education

COMPLEX ACTIVITIES CATEGORIES	COMPLEX ACTIVITIES INTERVENTIONS[1]
305 Toileting	305.1 Exercises: Practising of toileting: 305.1.1 while being in one's bed in the rehabilitation center 305.1.2 while sitting on the ward in the rehabilitation center 305.1.3 in different locations other than the rehabilitation center 305.2 Assessment 305.3 Education
306 Dressing	306.1 Exercises: Practising of dressing: 306.1.1 while being in one's bed in the rehabilitation center 306.1.2 while sitting on the ward in the rehabilitation center 306.1.3 in different locations other than the rehabilitation center 306.2 Assessment 306.3 Education
307 Eating and drinking	307.1 Exercises: Practising of eating and drinking: 307.1.1 while being in one's bed in the rehabilitation center 307.1.2 while sitting on the ward in the rehabilitation center 307.1.3 in different locations other than the rehabilitation center 307.2 Assessment 307.3 Education

[1]Not presented here is the code (300.8) for unspecified interventions in each category.

Chapter 6

Comparing contents of therapy for people with a spinal cord injury in postacute inpatient rehabilitation in Australia, Norway, and the Netherlands

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Submitted.

Abstract

Background. Research reports have described contents of therapy in SCI rehabilitation only as total number of therapy hours. We developed the Spinal Cord Injury-Interventions Classification System (SCI-ICS), a tool to classify therapy to improve mobility and self-care into 3 levels (body functions, basic and complex activities) and 25 categories.

Objectives. To compare specific contents and amount of therapy provided with the aim to improve mobility and self-care for people with SCI in Australia, Norway, and the Netherlands, and evaluate the use of the SCI-ICS outside the Netherlands.

Design. Prospective, descriptive study.

Methods. Physical, occupational and sports therapists in 6 centers recorded all therapy provided to all people with recent SCI in inpatient rehabilitation during 4 designated weeks. Each treatment session was classified using 1 or more SCI-ICS codes. Duration of each intervention was specified.

Results. Seventy-three therapists recorded 2526 treatments of 79 people with SCI (Netherlands 48, Australia 20, and Norway 11). Most therapy time was spent on exercises (overall mean 84%), and on categories at body function and basic activity level of the SCI-ICS. Therapy time significantly differed between countries for 13 of 25 categories. Mean time in minutes per treatment (Netherlands, 28; Australia, 43; Norway, 39), and in hours per patient per week (Netherlands, 4.3; Australia, 5.8; Norway, 6.2) differed significantly.

Limitations. The short period and small number of patients may have influenced the results.

Conclusions. Therapy in inpatient SCI rehabilitation in all 3 countries focused on mobility and self-care exercises at body function and basic activity level, but differences were present in focus on the various categories and therapy time. The SCI-ICS can be used reliably to describe therapy in different countries.

Introduction

Physical therapy, occupational therapy and sports therapy contribute to the improvement of physical performance and capacity, in terms of mobility and self-care, in people with spinal cord injury (SCI).[1,2]The concept of mobility covers sitting, standing, transfers, arm and hand use, walking, wheelchair mobility, and transportation. Self-care covers eating, drinking, washing, caring for body parts, dressing, and toileting.[3] A requirement for both clinical trials and observational research is that treatments need to be described in detail and characterized by means of uniform concepts and language.[4-6] Since no such classification system was available for SCI rehabilitation, we developed the Spinal Cord Injury-Interventions Classification System (SCI-ICS) for the main domains of SCI rehabilitation, namely mobility and self-care.[7-9]

The SCI-ICS comprises 3 levels (body functions, basic activities, and complex activities), 25 categories and a total of 139 different interventions. The levels and categories of the SCI-ICS were derived from the International Classification of Functioning and Health (ICF) 3 and the Van Dijk model.[10] The interventions were identified from clinical practice, general SCI literature[11,12], clinical practice guidelines[13,14], and classification systems developed for stroke rehabilitation.[4,15]

The key concept of the SCI-ICS is that therapists are instructed to classify their daily treatment sessions into levels and categories according to the aim of their treatments. Guidelines for classifying interventions are provided in the SCI-ICS manual.[16] Previous studies provided evidence for (1) high levels of consensus on the SCI-ICS amongst Dutch therapists[7], (2) the completeness and mutual exclusiveness of the categories[8], (3) the feasibility of the SCI-ICS for use by therapists of different disciplines and in different centers[8], and (4) good intra- and inter-rater agreement for the Dutch-language version of the SCI-ICS.[9]

Following these studies we compared the therapy provided to 48 people with with a recent SCI undergoing inpatient treatment in three rehabilitation centers in the Netherlands during the same 4 consecutive weeks.[17] The sample included a wide range of people with traumatic (47%) and non-traumatic SCI, with a mean age of 53 years (SD 16.2). The main finding was that the therapy provided to people with recent SCI in different centers in the Netherlands was more or less the same; comparable time was spent at the level of body function and basic activities, and therapy time per treatment (overall 28.1 minutes) and total mean time per patient per week (4.3 hours overall) were comparable. This similarity of therapy programs is probably caused by the intensive cooperation and exchange of theoretical and practical knowledge between centers specializing in SCI rehabilitation in the Netherlands.[17]

The next step was an international comparison of SCI rehabilitation to explore differences and similarities of SCI therapy across countries. We approached SCI centers in different parts of the world and found 2 SCI centers, in Australia and Norway, willing to participate in the present research. The centers all specialize in SCI rehabilitation, and are all in high-resource countries. However, compared to the Netherlands, people with SCI in Australia and Norway are admitted to a rehabilitation center much sooner after SCI onset, while length of stay in initial inpatient rehabilitation (LOS) is much longer in the Netherlands than in Australia.[18-20] The first aim of the present study was to compare contents of therapy time provided with the aim to improve mobility and self-care for people with SCI in Australia, Norway, and the Netherlands. We evaluated this by focussing on differences and similarities in terms of therapy time spent by country on the various levels, categories and types of interventions of the SCI-ICS, and by analyzing therapy time spent per patient per treatment session, and per week. The second aim was to evaluate the use of the SCI-ICS outside the Netherlands, by repeating the Dutch study[9] into the reliability of classifying interventions with the SCI-ICS, and by evaluating whether therapists in Australia and Norway were able to classify all their clinical activities into one or more categories.

Methods

Design

The spinal cord injury departments of Rijndam rehabilitation center (Rotterdam), St. Maartenskliniek (Nijmegen), and Rehabilitation center De Hoogstraat (Utrecht), all in the Netherlands; the Victorian Spinal Cord Service, Austin Health (Melbourne), Australia; and the Department of Physical Medicine and Rehabilitation, St. Olav's Hospital (Trondheim), Norway participated in the study. We selected three of the eight Dutch centers with a specialization in SCI, all three with a mean number of 28 beds for people with recent SCI and chronic SCI, which were considered to be representative of the Dutch SCI rehabilitation system.[17] The Australian and Norway specialized SCI centers reported having inpatient beds for people with recent SCI only (20 and 10, respectively). Inpatients with recent SCI were defined as people undergoing initial inpatient rehabilitation after onset of SCI, and inpatients with chronic SCI as those readmitted to the rehabilitation center (for example, for treatment of pressure ulcers).

For the purpose of this study, all therapists in each center recorded all therapy they provided to people with a recent SCI undergoing standard rehabilitation, each day during 4 consecutive weeks (20 working days). This 4-week period provided a sample of all therapy provided in the center. The period was based on a feasibility study[8] which revealed that this allows enough treatment sessions to be recorded to compare therapy between centers. Data collection in the 3 centers in the Netherlands took place in April 2008. Data collection in Australia took place in February 2009, and in Norway in June 2009. The study was approved by the scientific and ethical review boards of the 5 facilities. All people with SCI gave written consent for retrieving demographic and medical information from their medical records (e.g., level of injury, ASIA Impairment Scale (AIS)[21], cause of SCI, date of onset of SCI, and date of admission to the rehabilitation center).

Patients

Ninety-seven people undergoing initial inpatient rehabilitation at one of the five study centers at the time of the study were included. The study sample included 48 people in the Netherlands, 20 in Australia, and 11 (one patient was admitted additional to their standard number of people with SCI) in Norway. Fourteen were classified as having motor complete paraplegia (ASIA Impairment Scale (AIS) A and B), 16 motor incomplete paraplegia (AIS C and D), 21 motor complete tetraplegia (AIS A and B) and 22 motor incomplete tetraplegia (AIS C and D). Compared to the other two countries, Australia had a higher number of people with complete tetraplegia, and fewer with incomplete tetraplegia. (Table 1) The time from onset of SCI to the start of the study differed significantly between the countries ($p=0.01$).

Therapists

The study included all staff, assistants, and trainees of the physical therapists, occupational therapists, and sports therapy (n=73) departments of the participating SCI centers. (Table 1) In Australia, one professional who provided sports therapy could not be included, due to holiday leave. Staff physical therapists and occupational therapists were licensed. The Dutch physical therapy assistants were trained on the job and had no specific license. The Australian physical therapy assistant had a Bachelor's degree in Exercise Science. Three trainees were training to become licensed physical therapists, and one to become a licensed sports therapist.

Table 1. Patient and therapist characteristics.

Patient characteristics	**NL[1] (N[2]=48)**	**AU[3] (N=20)**	**NO[4] (N=11)**
Age (years; mean (SD))	53.2(16.2)	37.2(18.8)	43.7(20.1)
Sex (% men)	57.4	90.0	72.7
Cause of SCI (% traumatic)	46.8	90.0	63.6
Type of SCI:			
motor complete paraplegia	11(22.9%)	7(35%)	3(27.3)
motor incomplete paraplegia	15 (31.3%)	1(5%)	2(18.2)
motor complete tetraplegia	8(16.7%)	12(60%)	2(18.2)
motor incomplete tetraplegia	14(29.2%)	0(0%)	4(36.3)
Time between onset of SCI and admission (days; median (IQR[5] range))	47.0(20.0-119.0)	32.0(20.0-41.5)	16.0(13.0-77.0)
Time between onset of SCI and start of the study (days; median (IQR range))	163.0(94.0-258.0)	68.0(42.0-164.8)	67.0(21.0-158.0)
Therapist characteristics	**(N=53)**	**(N=13)**	**(N=7)**
Discipline			
Physical therapist (N)	20	6	4
Physical therapy assistant (N)	9	1	0
Physical therapy trainee (N)	3	0[6]	0
Occupational therapist (N)	16	4	3
Occupational therapy assistant (N)	0	2	0
Sports therapist (N)	4	0[7]	0
Sports therapy assistant (N)	1	0	0
Experience in SCI rehabilitation (years; mean (SD))	7.3(6.0)	4.7(3.6)	9.4(6.8)

[1] NL = Netherlands; represented by 3 rehabilitation centers combined.
[2] N = Number of patients included.
[3] AU = Austalia; represented by 1 center in Melbourne.
[4] NO = Norway; represented by 1 center in Trondheim.
[5] IQR = 25th, 75th percentile (interquartile range).
[6] In Australia, 2 physical therapy trainees were included at the start of the study, but since they did not record treatment sessions on their own, they were excluded from the analysis.
[7] The professional from the Community integration and Leisure Department who provided sports therapy was not available for the whole period of the study, and was therefore excluded from the analysis.

Procedure

The same procedure was used in each country. Therapists received the SCI-ICS manual[16] and were asked to study it thoroughly. The first author (SvL) then discussed the instrument with all therapists, and trained them to classify their therapy according to the SCI-ICS instructions. Next, all therapists were asked to practice recording their treatments with the SCI-ICS for 2 days, during which they could discuss difficulties of recording with SvL. After this, therapists were asked to record all treatment sessions provided to the included people with recent SCI for the 4-week recording period.

The SCI-ICS manual was translated into English[16] by SvL, and checked for identical content by a bilingual (Dutch-English) independent researcher from Australia, and an Australian researcher specializing in SCI rehabilitation. As part of the instruction, and to evaluate the reliability of recording with the English-language version of the SCI-ICS, the reliability study among Dutch therapists[9] was repeated by staff therapists in Melbourne and Trondheim. Fifteen of the 17 therapists observed a DVD with videotaped interventions and classified these using the English-language version of the SCI-ICS on two occasions. The first measurement round took place in the first week of recording, after which the participants were given general feedback on incorrectly assigned codes. The second measurement round took place after the recording period.

Six occupational therapists observed and scored 20 videoclips showing occupational therapy interventions (6x20x2=240 observations), and 9 physical therapists observed and scored 16 videoclips of physical therapy interventions (9x16x2=288 observations). Additionally, since the Melbourne and Trondheim centers did not have separate sports departments, and sports interventions were expected to be mainly provided by physical therapists, 7 out of 9 physical therapists (Melbourne: 3, Trondheim: 4) observed and scored the 12 sports videoclips (7x12x2=168 observations). Two staff therapists did not participate in the reliability procedure due to planned holiday leave. Recordings by assistants and trainees, and recordings by therapists who did not participate in the reliability procedure, were checked by the other therapists.

Instrumentation

The structure and guidelines of the SCI-ICS[16], enables therapists to classify therapy according to the aim of the treatment into three levels, 25 categories and a total of 139 interventions. The levels used in the SCI-ICS are defined as: (1) body functions, i.e. interventions aimed at influencing body functions and structures, (2) basic activities, i.e. interventions aimed at practising skills for positions and

movements, and (3) complex activities, i.e. interventions aimed at practising skills for positions and movements in task-oriented and context-specific activities (defined as activities at a specific location outside the exercise room, inside or outside the rehabilitation center). Each category describes the aim of the intervention and includes several types of intervention: exercises, assessment, education, equipment, and unspecified. Exercise interventions are further subdivided into 1-6 groups of methods and modalities. Modalities include electrotherapeutic applications (e.g., electrical stimulation) and physical agents (e.g., cryotherapy). Assessment includes examination and evaluation. Education includes all types of patient-related instructions. Equipment, only assigned to the categories at basic activity level, includes the prescription, application, and production of devices and other equipment. Unspecified was added to each category to allow therapeutic activities not listed in the SCI-ICS to be recorded. All instructions to classify therapy, as well as definitions, inclusion and exclusion criteria, and examples from clinical practice, are included in a 52-page manual,[16] which is available on request.

Therapists were asked to record on a separate recording form each treatment session in which both patient and therapist were physically present. (Appendix 1) Therapists were asked to check a box for individual or group treatment. Individual treatment was defined as a session in which the number of therapists was equal to or larger than the number of patients. If more than one therapist was actively involved in the treatment (individual or group), only one therapist completed a recording form for each patient. The number of other actively involved therapists could be indicated by checking a box. For therapy intended to improve mobility and self-care, the recording form allowed the therapists to record 1 treatment session with multiple interventions using codes from the SCI-ICS, and to record the time spent on each intervention, in 5-minute increments. (Appendix 1)

We also explored therapy activities directed at other domains than mobility and self-care by asking the therapists to record the therapy time spent on the other domains of the ICF[3] (e.g., communication), that are not included in the SCI-ICS. (Appendix 1) These domains were defined according to the ICF[3] and were not sub-divided any further.

Statistical analysis

Reliability was evaluated by calculating the percentage of codes correctly assigned by the participants (agreement between the first author and the participants) at the 1st and 2nd measurements, and the percentage of agreement between the 1st and 2nd measurements by the same therapist (intrarater

reliability).[9] It was not possible to compute Cohen's Kappa for chance-corrected agreement. In the case of very unevenly distributed data, Kappa becomes highly sensitive to small departures from perfect concordance.[22]
Contents of therapy were expressed in two ways: the distribution of total therapy time (in percentage by country) over different levels, categories and types of interventions, and the mean time in minutes per patient per week. Univariate ANOVA was used to detect significant differences ($p<0.05$) between countries, controlling for different ASIA classification (motor complete paraplegia, motor incomplete paraplegia, motor complete tetraplegia, motor incomplete tetraplegia). Pairwise comparisons between countries were made using post-hoc analysis with Bonferroni. Data were analyzed using SPSS version 15.0.[23]

Results

Reliability

The reliability of classifying with the English-language version of the SCI-ICS proved to be good: the percentage of codes correctly assigned by the participating therapists (agreement between researcher and participants) was high (Melbourne: 95.4% 1st measurement and 96.9% 2nd measurement; Trondheim: 90.8% 1st measurement and 96.7% 2nd measurement). The intrarater agreement was 92.3% for Melbourne and 88.8% for Trondheim.

Recorded treatment sessions

During a total of 2526 treatments, the therapists reported 5144 interventions listed in the SCI-ICS. Sixty-five percent (1653) of all treatments were provided by the physical therapy departments, 29 percent by the occupational therapy departments and 6 percent by the Dutch sports therapists. In all 3 countries, almost all therapy time (95%) was spent on mobility and self-care interventions. (Table 2)
The mean number of treatments (overall 8.9, SD 3.8) per patient per week did not differ significantly ($p=0.40$) between the countries. The duration of a treatment session differed significantly ($p=0.01$) between the countries: 28.1 mins. (SD 7.7) in the Netherlands, 43.3 mins. (SD 6.3) in Australia, and 38.9 mins. (8.0) in Norway. The number of interventions per treatment varied: the Dutch therapists used 1 to 5, the Australian therapists 1 to 10, and the Norwegian therapists 1 to 6 interventions. Only the Dutch therapists provided a substantial percentage of group treatments.

Table 2. General characteristics of the interventions by country.

Total number of recorded treatments	NL[1] (N[2]=1640)	AU[3] (N=628)	NO[4] (N=258)
Total number of recorded interventions:	2712	1752	680
For mobility and self-care (%)	95.7	95.4	95.3
For other domains of the ICF(%)	4.3	4.6	4.7
Number of interventions per treatment:			
1 intervention (%)	56.6	30.9	25.6
2 interventions (%)	28.5	16.7	23.3
3 interventions (%)	11.7	21.2	28.3
4 interventions (%)	2.4	15.8	14.1
> 4 interventions (%)	0.8	15.4	8.7
Total therapy time in minutes:	48970	29705	11830
For mobility and self-care (%[5])	93.8	89.1	90.3
For other domains of the ICF (%)	6.2	10.9	9.7
Proportion of therapy time for mobility and self-care by discipline (%[6])			
Physical therapy	67.8	71.9	67.6
Occupational therapy	22.7	28.1	32.3
Sports therapy	9.5	0	0
Proportion of therapy time given as individual therapy (%)	61.0	93.7	84.5
Physical therapy (%)	61.9	91.2	77.8
Occupational therapy (%)	65.9.	100	98.8
Sports therapy (%)	42.9	0	0

[1] NL = Netherlands; represented by 3 rehabilitation centers combined.
[2] N = Total number of recorded interventions in individual and group treatment sessions.
[3] AU = Austalia; represented by 1 center in Melbourne.
[4] NO = Norway; represented by 1 center in Trondheim.
[5] The percentage of time spent on mobility and self-care and on other domains of the ICF (not included in the SCI-ICS) was calculated for each country.
[6] The percentage of time was calculated for each discipline.

Therapy time by type of intervention, level, and category

With respect to type of intervention, the greatest amount of time was spent on exercise interventions in all 3 countries (overall mean 84%). Therapists in Australia and Norway did not record any interventions as unspecified. (Table 3) Significant differences (p=0.04) were found in total therapy time per patient per week: patients in Norway and Australia received more therapy than patients in the Netherlands. (Table 3)

In all countries, the largest proportion of therapy time was spent at the level of body functions and basic activities. Overall, the centers spent the greatest amount of therapy time on 'Muscle power' (all countries), 'Walking' and 'Manual wheelchair propulsion' (Netherlands), 'Transfers' and 'Body positions and movements' (Australia), and 'Muscle length' and 'Hand and arm use' (Norway). In all countries, the least amount of time (if any) was spent on 'Neuropathic pain', 'Respiratory system', 'Caring for body parts', 'Washing oneself', and 'Toileting'. Significant differences between the countries in mean therapy time per category (in minutes per patient per week) were found for 13 out of 25 categories. (Table 3)

Twenty-two categories were recorded by physical therapists and occupational therapists in at least 1 of the 3 countries, and 12 by physical therapists and occupational therapists in all countries. The Dutch sports therapists assigned therapy time to 9 categories ('Cardiovascular system', 7 basic activity categories, and 'Moving around outdoors'), spending most time on the categories of 'Swimming', 'Manual wheelchair propulsion', and 'Cardiovascular system'. Table 4, 5 and 6 show the percentages belonging to each category at the 3 levels.

Table 3. Distribution of therapy time over the levels, categories and types of interventions of the SCI-ICS, by country.

Therapy time spent		%[1]	
Countries	**NL**	**AU**	**NO**
Type of interventions			
Exercises	84.2	81.8	84.8
Assessment	4.2	5.4	4.2
Education	5.1	3.5	3.5
Equipment	6.1	9.4	7.5
Unspecified	0.4	0.0	0.0
Levels			
Body functions	45.4	46.7	56.4
Basic activities	48.6	48.9	29.4
Complex activities	6.0	4.4	14.2
Categories			
Muscle power	19.5	31.2	21.9
Muscle length	4.1	6.5	20.8
Muscle tone	4.2	2.4	3.2
Joint mobility	7.5	1.8	4.8
Sensory functions	0.8	0.8	1.1
Neuropathic pain	0.0	0.1	0.0
Musculoskeletal pain	3.1	1.7	3.6
Skin and related structures	0.3	1.3	0.0
Cardiovascular system	5.5	0.9	1.1
Respiratory system	0.5	0.0	0.0
Hand and arm use	6.8	8.7	9.6
Body positions and movements	4.3	9.5	4.4
Transfers	4.4	11.8	2.6
Standing	2.9	5.1	2.5
Walking	13.7	1.9	2.8
Manual wheelchair propulsion[4]	10.6	6.3	3.3
Transportation	2.1	4.4	3.7
Swimming	3.7	1.2	0.5
Moving around indoors	2.7	2.3	2.9
Moving around outdoors	1.3	0.5	5.4
Washing oneself	0.3	0.1	0.0
Caring for body parts	0.3	0.0	0.0
Toileting	0.2	0.2	0.1
Dressing	1.1	0.9	0.8
Eating and drinking	0.1	0.4	5.1
Total	100	100	100

[1] Percentage of time spent, by type of intervention, by level, and by category. [2] Mean therapy time in minutes per week per patient. [3] Significant difference ($p<0.05$) in mean number of minutes per week was calculated with univariate analysis for country and for ASIA classification (tetraplegia motor complete (AIS A and B) and incomplete (AIS C and D), paraplegia motor complete (AIS A and B) and incomplete (AIS C and D). [4] Manual wheelchair propulsion: the SCI-ICS calls this category 'Use and driving of manual wheelchair and/ or (hand)cycle and or bicycle'.

	Mean[2], SD			Sign[3].
NL	AU	NO	country	SCI
215.7(137.1)	282.1(121.4)	298.4(131.8)	0.12	0.20
11.9(14.8)	19.6(13.7)	35.3(34.8)	0.01	0.78
14.2(15.2)	12.1(7.4)	22.3(17.1)	0.24	0.41
17.6(17.5)	32.7(23.4)	34.3(29.3)	0.09	0.28
0.9(2.3)	0.0	0.0	NA[5]	0.81
113.7 (92.0)	159.3(96.1)	206.6(74.7)	0.01	0.01
127.4(74.0)	171.1(74.5)	115.1(62.5)	0.08	0.72
19.1.(49.9)	20.0(18.2)	68.3(38.3)	0.02	0.54
49.9(48.1)	106.6(72.6)	92.4(58.4)	0.00	0.00
10.1(16.1)	23.1(19.9)	67.5(56.4)	0.00	0.09
11.9(28.1)	13.4(14.5)	18.8(19.6)	0.75	0.39
18.1(27.0)	6.9(7.4)	26.1(23.1)	0.03	0.09
1.9(8.5)	6.3(5.2)	12.1(8.8)	0.02	0.40
2.5(0.25)	1.6(0.63)	0	0.00	0.86
7.5(24.4)	9.6(7.1)	15.3(18.5)	0.55	0.12
0.7(2.1)	20.9(33.3)	0	0.00	0.92
13.7(22.7)	11.2(8.6)	20.2(16.8)	0.46	0.25
1.1(5.16)	0	1.3(-)	0.84	0.60
17.5(24.4)	31.3(26.0)	49.4(51.1)	0.03	0.00
11.4(13.4)	37.2(29.8)	24.9(24.5)	0.01	0.09
12.8(22.3)	45.1(35.8)	20.8(14.9)	0.00	0.03
7.0(11.8)	30.5(32.6)	22.5(15.0)	0.00	0.12
34.5(51.6)	17.4(18.7)	23.8(16.0)	0.66	0.01
29.1(32.4)	30.3(23.4)	20.5(9.5)	0.58	0.03
5.4(10.9)	30.1(30.1)	32.0(14.8)	0.00	0.27
9.4(13.4)	17.3(8.4)	18.8(8.8)	0.33	0.97
9.6(39.1)	13.5(13.0)	22.4(28.3)	0.68	0.51
3.8(9.2)	4.4(3.1)	32.8(16.1)	0.00	0.42
0.6(2.2)	2.3(1.1)	0	0.29	0.76
0.7(2.5)	0	0	NA	0.11
0.9(2.9)	5.0(3.5)	5.0(-)	0.14	0.34
3.0(7.8)	16.4(7.0)	14.2(11.2)	0.14	0.34
0.4(1.6)	5.1(3.1)	27.3(12.4)	0.00	0.23
260.2(144.8)	347.3 (120.8)	371.3(108.6)	0.04	0.12

[5] NA=not applicable. Post-hoc tests were not applied because there were fewer than 3 groups.

Table 4. Exercise interventions by category at body function level during 4 weeks.

Exercise interventions at body function level[1]	N[2]/ %[3]NL	N/ % AU	N/ % NO
Muscle power	(N=452)	(N=401)	(N=136)
active assisted exercises	17.0	42.6	26.5
active exercises	23.9	31.7	21.3
resisted active exercises	59.1	23.9	52.2
modalities	0	1.7	0
Muscle length	(N=157)	(N=145)	(N=124)
passive or active-assisted range of motion exercises or stretches administered by the therapist	59.2	79.3	87.9
stretching performed by the patient himself/herself	40.8	11.0	12.1
modalities	0	9.7	0
Muscle tone	(N=86)	(N=60)	(N=26)
passive or active-assisted range of motiorn exercises or stretches administered by the therapist	53.5	85.0	80.8
stretching performed by the patient himself/herself	36.0	15.0	19.2
relaxation therapy	9.3	0	0
modalities	1.2	0	0
Joint mobility	(N=189)	(N=36)	(N=35)
manual mobilization techniques	94.7	100.0	97.1
modalities	5.3	0	2.9
Sensory functions	(N=15)	(N=0)	(N=4)
practising of sensory functions	86.7	0	0
modalities	13.3	0	0
Neuropathic pain	(N=0)	(N=0)	(N=0)
neuropathic pain treatment	0	0	0
modalities	0	0	0
Musculoskeletal pain	(N=49)	(N=22)	(N=22)
manual techniques	18.4	81.8	63.6
modalities	81.6	18.2	36.4
Skin and related structures	(N=1)	(N=21)	(N=0
manual techniques	0	85.7	0
modalities	100.0	14.3	0
Cardiovascular system	(N=90)	(N=5)	(N=2)
cardiovascular fitness training without equipment	18.9	20	0
cardiovascular fitness training with equipment	81.1	80	100
Respiratory system	(N=20)	(N=0)	(N=0)
exercises for breathing strategies without devices	35.0	0	0
exercises for breathing strategies with devices	60.0	0	0
modalities	5.0	0	0

[1] Not reported in table 4, table 5 and 6 are the other recorded types of interventions (assessment, education, equipment, unspecified) in each category. All definitions of the categories and interventions are described in the manual. [2] N=total number of recorded exercise interventions during 4 weeks. [3] Percentage of number of recorded exercise interventions, by category, calculated for each country during 4 weeks.

Table 5. Exercise interventions by category at basic activity level during 4 weeks*.

Exercise interventions at basic activity level	N/ % NL	N/ % AU	N/ % NO
Hand and arm use	(N=132)	(N=96)	(N=43)
picking up, grasping, manipulating, releasing, and reaching	69.7	65.6	69.8
lifting, carrying, putting down, pulling, and pushing	9.8	14.6	2.3
practising arm and hand skills in self-care in an exercise room	10.6	13.5	18.6
practising arm and hand skills in sports activities	9.8	6.3	9.3
Body positions and movements	(N=105)	(N=127)	(N=26)
in/ to prone, supine, and side lying position	34.3	31.5	11.5
with the use of arms and legs (e.g., kneeling)	12.4	0.8	3.8
sitting and moving in a sitting position, mainly with the use of the arms	51.4	64.6	84.6
in sports activities while sitting	1.9	3.1	0.0
Transfers	(N=111)	(N=201)	(N=17)
wheelchair to/from treatment table (equal height)	55.0	36.8	76.5
wheelchair to/from objects with different heights and forms	21.6	12.4	0.0
wheelchair to/from toilet, shower/commode chair, tub seat	0.0	7.0	0.0
wheelchair to/from bed	7.2	11.4	17.6
wheelchair to/from car	6.3	11.9	5.9
lifting by persons and/ or lifts/hoists	9.9	20.4	0.0
Standing	(N=97)	(N=75)	(N=19)
standing and standing balance	69.1	50.7	36.8
getting up and sitting down	24.7	46.7	57.9
sports activities, while standing	6.2	2.7	5.3
Walking	(N=261)	(N=21)	(N=19)
on a treadmill with or without suspension equipment	7.7	19.0	0.0
in water (hydrotherapy)	9.6	28.6	5.3
indoors	69.7	52.4	94.7
outdoors	10.7	0.0	0.0
sports activities, while walking	2.3	0.0	0.0
Manual wheelchair propulsion	(N=119)	(N=32)	(N=4)
hand rim wheelchair propulsion indoors	40.3	65.6	100.0
hand rim wheelchair propulsion outdoors	10.1	0.0	0
hand rim wheelchair propulsion in sports activities	7.6	18.8	0
hand cycling or bicycling indoors	16.8	6.3	0
hand cycling or bicycling outdoors	25.2	9.4	0
Transportation	(N=14)	(N=16)	(N=1)
powered wheelchair propulsion indoors	35.7	43.8	100.0
powered wheelchair propulsion outdoors	28.6	56.3	0
other transportation propulsion indoors	7.1	0.0	0
other transportation propulsion outdoors	28.6	0.0	0
Swimming	(N=67)	(N=10)	(N=3)
swimming	100.0	100.0	100.0

* See footnotes table 4.

Table 6. Exercise interventions by category at complex activity level during 4 weeks*.

Exercise interventions at basic activity level	N/ % NL	N/ % AU	N/ % NO
Moving around indoors	(N=37)	(N=17)	(N=10)
to and from the ward to other rooms in the rehabilitation center	64.9	23.5	30.0
on the ward in the rehabilitation center	16.2	0.0	10.0
in one's home	5.4	17.6	20.0
In buildings	13.5	58.8	40.0
Moving around outdoors	(N=7)	(N=12)	(N=10)
in the neighbourhood of the rehabilitation center	0.0	8.3	30.0
in the neighbourhood of one's home	42.9	16.7	0.0
to and from buildings	42.9	75.0	70.0
In recreational areas	14.3	0.0	0.0
Washing oneself	(N=1)	(N=0)	(N=0)
while being in one's bed in the rehabilitation center	100.0	0	0
while sitting on the ward in the rehabilitation center	0	0	0
in different locations other than the rehabilitation center	0	0	0
Caring for body parts	(N=2)	(N=0)	(N=0)
while being in one's bed in the rehabilitation center	50.0	0	0
while sitting on the ward in the rehabilitation center	50.0	0	0
in different locations other than the rehabilitation center	0	0	0
Toileting	(N=5)	(N=1)	(N=1)
while being in one's bed in the rehabilitation center	40.0	100.0	0
while sitting on the ward in the rehabilitation center	60.0	0	100.0
in different locations other than the rehabilitation center	0	0	0
Dressing	(N=16)	(N=4)	(N=3)
while being in one's bed in the rehabilitation center	62.5	50.0	66.7
while sitting on the ward in the rehabilitation center	37.5	50.0	33.3
in different locations other than the rehabilitation center	0	0	0
Eating and drinking	(N=2)	(N=6)	(N=13)
while being in one's bed in the rehabilitation center	50.0	16.7	0
while sitting on the ward in the rehabilitation center	50.0	0.0	30.8
in different locations other than the rehabilitation center	0	83.3	69.2

* See footnotes table 4.

Discussion

The primary aim of this study was to compare the contents of therapy time provided by physical theray, occupational therapy, and sports therapy with the aim to improve mobility and self-care for people with a recent SCI in rehabilitation centers in Australia, Norway and the Netherlands. We found several striking similarities: in all countries, most time was spent on exercise interventions at the levels of body functions and basic activities, while little time was spent on practising skills in task-oriented and context-specific activities, or on other types of interventions (e.g., education, equipment). We however also found differences between countries in the focus on various categories. Other key differences between countries were the way sports therapy was provided, that only in the Netherlands many treatments were provided as 'group treatments', and that people with recent SCI in Norway and Australia received more therapy time per week, and in longer therapy sessions, than those in the Netherlands.
The second aim was to evaluate the use of the SCI-ICS by therapists outside the Netherlands. We found good reliability and feasibility of the English-language version of the SCI-ICS. These results expand on the findings of our earlier studies on the Dutch SCI-ICS[7-9] that the SCI-ICS is a valid, reliable and feasible instrument to record interventions for people with SCI across countries.
The 3 countries provided therapy mainly in exercise rooms (interventions aimed at practising skills for positions and movements), rather than task-oriented therapy (interventions aimed at practising skills for positions and movements in task-oriented and context-specifc activities) in the patient's bedroom or bathroom at the rehabilitation center (self-care), or outside the rehabilitation center (outdoor mobility). Only in Norway did the therapists go outdoors with patients each week to do shopping or to practice other activities in 'real life situations'. Such activities also took place in the other centers, but not on a weekly basis.
The most likely explanation for the low number of self-care training interventions recorded (in the category of 'Hand and arm use' at basic activity level and in the self-care categories at the complex activity level), could be that occupational therapists are mainly responsible for creating the conditions (e.g., improving hand function, providing appropriate equipment) that allow people to perform self-care activities by themselves, and that the actual training of self-care interventions primarily takes place outside planned therapy hours, guided by the nursing staff.[24] Given some evidence supporting the influence of the environment on task difficulty, advanced activities, such as walking in the community or getting in and out of a car, should be practised to facilitate participation.[1,25-29] Although all therapists agreed about the importance of task-oriented and context-specific activities (complex activity level; practising in 'real life situations'), these require extra effort and time to practice at other locations than the exercise room.

The differences between the countries in the mean therapy time spent per patient per week on the various categories raises questions that need to be looked at in more detail. For example, one explanation for the differences we found in the categories of 'Muscle power', 'Muscle length', and 'Manual wheelchair propulsion' might be that the time that had elapsed between the onset of SCI and the moment the recordings were made was shorter for the patients included in Australia and Norway than for the Dutch patients. In the first phase after the onset of an SCI, key impairments to be treated or prevented by physical therapists include muscle weakness and muscle contractures.[1] By contrast, 'advanced' skills, such as wheelchair propulsion and hand cycling indoors and outdoors, are likely to be trained once patients are past their 'early' postacute phase. To date, however, there is no evidence to confirm or reject this hypothesized shift of focus of therapy over time, indicating a need for further investigation.

The importance of participating in sports activities after an SCI to promote physical activity and improve quality of life has been emphasized in other studies.[1, 12, 30-33] Only in the Netherlands was sports therapy provided by licensed sports therapists, who had been trained at Dutch Sports Academies. In the Netherlands, the specific contribution of sports therapy is regarded as essential for the improvement of people's physical capacity, to enable them to perform activities requiring much energy, such as transfers and self-care.

At the Trondheim center, it is only after primary inpatient rehabilitation that disabled persons (e.g., persons with SCI) have access to the 4 sports facilities for the disabled in the country.

At the Melbourne center, sports therapy is provided by the physical therapists and the Community integration and Leisure Department (CLD), in conjunction with specialist wheelchair sports coaches. The CLD has a sociological orientation, and the professional responsible for the sports therapy has a background in 'general recreational studies'. Further research into the role of sports in rehabilitation is needed.

The finding that people with SCI in inpatient rehabilitation in Norway and Australia received more therapy time per week than those in the Netherlands calls for further study into factors that might influence the amount and intensity of therapy provided but that were outside the scope of our study, like, for example, differences between countries in reimbursement systems, staff-bed ratio's and mean length of stay. No research evidence is available on optimal therapy intensity and the consequences for achieving optimal outcomes.[34-36] Further research linking duration and intensity of treatment sessions with functional outcomes of rehabilitation is needed to examine the efficiency and effectiveness of SCI rehabilitation.

The only classification systems comparable to the SCI-ICS are the recently introduced discipline-specific physical therapy[37], occupational therapy,[38] and

therapeutic recreation[33] taxonomies of the SCIRehab project, including a total of seven discipline-specific SCI treatment taxonomies.[39,40] Whereas the physical therapy[37], and occupational therapy[38], taxonomies and our system focus on similar activities, the therapeutic recreation taxonomy[33] was developed for certified therapeutic recreation therapists and focuses on 6 activities, 3 of which, 'Sports' and 'Aquatics' and 'Outdoor', are comparable to activities incorporated in our system. However, the therapeutic recreation activities seem to be mainly 'leisure' focused, whereas our sports activities focus on improving physical performance and capacity.

The overall difference between the SCI-ICS and SCIRehab systems is that our system is based on the ICF[3] and on international SCI literature[7], enabling international cross-cultural use, while the SCIRehab taxonomies were developed by leading clinicians from a select group of SCI units in the United States only.[39,40] The fact that we used an ICF[3] based classification allowed us to develop 1 system for 3 disciplines. The conclusion of the developers of the SCIRehab taxonomies,[40] that many types of treatment are unique to 1 discipline, and few are used across disciplines, is not supported by our finding that many interventions were provided by all 3 disciplines (e.g., interventions for 'Manual wheelchair propulsion'), and that the interventions provided by 1 discipline varied between countries. Another difference between the SCI-ICS and the SCIRehab systems[33, 37-40] is the level of detail regarding additional descriptors in the SCIRehab (e.g., whether a walking device is used, the amount of assistance needed, and factors impacting on sessions).[37,40] We restricted our system to the scoring of the actual contents of therapy with a limited number of categories. Future research to compare these two classification systems might reveal relative merits and limitations. The results of a feasibility study[8] of our system, and the good results obtained in studies on the reliability of the Dutch[9] and English versions of SCI-ICS appear to support our approach.

Study limitations

Our study had some limitations. First, the fairly short period of 4 weeks of recording resulted in low statistical power, while the large differences in patient characteristics also limited us in detecting statistically significant differences. Therefore, the differences in mean therapy time per patient per week we found should be interpreted with caution.

Second, only 3 Dutch, 1 Australian, and 1 Norwegian center participated, and their patient populations might not be representative of the whole SCI population in these countries. However, our Dutch sample was comparable (in terms of, e.g., the ratio of traumatic SCI (TSCI) to non-traumatic SCI (NTSCI), age, sex, and the distribution of SCI subgroups) to the population described in the study by Osterthun et al.[19] A study by New et al.[41] and the 2006-2007

report based on statistics of the Australian Spinal Cord Register (ASCIR)[42] indicate that the Australian patient sample in our study was comparable with the ASCIR population in terms of TSCI-NTSCI ratio, age, and sex. As regards subgroup distribution, half of the cases reported in the ASCIR involved the cervical segments, making the ASCIR population comparable to our population, but the report also mentioned incomplete tetraplegia as the most common category, whereas this category was lacking from our Australian sample. On the other hand, all patients admitted to the centers in Australia and Norway were included, so our sample is representative of these centers.

A third limitation was that we only corrected for ASIA classification and not for other patient characteristics (e.g., age, cause of SCI). Future studies with more homogeneous patient groups or with larger patient groups, allowing correction for multiple patient characteristics, are needed to compare therapy programmes between countries.

The final limitation of our study is that we could not include the professional of the Australian CLD department who provided sports therapy additional to the physical therapy staff. Thus, we cannot draw conclusions on the total package of sports therapy provided at the Melbourne site.

Conclusions

This study showed that SCI-ICS can be used reliably to compare therapy in postacute inpatient SCI rehabilitation between different countries. Key similarities were that all 3 countries focused on exercises at the levels of body function and basic activities, and that little time was spent on task- and context-specific activities. Key differences were found in the amount of therapy time and in the focus on different categories. The results warrant more research into the contents of SCI therapy with larger numbers of patients over longer periods of time.

References

1. Harvey L. Management of spinal cord injuries. Sydney: Butterworth Heinemann Elsevier, 2008.
2. Harvey L. The effectiveness of physical interventions for people with spinal cord injuries: a systematic review. Spinal Cord. 2008;1-12.
3. World Health Organization. International Classification of functioning, disability and health: ICF. Geneva: WHO; 2001.
4. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "Black Box"of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-686.
5. White J, Hart T. It's more than a black box; It's a Russian Doll. Defining rehabilitation treatments. Am J Phys Med Rehabil. 2003;82:639-652.
6. Chen CC, Heinemann AW, Granger CV, Linn RT. Functional gains and therapy intensity during subacute rehabilitation: A study of 20 facilities. Arch Phys Med Rehabil. 2002;83:1514-1523.
7. van Langeveld SA, Post MW, Asbeck FW van, Postma K, Dam D ten, C.Pons. Development of a classification of physical, occupational, and sports therapy interventions to document mobility and self-care in spinal cord injury rehabilitation. J Neurol Phys Ther. 2008;32:2-7.
8. van Langeveld SA, Post MW, Asbeck FW van, Postma K, Leenders J, C. Pons. Feasibility of a Classification System for Physical Therapy, Occupational Therapy, and Sports Therapy Interventions for Mobility and Self-Care in Spinal Cord Injury Rehabilitation. Arch Phys Med Rehabil. 2008;89:1454-1459.
9. van Langeveld Sacha A van, Post MW, Asbeck FW van, Horst ter P, Leenders J, Postma K, Lindeman E. Reliability of a new classification system for mobility and self-care in spinal cord injury rehabilitation: the Spinal Cord Injury- Interventions Classification System. Arch Phys Med Rehabil. 2009;90:1229-1236.
10. van Dijk AJ. Quality of life assessment: its integration in rehabilitation care through a model of daily living. Scand J Rehabil Med. 2000;32:104-10.
11. Kirshblum S, Campagnolo DI, DeLisa JA, editors. Spinal cord medicine. Philadelphia: Lippincott Williams & Wilkins; 2002.
12. Jacobs PL, Nash MS. Exercise recommendations for individuals with spinal cord injury. Sports Med. 2004;34:727-51.
13. American Physical Therapy Association. Guide to physical therapy practice. 2nd ed. Alexandria: APTA; 2001. p. 105-27, 223-39, 437-53.
14. Occupational Therapy Practice Framework: domain and process 3. Am J Occup Ther. 2002;56: 609-39.
15. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the "black box" of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-8.
16. van Langeveld S. The Spinal Cord Injury-Interventions Classification System manual. 2009.

17. van Langeveld S, M Post, F v Asbeck, P ter Horst, J Leenders, K Postma, H Rijken, E Lindeman. Contents of physical therapy, occupational therapy, and sports therapy sessions for patients with spinal cord injury in 3 Dutch rehabilitation centers. (Submitted July 2009).
18. de Groot S, Dallmeijer AJ, Post MWM, van Asbeck FWA, Nene AV, Angenot ELD. Demographics of the Dutch multicenter prospective cohort study 'Restoration of mobility in spinal cord injury rehabilitation'. Spinal Cord. 2006:44;668-675.
19. Osterthun R, Post M, van Asbeck F, on behalf of the Dutch-Flemish Spinal Cord Society. Characteristics, length of stay and functional outcomes of patients with spinal cord injury in Dutch and Flemish rehabilitation centres. Spinal Cord. 2009;47:339-344.
20. Tooth L, McKenna K, Geraghty T. Rehabilitation outcomes in traumatic spinal cord injury in Australia: functional status, length of stay and discharge setting. Spinal Cord. 2003;41:220-230.
21. Marino RJ, Barros T, Biering-sorensen F, Burns SP, Donovan WH, Graved DE. International standards for neurological classification of spinal cord injury. J spinal Cord Med. 2003;26: 50-56.
22. Feinstein AR, Cicchetti DV. High agreement but low kappa : 1. the problem of two paradoxes. J Clin Epedemiol. 1990;43:543-549.
23. Supplier: Spss Inc 233 S Wacker Dr. 11thFL, Chicago, IL 60606.
24. Heinemann AW, Kirk PK, Hastie BA, Semik P, Hamilton BB, Linacre JM, Wright BD, Granger C. Relationship between disability measures and nursing effort during medical rehabilitation with traumatic brain injury and spinal cord injury. Arch Phys Med Rehabil. 1997:78;143-149.
25. Richards LG, Latham NK, Jette DU, Rosenberg L, Smout RJ, DeJong G. Characterizing occupational therapy practice in stroke rehabilitation. Arch Phys Med Rehabil. 2005;86:51-60.
26. Latham NK, Jette DU, Slavin M, et al. Physical Therapy during stroke rehabilitation for people with different walking abilities. Arch Phys Med Rehabil. 2005;86:41-50.
27. Shumway-Cook A, Patla AE, Stewart AL, Ferrucci L, Ciol MA, Guralnik JM. Environmental demands associated with community mobility in older adults with and without disabilities. Phys Ther. 2002;82:670-81.
28. Spooren AI, Janssen-Potten YJ, Kerckhofs E, Seelen HA. Outcome of motor training programmes on arm and hand functioning in patients with cervical spinal cord injury according to different levels of the ICF: a systematic review. J Rehab Med. 2009;41:497-505.
29. Mastos M, Miller K, Elasson AC, Imms C. Goal-directed training: linking theories of treatment to clinical practice for improved functional activities in daily life. Clin Rehabil. 2007;21:47-55.
30. Devillard X, Rimaud D, Roche F, Calmels P. Effects of training programs for spinal cord injury. Annales de réadaptation et de médecine physique. 2007:50;490-498.
31. Tasiemski T, Kennedy P, Gardner BP, Taylor N. The association of sports and physical recreation with life satisfaction in a community sample of people with spinal cord injury. NeuroRehabil. 2005;20:253-265.
32. Wahman K, Biguet G, Levi R. What promotes physical activity after spinal cord injury? An interview study from a patient perspective. Disabil Rehabil. 2006:28;481-488.
33. Cahow C, Skolnick S, Joyce J, Jug J, Dragon C, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab project series: the therapeutic recreation taxonomy. J Spinal Cord Med. 2009;32:298-306.

34. Jette DU, Warren RL, Wirtalla C. The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. Arch Phys Med Rehabil. 2005;86:373-379.
35. Keith RA. Treatment strength in rehabilitation. Arch Phys Med Rehabil. 1997;78:1298-1304.
36. Jette DU, Warren RL, Wirtalla C. Rehabilitation in skilled nursing facilities. Am J Phys Med Rehabil. 2004;83:704-711.
37. Natale A, Taylor S, LaBarbera J, Bensimon L, McDowell S, Mumma S, Backus D, Zanca J, Gassaway J. Classification of SCI rehabilitation treatments SCIRehab Project Series: the Physical Therapy Taxonomy. J Spinal Cord Med. 2009;32:270-282.
38. Ozelie R, Sipple C, Foy T, Cantoni K, Kellogg K, Lookingbill J, Backus D, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab Project series: the occupational therapy taxonomy. J Spinal Cord Med. 2009;32:283-297.
39. Whiteneck G, Gassaway MS, Dijkers M, Jha A. Classification of SCI rehabilitation treatments. New approach to study the content and outcomes of spinal cord injury rehabilitation: the SCIRehab project. J Spinal Cord Med. 2009;32:251-259.
40. Gasaway J, Whiteneck G, Dijkers D. Classification of SCI rehabilitation treatments. Clinical taxonomy development and application in spinal cord injury research: the SCIRehab project. J Spinal Cord Med. 2009;32:260-269.
41. New PW, Sundararajan V. Incidence of non-traumatic spinal cord injury in Victoria, Australia: a population based study and literature review. Spinal Cord. 2008:46;406-411.
42. Cripps RA. Spinal cord injury, Australia, 2006-2007. AIHW injury research and statistics series No 48. Adelaide: Australian Institute of Health and Welfare. Flinders University 2009.

APPENDIX 1
The recording form

A

RECORDING FORM

Patient code

B

	day	month	year
Date			2008

Center

Name therapist

C

Enter one type of treatment session: individual or group.
If it concerns a group treatment session, write down the name.

☐ Individual treatment

☐ Group treatment Name group

D

If other disciplines are actively involved, mark the number in the boxes or write down the discipline(s).

☐	OT	☐	PT	☐	Sport	Other disciplines, namely:
☐	OT a	☐	PT a	☐	Sport a	☐
☐	OT s	☐	PT s	☐	Sport s	☐

E: table 1

Enter one intervention code per box for the intervention (s) that is/ are directed at 1 or more categories from the classification for Mobility and Self-care. One of the involved therapists records the treatment session.

	Intervention code	Duration of intervention: tick 1 box per intervention						
		5 min	10 mi	15 min	20 min	25 min	30 min	>30 min nl:
1								min
2								min
3								min
4								min
5								min

F: table 2

Mark in number in the time column the time spent on any interventions on other domains of the ICF, tests or unspecified interventions. One of the involved therapists records the treatment session.

Other activities; not included in the SCI-ICS	Time
Communication	min
Domestic life	min
Major life areas: work, education, economic life	min
Community, social and civic life: e.g. recreation and leasure, hobby	min
Tests for > 1 category from the classification or for more domains of the ICF	min
Unspecified	min

Abbreviations: a = assisstant, s = student (trainee).

Chapter 7

General discussion

Summary

Nederlandse samenvatting

General discussion

This chapter discusses the main conclusions of the research reported on in this thesis, and addresses its strengths and methodological considerations. In the light of our results we also present some suggestions for the further development of our newly developed tool to document therapy, as well as its use in research and clinical practice.

Main conclusions

We developed and evaluated the Spinal Cord Injury-Interventions Classification System (SCI-ICS), a tool to document treatment sessions of physical therapists, occupational therapists and sports therapists regarding the main domains of spinal cord injury (SCI) inpatient rehabilitation, namely mobility and self-care. The final version of the SCI-ICS comprises a hierarchical structure with three levels (body functions, basic activities and complex activities), 25 categories and 139 grouped interventions. We showed that the SCI-ICS is a valid, reliable and feasible instrument to record interventions intended to improve the mobility and self-care of patients with SCI by the three disciplines in different settings.

Our combined inductive and deductive approach, which started by deriving a classification from theoretical models and went on to pre-test this classification in a Delphi consensus procedure and a feasibility study, appeared successful. (Chapters 2 and 3) The SCI-ICS proved sufficiently complete, as only 2% of all mobility and self-care interventions were recorded as unspecified. (Chapter 3) The SCI-ICS also proved sufficiently focused, as all three levels, almost all categories and all types of interventions (e.g., exercises, education) were used to record treatments applied in everyday practice. (Chapter 3) The comparative studies described in Chapters 5 and 6 also provided evidence of the completeness of the SCI-ICS, as only 0.4% of all interventions were recorded as unspecified and, again, all three levels, almost all categories and all types of interventions were used. Comparing our classification with the recently published ICF core set for SCI[1] – based on a process in which 33 multidisciplinary SCI experts from 30 countries reached formal consensus on the ICF categories that were most relevant to the early post-acute rehabilitation context – showed that nine out of ten SCI-ICS body function categories and all SCI-ICS basic and complex activities categories were included in the ICF core set.

The SCI-ICS enables users to quickly record treatments in routine practice. Therapists recorded the majority (88%) of treatments, consisting of 1 to 5 interventions, within 3 minutes, and 45% within 1 minute. (Chapter 3) Data on the feasibility of other classification systems are sparse. De Jong et al.[2] only reported the time needed to record treatment sessions lasting between 30 seconds and 3 minutes, and Tyson[3] reported that their system took about 5 minutes to complete and was easy to use. The SCIRehab project[4-8] reported[5] that a session in which only one

therapy activity took place required less than 1 minute (using a hand-held electronic device), but that recording more activities would take more time.
The SCI-ICS is easy to use. Nearly all (93%) of the treatment sessions were recorded without much doubt, and the manual was rated as clear by the therapists. (Chapter 3) By contrast, three publications on the feasibility of classifications of treatments in stroke[3,9,10] reported that their categories elicited doubt, and the activity categories of one other classification[11] were not mutually exclusive. Only two other authors[3,12] developed a manual for their stroke taxonomies, but failed to test its feasibility, and only two[2,3] reported a limited testing procedure of the recording form.
Our research further proved that the SCI-ICS is a reliable tool with which therapists in different settings and countries can record interventions. (Chapters 4 and 6) We examined not only the reliability of the Dutch-language version of the SCI-ICS, but also that of the English-language version as used by native English (Australian) and non-native English (Norwegian) speakers. (Chapter 6) Our study provided a more realistic reliability testing than previous studies[10,12], as these used researchers, instead of therapists, as their subjects.
Using the SCI-ICS enabled us to compare the contents of therapy between specialized SCI centers in different countries and continents. (Chapters 5 and 6) There were few differences in therapy contents between three Dutch centers. (Chapter 5) These findings confirmed our expectation that they would be generally similar, which was based on the fact that therapists from these three centers share theoretical and practical knowledge on the treatment of patients with SCI in meetings and workshops organized by the Dutch-Flemish SCI Association.
Between the centers in the Netherlands, Australia and Norway, however, there were more differences than similarities: the most frequently recorded interventions were found in different categories, 13 out of 25 categories differed between countries in the amount of therapy time, as well as the overall mean therapy time per patient per week differed between countries. (Chapter 6)
In the comparative studies (Chapters 5 and 6) the SCI-ICS was extended with the option to record therapy directed at other domains of the ICF[13] (e.g., communication, domestic life). However, our findings for all centers and countries showed that by far the largest proportion of time (94% overall) was spent on mobility and self-care interventions. (Chapters 5 and 6) Unfortunately, the only other SCI therapy registry, the SCIRehab project[4-8], which also incorporates domains such as communication, has not published data on the contents of therapy to date.
In all centers and countries, most of the time was spent on exercise interventions at the body function and basic activity levels, and the smallest proportion of time on task- or context-specific activities. (Chapters 5 and 6) Given some evidence[15] supporting the influence of the environment on task difficulty, advanced activities, such as walking in the community or getting in and out of a car, should be practised to facilitate participation outside the home.[11,14,15] The lack of task-related

and context-specific activities has also been found in stroke studies[11,14], which concluded that the lack of higher-level activities might be caused by the limited length of stay (LOS) in inpatient rehabilitation (ranging from 11 to 23 days). The argument that LOS influences the focus of therapy is not supported by our findings, as the proportion of time spent on complex activities was also small in the Dutch centers, where patients with a long LOS were recorded. (Chapter 5) Furthermore, the therapists at the Norwegian center, who recorded patients in early post-acute rehabilitation, spent more time on interventions at the complex activity level than the Dutch or Australian therapists. (Chapter 6)
In all centers and all countries, high numbers of interventions were recorded in the categories of 'Muscle power', 'Manual wheelchair propulsion', 'Walking', 'Body positions and movements', 'Transfers', 'Muscle length' and 'Joint mobility'. (Chapters 5 and 6) Small numbers of interventions were recorded for 'Neuropathic pain', 'Respiratory system' and the self-care interventions at complex activity level, with the exception of 'Dressing'. (Chapters 5 and 6) A similar focus has been described in stroke studies[11,14], in which therapists focused especially on gait training, prefunctional activities, upper extremity activities and dressing.
Finally, most categories were used by more than one discipline in at least one of the three countries. Only two categories were used by one discipline only ('Respiratory system' by the physical therapists, and 'Eating and drinking' by the occupational therapists). (Chapter 6) These results highlight SCI rehabilitation as a multidisciplinary effort.

To summarize, what new knowledge was gained by this study?

- We developed a tool to record the contents of SCI therapy at three levels of functioning and 25 categories linked to the ICF.
- We collected clinical SCI treatment data for the first time, and showed that therapists mainly provide therapy at the body function and basic activity levels and focus therapy on a few categories.
- We reported on the distribution of SCI therapy over different domains of functioning, especially mobility and self-care, based on direct collection of clinical treatment data in five rehabilitation centers, and found mostly similarities between treatment programmes within the Netherlands, but differences in treatment between the Netherlands, Australia and Norway.
- We found evidence of overlap of treatments among physical therapy, occupational therapy and sports therapy.

Methodological considerations

Our study aims were twofold; we wanted (1) to develop a feasible, valid and reliable classification system of treatments to improve the mobility and self-care of patients with SCI in inpatient rehabilitation, which could be used by different

disciplines (physical therapy, occupational therapy and sports therapy), in different settings and countries, and (2) we wanted to compare and describe specific contents of therapy between settings and countries, and thus evaluate our newly developed system. In this section, we reflect on the choices we have made.
Our first choice was to use a Delphi consensus procedure to test the first version of our classification. (Chapter 2) We wanted to evaluate whether the interventions in our list reflected the clinical treatments actually provided in SCI rehabilitation. We chose this procedure to minimize group pressure on the opinion of the participants. Since group decision-making is typically dominated by one individual or by coalitions representing vested interests[16], we chose a consensus procedure with one introductory conference, and a two-round postal questionnaire survey. This procedure[16] offered us the opportunity to contact a large group of experts, minimize the amount of time required from them, complete the procedure in a short time, and, as responses were obtained anonymously, avoid the results being influenced by the group view.[16-19] Additional favourable effects of this Delphi procedure[16] were that it familiarized the participating therapists with the terminology of the ICF[13] and our definitions of the categories, and it motivated them to participate in the other studies.[20,21] This enthusiasm was very useful for the subsequent studies, in which we found it easy to recruit all the therapists we needed. Only one other classification[22], in stroke rehabilitation, was developed using a Delphi consensus procedure, but no details of the procedure were reported. Others reported that their systems were developed in procedures featuring close involvement of[9,12], or discussions[3] with, front-line professionials from a restricted number of centers (two to four). De Jong et al.[2] used telephone conference calls over a period of eight months in which subcommittees of multidisciplinary stroke teams at eight centers discussed the topics of their taxonomy. The SCIRehab project[5] used a comparable procedure to develop its taxonomies[6-8]; leading clinical experts from six centers in the USA worked separately and together for several months, using two face-to-face meetings and weekly telephone conferences. We concluded that the modified Delphi consensus procedure applied in our study was appropriate to evaluate the first draft of the SCI-ICS, and it proved useful to involve the professionals in an early phase of the research. (Chapter 2)
Another choice concerned the method we used to test the reliability of our instrument. (Chapter 4) Literature on this was sparse, and the two stroke studies[10,12] that were available taught us that there was no ideal model for testing the reliability of our classification. As observations of 'live' interventions were not feasible[10,12], using videotaped interventions allowed us to standardize the materials so that each observer had the opportunity to classify the same action. At the start of our research, we also considered written case scenarios, but we felt that videos would provide more realistic examples, which would add to the quality of our reliability testing.

The SCI-ICS is not a measure, and has no summary scores, so that reliability had to be tested at item level. Because of time restrictions, we chose not to include all 139 different subcategories of the SCI-ICS in the reliability testing. Instead, we randomly selected interventions using the database from the feasibility study (Chapter 3), ensuring that the most commonly performed interventions had the highest chance of being selected. Moreover, we decided to involve therapists (n=15) from different centers and countries, instead of researchers, as was done in the two stroke studies[10,12], to make the reliability testing as realistic as possible. (Chapter 4) The participating therapists reported that observing the videotaped interventions had really helped them to understand the structure and concept of the classification. Summarizing, the decisions we made appear to have strengthened our reliability study.

The most difficult methodological issue was to choose the right duration of the recording period in the comparative studies (Chapters 5 and 6), to provide us with sufficient data to compare treatments between settings, while minimizing the burden of participation for the therapists. Since no comparable studies in SCI rehabilitation were available and we did not have accurate information on the provision of treatments, we used data from the feasibility study (Chapter 3) to design the comparative studies. (Chapters 5 and 6) We considered a selection of three of the eight Dutch specialized SCI centers to be representative of the Dutch SCI rehabilitation system. The feasibility study (Chapter 3) revealed that a recording period of one month would provide a sufficient number of recorded treatment sessions for comparative analyses between centers. We included (Chapter 5 and 6) only patients with a recent SCI in inpatient rehabilitation, in order to minimize bias due to differences in the proportions of treatments provided to inpatients and outpatients, and in the proportions of treatments provided to patients with a recent SCI and to re-admitted patients. Data collection in the Netherlands (Chapter 5) took place in April, to avoid the holiday seasons. What we were not able to control was the number of available patients. Therapists in Nijmegen and Utrecht reported that far fewer patients with a recently acquired SCI than usual were admitted to their wards during the time of the study. Extending the period of recording would not have solved this problem, as the turnover of patients with a recent SCI is low. Although the Dutch sample was too small to enable us to report on analyses of treatments in subgroups of patients with an SCI (e.g., tetraplegia motor-complete), the number of collected treatment sessions was sufficient for comparative analysis between the Dutch centers, which fitted our aim. (Chapter 5)

A final hurdle we had to take was that of finding SCI-specialized settings abroad which would be interested in participating. Presentations at meetings of the International Spinal Cord Society enabled us to interest colleagues in Melbourne and Trondheim. The Victorian Spinal Cord Service at the Talbot rehabilitation Centre of the Austin Health in Melbourne reported that they had twenty inpatient

beds for patients with a recently acquired SCI, while the spinal unit at St.Olav's hospital in Trondheim had eleven. Although eleven patients was a small number, we estimated that we would be able to capture sufficient numbers of treatment sessions for comparative analyses. Due to lengthy ethical procedures, the timing of the study period was less than ideal. In Australia, the research took place in February, which meant that the only professional at the Community integration and Leisure Department was on summer holiday. The study in Norway took place in June, and some of the staff therapists were not able to complete the whole research period (4 weeks) due to holidays, but their colleagues took over their patients, so this had only a minor impact on the data collection. In conclusion, one month of recordings proved sufficient to compare treatment sessions between centers. We had a high success rate in terms of including therapists, and although small, the number of patients was sufficient to address the aims of this research project.

Suggestions for future development of the SCI-ICS

De Jong et al.[2] proposed eight criteria for a sound intervention classification system: theoretical integrity, domain completeness, multiple dimensions, sufficient level of detail, non-burdensome, clinical and research utility, reliability and future development. The final version of SCI-ICS (version 1.0) meets all these criteria. Moreover, a comparison of our listed interventions with the interventions described in the physical therapy[6] and occupational therapy[7], and to some extent in the therapeutic recreation[8] taxonomy of the SCIRehab project shows a high level of comparability. In the light of this, and of our findings, we conclude that SCI-ICS version 1.0 is suitable for further use in clinical practice and for research purposes. Nevertheless, I would like to make some suggestions for further development of (1) the instrument itself, (2) the training module and (3) the recording form. In addition, the paragraphs below discuss the option of expanding the use of the SCI-ICS to other disciplines involved in SCI rehabilitation and adding domains of functioning from the ICF.[13]

Suggestions for future development of the instrument itself

The definitions of the levels described in the manual are satisfactory. Some case scenarios involving difficult to classify interventions identified in this research should be added to the manual. This includes case scenarios on skin care management, self-care interventions and equipment interventions. The mobility and self-care categories proved complete. Several recently implemented interventions which have become increasingly important in SCI inpatient rehabilitation, such as computer games, the application of functional electrical stimulation to walking or cycling, upper extremity skills assistance and the application of robotics in the training of walking and arm and hand skills, will be added or refined.[6,23]

Suggestions for future development of the training module

Our training module for professionals to use the SCI-ICS proved highly useful, and will be used in further clinical and research projects. The training module involves reading the manual, attending an instructional meeting, two days of practising the recording of treatments, with the opportunity to receive feedback, and scoring the videotaped interventions to evaluate appropriate scoring with the SCI-ICS. The training module has already been applied in a multicenter trial in Australia, the Spinal Cord Injury and Physical Activity study (SCIPA).[24] A 'train the trainer' procedure was used, in which the most senior local physical therapist provided the instructions and feedback, assisted by e-mail consultations with me.

Suggestions for future development of the recording form

The recording form was rated satisfactory. (Chapters 5 and 6) A great improvement would be to capture the data electronically, as was done in the SCIRehab project.[4-8] This would allow the use of drop-down menus and eliminate the need to record codes from the SCI-ICS, thereby not only saving therapists' valuable time, but also eliminating separate data entry costs.[5]

Suggestions for including other disciplines

The therapists in our study recorded few interventions for self-care at the basic and complex activity levels (e.g., toileting). (Chapter 6) Such interventions will most often be provided by the nursing staff. As described in Chapter 1, we considered including therapy activities by nursing staff to improve mobility and self-care, but it appeared too difficult to classify the numerous and unstructured contacts between nurses and patients throughout the day. The SCIRehab project recently introduced a nursing taxonomy[25], which allows ten educational (e.g., bladder management) and three care management (e.g., psychosocial support) interventions to be recorded, provided these are applied in one-on-one sessions and last 10 minutes or more. Since the SCI-ICS focuses on therapy, adding interventions by the nursing staff first requires separating 'care' (e.g., cleaning a patient after incontinence, providing medication) from 'therapy' (e.g., education on skin care, training of transfers) to allow unbiased data collection. If it is possible to resolve this issue, adding the nursing staff would be a valuable next step for further development of the SCI-ICS.

The international study (Chapter 6) taught us that sports therapy can be provided by professionals from different backgrounds and departments. In the Netherlands, sports therapists, (educated at Dutch Sports Academies) were part of the multidisciplinary teams, while in Australia, sports therapy was delivered by a professional from the Community integration and Leisure Department (CLD). This department also focuses on other leisure activities, such as arts and crafts, gardening and community outings. The activities of the CLD in Australia are

comparable to those of recreational therapists in the USA, as described in the therapeutic recreation taxonomy of the SCIRehab project.[8] In implementing the SCI-ICS, it is therefore important to include all therapists providing the interventions classified in this system, and not to focus solely on the name of a discipline or department.

Suggestions for including other domains of functioning from the ICF

Chapters 5 and 6 reported on the addition of other ICF domains to the recording form. Our finding that only a small percentage of time was spent on these additional domains in all centers and countries was on the one hand surprising, but on the other hand provided evidence that mobility and self-care are indeed the key domains of inpatient SCI rehabilitation. However, I think it would be valuable and feasible to add some of these other ICF domains to the SCI-ICS. The occupational therapy taxonomy[7] of the SCIRehab project describes 'communication' and 'home management skills' interventions which might be used as a start to develop these domains and categorize them at the three levels of functioning.
One other therapy area which needs to be considered for expansion of the SCI-ICS is that of cognitive functions. The preliminary version of the SCI-ICS included a 'cognitive functions' category at the body function level. Based on comments by therapists at the invitational conference of the Delphi consensus procedure, we removed this category, as it is not part of the ICF mobility and self-care domains and it is not an SCI-specific function. Throughout the research project, however, therapists stated that they provided 'cognitive therapy', for instance to patients with concomitant traumatic brain injury (TBI). Kirschblum et al.[23] reported that approximately 25% to 64% of people with acute SCI sustain a TBI, but that the impact of associated cognitive and behavioural difficulties is unclear and needs further research. From clinical experience I know that the occurrence of cognitive impairments requires a different therapeutic approach. The SCIRehab project[5-8] solved this issue by creating a list of factors that impact on sessions, but although I see opportunities in this, it would also make the recording more complicated and time-consuming. Moreover, cognitive impairments and limitations can not only be regarded as an 'impacting factor' on therapy but can also be the main target of the intervention. I would therefore consider extending the SCI-ICS with cognitive therapy interventions. Since there are many therapy-impacting factors – the SCIRehab taxonomies[5-8] identify 26 separate factors – these data should be collected separately (e.g., together with other patient characteristics), if required to answer specific questions.

Implications for clinical use and future research with the SCI-ICS

Satisfying the increasing demands for accountability of the therapy provided in post-acute SCI rehabilitation requires that treatment sessions are recorded unambiguously and in a uniform language. Implementing the SCI-ICS allows data

on actually provided therapy to be obtained. These data might enable us to adjust and improve effective and efficient clinical decision making in therapy programmes for patients with an SCI, and might facilitate comparisons of therapy between settings and countries. The final two paragraphs below offer suggestions for the use of the SCI-ICS in future research and clinical practice.

Suggestions for the use of the SCI-ICS in research

At the start of our research, I was involved as a research assistant in a Dutch longitudinal cohort study on the restoration of mobility of persons with SCI.[26] This project inspired me to develop the SCI-ICS. A battery of measures reflecting different aspect of functioning were administered at the start of rehabilitation, three months into active rehabilitation, at discharge and one year after discharge.[26,27] This research yielded valuable information on, for example, the improvement in physical capacity, respiratory functions, arm and hand use, walking and wheelchair propulsion. However, although an attempt was made to link these outcome data to the therapy provided, this attempt failed since no classification system of interventions was available.

Now that the SCI-ICS is available, the therapy provided can be related to outcome measures and patient characteristics (e.g., level of injury), which can be used to study the effectiveness and efficiency of rehabilitation programmes. The authors of a few stroke studies[11,14] have described how therapy during inpatient rehabilitation varied with the functional status at admission, and how time spent in the various categories related to functional status at discharge.

Another application of the SCI-ICS would be to correlate patient characteristics with therapy provided and domain-specific outcomes. For example, time spent on walking exercises could be related to scores on walking tests such as the Walking Index for SCI[28], or time spent on hand rim wheelchair mobility could be related to scores on the Wheelchair Circuit Test.[29] Further, time spent on categories which are considered relevant for the improvement of arm and hand use could be related to results of outcome measures for activities involving arm and hand use, such as the Van Lieshout test[30] or the Grasp Release Test.[31] An example is the SCIPA project called 'Functional electrical stimulation for hand function in quadriplegia'.[24] In this multicenter trial, which tests a new concept in rehabilitation, participants will practise grasp and release movements of the hand using a new workstation that provides functional electrical stimulation. This study will use relevant categories of the SCI-ICS (e.g., 'Muscle power', 'Muscle length', 'Hand and arm use') to describe conventional therapy for arm and hand skills.

Suggestions for the use of the SCI-ICS in clinical practice

The SCI-ICS can be used in various ways in clinical practice. First, if detailed information is desired, recording at the level of the subcategories is recommended.

This will reveal what therapy a patient has actually received, how much time was spent on it and by whom. Presenting an overview of therapy that has been provided in the period prior to a team conference can help give direction to therapy programmes and facilitate interdisciplinary communication and communication with the patient. This is illustrated by the therapy data of one patient, six months post-SCI, for one week during our study. (Table 1) In this week, this patient received 20 treatment sessions to improve mobility and self-care, with a total time of 9.5 hours. Ninety-five percent of this time was spent on exercises. Such an overview might be useful for team discussions. For example, given the time that has elapsed since the onset of SCI, should there not be a shift towards activity-based training instead of the ongoing focus on body functions (e.g., stretching of muscles)? What are the functional goals related to 'hand function', and if there are goals, is one group session per week enough to achieve these goals? Is the distribution of therapy over time optimal? And, is it correct that this patient did not receive any sports therapy? A condensed presentation of these data is shown in Table 2. This information is less detailed, but still provides relevant information on what has been done, and can guide the team and the patient in optimizing the therapy programme to achieve rehabilitation goals. This information might also facilitate teams in critically evaluating the length of stay in inpatient rehabilitation. For example, this patient received 9.5 hours of therapy in one week, which was a long time compared to other patients in the study, who sometimes received only 3 hours in a week. If there is no obvious reason for such a low intensity, such as bed rest due to pressure ulcers, is it still justified to keep the patient in an expensive inpatient setting?

The next step would be to implement the SCI-ICS in regular clinical practice in the Netherlands. Our feasibility study (Chapter 3) showed that the time needed to classify might not be the main barrier to implementing the SCI-ICS in clinical practice. Also, the majority of the 73 therapists participating in this project stated that it was useful to be faced with the question 'what is the goal of the therapy I am providing', and to specify what the therapy time was spent on. However, recording with the SCI-ICS will come on top of other administrative duties and will consequently be burdensome in the near future. If we wish to facilitate implementation of the SCI-ICS, it is thus crucial to integrate it in the regular administrative systems (to minimize burden) and enable data to be presented in a timely and clinically meaningful way (to enhance motivation).

We have recently received a grant from the Netherlands Organisation for Health of Research and Development (ZonMw) for the implementation of the SCI-ICS in four rehabilitation centers in the Netherlands. The main aims of this implementation project will be to investigate the feasibility of recording interventions on a daily basis, to develop clinically meaningful overviews of therapy data and to develop an electronic version of the SCI-ICS.

Table 1. Description of the contents of treatment sessions[1] of a male patient with traumatic moter-incomplete tetraplegia AIS C, six months post trauma. The interventions described correspond to the subcategories in the manual.

	Monday	Tuesday
Physical therapy individual	- Stretching (muscle length) (5[2]) - Manual mobilization techniques (joint mobility) (25) - Manual mobilization techniques (joint mobility) (20) - Breathing strategies without equipment (10)	- Stretching (muscle length) (5) - Manual mobilization techniques (joint mobility) (25) - Active assisted muscle power exercises (20)**
Physical therapy group	Walking group: - Walking indoors (30) Assistant group[3]** - Active muscle power exercises(15)	
Occupational therapy individual	- Moving around outdoors; in recreational areas (30)	- Handrim wheelchair propulsion indoors (25)
Occupational therapy group		
Total therapy time in minutes	135	75

Wednesday	Thursday	Friday
- Manual mobilization techniques (joint mobility) (25) - Stretching (muscle length) (5)	- Passive range of motion exercises (muscle tone) (15) - Manual mobilization techniques (joint mobility) (15) - Active assisted muscle power exercises (25)** - Walking outdoors (30)** - Active assisted muscle power exercises (30)**	- Walking in water (30)
Walking group: - Walking indoors (30)	Therapy group: - Active assisted muscle power exercises (10) - Car transfer (30) - Getting up and sitting down (5)	Therapy group: - Active assisted muscle power exercises (30)
Therapy group: - Active muscle power exercises (20) - Passive range of motion exercises (muscle length) (15)		Assistent group: - Active muscle power exercises (15)**
		Hand group: - picking up, grasping, manipulating, releasing and , reaching (15) - lifting carrying, putting down (15)
95	160	105

[1] The order in which the treatment sessions are listed for each day is not related to the hour of the day.
[2] Number of minutes per intervention shown between brackets.
[3] ** =therapy provided by physical therapy assistant.

Table 2. Distribution of total therapy time in 79 recorded treatment sessions over all 25 categories of one patient over a 4-week period.

	Total time	Percentage
Levels		
Body function level	1360	57
Basic activities level	900	38
Complex activities level	120	5
Categories		
Muscle power	805	34
Muscle length	185	8
Muscle tone	65	3
Joint mobility	295	13
Sensory functions	0	0
Neuropathic pain	0	0
Musculoskeletal pain	0	0
Skin and related structures	0	0
Cardiovascular system	0	0
Respiratory system	10	0
Hand and arm use	250	11
Body positions and movements	0	0
Transfers	40	2
Standing	25	1
Walking	400	17
Manual wheelchair propulsion	75	3
Transportation	0	0
Swimming	110	5
Moving around indoors	30	1
Moving around outdoors	30	1
Washing oneself	30	1
Caring for body parts	0	0
Toileting	0	0
Dressing	0	0
Eating and drinking	0	0

References

1. Kirchberger I, Cieza A, Biering-Sørensen F, Baumberger M, Charlifue S, Post MW, Campbell R, Kovindha A, Ring H, Sinnot A, Kostanjsek N, Stucki G. ICF core set for individuals with spinal cord injury in the early post-acute context. Spinal Cord. 2009:1-8.
2. De Jong G, Horn SD, Gassaway JA, Slavin MD, Dijkers MP. Toward a taxonomy of rehabilitation interventions: using an inductive approach to examine the "Black Box"of rehabilitation. Arch Phys Med Rehabil. 2004;85:678-686.
3. Tyson SF, Selley A. The development of the stroke physiotherapy intervention recording tool (SPIRIT). Disabil Rehabil. 2004;26:1184-1188.
4. Whiteneck G, Gassaway MS, Dijkers M, Jha A. Classification of SCI rehabilitation treatments. New approach to study the content and outcomes of spinal cord injury rehabilitation: the SCIRehab project. J Spinal Cord Med. 2009;32:251-259.
5. Gasaway J, Whiteneck G, Dijkers D. Classification of SCI rehabilitation treatments. Clinical taxonomy development and application in spinal cord injury rehabilitation research: The SCIRehab project. J Spinal Cord Med. 2009;32:260-269.
6. Natale A, Taylor S, LaBarbera J, Bensimon L, McDowell S, Mumma S, Backus D, Zanca J, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab project Series: The physical therapy taxonomy. J Spinal Cord Med. 2009;32:270-282.
7. Ozelie R, Sipple C, Foy T, Cantoni K, Kellogg K, Lookingbill J, Backus D, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab project series: The occupational therapy taxonomy. J Spinal Cord Med. 2009;32:283-297.
8. Cahow C, Skolnick S, Joyce J, Jug J, Dragon C, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab project series: The therapeutic recreation taxonomy. J Spinal Cord Med. 2009;32:298-306.
9. Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box therapy- a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. Clin Rehabil. 1999;13:301-309.
10. van Vliet PM, Lincoln NB, Robinson E. Comparison of the content of two physiotherapy approaches for stroke. Clin Rehabil. 2001;15:398- 414.
11. Richards LG, Latham NK, Jette DU, Rosenberg L, Smout RJ, De Jong G. Characterizing occupational therapy practice in stroke rehabilitation. Arch Phys Med Rehabil. 2005;86:S51-60.
12. De Wit L, Kamsteegt H, Yadav B, Verheyden G, Feys H, De Weerdt W. Defining the content of individual physiotherapy and occupational therapy sessions for stroke patients in an inpatient rehabilitation setting. Development, validation and inter-rater reliability of a scoring list. Clin rehabil. 2007;21:450-459.
13. World Health Organization: International classification of functioning, disability and health: ICF. Geneva: WHO; 2001.

14. Latham NK, Jette DU, Slavin M, et al. Physical Therapy during stroke rehabilitation for people with different walking abilities. Arch Phys Med Rehabil. 2005;86:S41-50.
15. Shumway-Cook A, Patla AE, Stewart AL, Ferrucci L, Ciol MA, Guralnik JM. Environmental demands associated with community mobility in older adults with and without disabilities. Phys Ther. 2002;82:670-81.
16. Jones J, Hunter D. Using the Delphi and nominal group technique in health services research. In: Pope C, Mays N (eds.) Qualitative research in health care.2nd ed. London: BMJ Books; 2000.
17. Weigl M, Cieza A, Andersen C, Kollerits B, Amann E, Stucki G. Identification of relevant ICF categories in patients with chronic health conditions: a Delphi exercise.
J Rehabil Med. 2004;(Suppl)44:12-21.
18. Creswell JW. Research design. Qualitative, quantitative, and mixed methods approaches. 2nd ed. Thousand oaks, California: Sage publications; 2003.
19. Stucky G and Grimby G. ICF core sets for chronic conditions. J Rehabil Med. 2004;(Suppl)44:5-6.
20. Grol R, Baker R, Moss F, eds. Quality improvement research: understanding the science of change in health care. London: BMJ Books; 2003.
21. Grol R. Successes and failures in the implementation of evidence-based guidelines for clinical practice. Medical Care. 2001:39;46-54.
22. Bode RK, Heinemann AW, Semik P, Mallinson T. Patterns of activities across length of stay and impairment levels: peering inside the 'black box' of inpatient stroke rehabilitation. Arch Phys Med Rehabil. 2004;85:1901-1908.
23. Kirschblum SC, Priebe MM, HO CH, Scelza WM, Chiodo AE, Wuermser LA. Spinal cord injury medicine. 3. Rehabilitation phase after acute spinal cord injury. Arch Phys Med Rehabil. 2007;88:62-70.
24. Victorian Neurotrauma Initiative. Spinal Cord Injury and Physical Activity (SCIPA). Functional electrical stimulation for hand function in Quadriplegia. www.vni.com.au.
25. Johnson K, Bailey J, Rundquist J, Dimond P, McDonald CA, Reyes IA, Thomas J, Gassaway J. Classification of SCI rehabilitation treatments. SCIRehab project series: The supplemental nursing taxonomy. J Spinal Cord Med. 2009;32:329-335.
26. The Umbrella project. Physical strain, work capacity and mechanisms of restoration of mobility in the rehabilitation of persons with SCI; granted by the Netherlands Organisation for Health of Research and Development (Zonmw). www.fbw.vu.nl/onderzoek/A4zon/ZONenglish/index.htm
27. Haisma J. Physical Capacity and complications during and after inpatient rehabilitation for spinal cord injury (Thesis). Rotterdam: Erasmus University Rotterdam; 2008.
28. Marino RJ, Scivoletto G, Patrick M, Tamburella F, Read MS, Burns AS, Hauck W, Ditunno J Jr. Walking index for spinal cord injury version-2 (WISCI-II) with repeatability of the 10-m walk time: Inter-intrarater reliability. Am J Phys Med Rehabil. 2010;89:7-15.
29. Kilkens OJ, Dallmeijer AJ, de Witte LP, van der Woude LH, Post MW. The wheelchair circuit test: construct validity and responsiveness of a test to asses manual wheelchair mobility in persons with a spinal cord injury. Arch Phys Med Rehabil. 2004;85:424-31.

30. Post MW, Lieshout G van, Seelen HA, Snoek GJ, IJzerman M, Pons C. Measurement properties of the short version of the Van Lieshout Test (VLT-SV) for arm/hand function of persons with tetraplegia after spinal cord injury. Spinal Cord. 2006;44:763-71.
31. Stroh Wuolle KS, Van Doren CL, Thrope GB, Keith MW, Hunter Peckham P. Development of a quantative hand grasp and release test for patients with tetraplegia using a hand neuroprosthesis. J Hand Surg. 1994;19:209-218.

Summary

Chapter 1, the introduction, describes the rationale and the main aims of the research project and presents an outline of this thesis. Inpatient rehabilitation in specialized spinal cord injury units is regarded worldwide as the best treatment for the complex consequences of spinal cord injury. However, little is known about the elements that make this the 'best treatment'. To date, therapy provided in rehabilitation has only been recorded for administrative purposes: the number of treatments, the hours of therapy, and by whom it is provided (e.g., physical therapists, occupational therapists). Since there is no instrument to record therapy time, nor the contents of therapy, it is impossible to compare rehabilitation treatments between patients, centers and countries. The research described in this thesis focused on the development and evaluation of a clear, uniform, reliable and complete classification system of interventions used by physical therapists, occupational therapists and sports therapists to improve the mobility and self-care of patients with a spinal cord injury. This classification system enables the contents of treatments to be identified, information that can be used to improve the effectiveness and efficiency of inpatient rehabilitation of patients with a spinal cord injury.

Chapter 2 describes how the first version of the classification system, which was later named the Spinal Cord Injury-Interventions Classification System (SCI-ICS), was tested in a modified Delphi consensus procedure. The main aim of this study was to reach consensus about definitions of the levels, the categories and interventions in the system and to refine them if necessary. A total of 30 therapists from 10 Dutch and Flemish specialized SCI rehabilitation centers completed the first and second Delphi rounds. The results showed that the SCI-ICS met with high levels of consensus among the therapists in terms of the definitions of the 3 levels (range 87%-100%), the terminology used and the completeness of the classification (range 75%-100%). The perceived relevance of the categories for therapists' everyday work differed between disciplines. We concluded that the SCI-ICS seemed a potentially useful classification system to record clinical treatment sessions in physical therapy, occupational therapy and sports therapy for persons with spinal cord injury.

Chapter 3 reports on a study into the feasibility of the SCI-ICS. A total of 36 physical therapists, occupational therapists, and sports therapists from 3 Dutch specialized spinal cord injury rehabilitation centers used the SCI-ICS to record 856 treatment sessions of 142 inpatients and outpatients during 4 consecutive weeks, and completed questionnaires on the clarity of the SCI-ICS. Ninety-eight

percent of all interventions could be classified, and the categories and interventions were mutually exclusive. Ninety-three percent of the treatment sessions were classified with little or no doubt. The therapists were able to record 45% of the treatment sessions within 1 minute, and 86% within 3 minutes. The therapists evaluated the general chapter of the manual (describing the structure and definitions of the SCI-ICS, and case-studies) as clear to very clear (77%), and rated the specific chapter (describing all inclusion and exclusion criteria of interventions, and detailed examples) as clear to very clear for 89% of the cases for which they consulted it. The SCI-ICS was evaluated as useful and easy to use. The feasibility study yielded several suggestions for improvement, which we used to refine the SCI-ICS. The SCI-ICS appeared suitable as a tool to record the contents of spinal cord injury treatment sessions in different settings and by different therapists.

In **Chapter 4** we evaluate the reliability of the Dutch-language version of the SCI-ICS. Forty-eight randomly selected and videotaped interventions were observed and classified twice by 15 participants (12-20 per discipline) from 3 Dutch specialized spinal cord injury rehabilitation centers. A 4- or 5-digit code from the SCI-ICS was used to identify the level, category and type of the intervention. High levels of agreement between the researcher and the participants were found for both measurements, with at least 92% correctly classified interventions. The intrarater reliability (therapists with themselves, comparing the 1st and 2nd measurements) was also good (91%). The interrater reliability (therapist with other (paired) therapist for the 1st and 2nd measurements combined) was high for the physical therapists and the occupational therapists (92% and 87% respectively), but lower for the sports therapists (69%). This part of our study provided the first evidence of the reliability of the SCI-ICS.

Chapter 5 describes and compares the contents of interventions to improve mobility and self-care for patients with spinal cord injury in post-acute rehabilitation in 3 Dutch specialized spinal cord injury rehabilitation centers. During 4 consecutive weeks, 53 therapists used the SCI-ICS to record 1640 treatments of 48 patients with a recently acquired spinal cord injury. Since there was no evidence at that stage that mobility and self-care are the main domains of spinal cord injury rehabilitation treatment, this part and the subsequent part of the study used a version of the SCI-ICS that also included the option to record therapy aimed at other domains of the ICF (e.g., communication, domestic life). Findings showed that in all centers, the major part (94% overall) of the total recorded therapy time was spent on mobility and self-care interventions. The mean therapy time per patient per week (4.3 hours overall) did not differ

between centers, and all centers spent most of this therapy time at the levels of body functions and basic activities, and least on task- and context-specific interventions at the complex activity level. The time spent on each level did not differ between the centers. In terms of the categories, most time was spent on interventions to improve muscle power, walking, and hand rim wheelchair propulsion. The time investment per category only differed between the centers for the categories of 'Joint mobility', 'Hand rim wheelchair propulsion' and 'Toileting'. All disciplines in all centers recorded the largest percentage of the time as exercise interventions (84% overall). This study showed more similarities than differences between 3 Dutch rehabilitation centers in terms of the therapy provided to their inpatients with spinal cord injury.

In **Chapter 6** we describe and compare the contents of physical therapy, occupational therapy and sports therapy for patients with a spinal cord injury in post-acute inpatient rehabilitation in Australia, Norway and the Netherlands.
Seventy-three therapists used the SCI-ICS to record 2526 treatments of 79 patients with a recently acquired spinal cord injury (48 in the Netherlands, 20 in Australia and 11 in Norway) during 4 consecutive weeks. As part of the procedure, the reliability of the English-language version of the SCI-ICS used by the Australian and Norwegian staff was tested, and proved to be good. Again, we found in all countries that by far the largest proportion of time (92% overall) was spent on mobility and self-care interventions. There were differences between the countries in the mean time spent per treatment (28 minutes in the Netherlands, 43 in Australia and 39 in Norway), and the total time per patient per week (4.3 hours in the Netherlands, 5.8 in Australia and 6.2 in Norway). Key similarity was the focus on exercises at the body function and basic activity levels, and the small proportion of time spent on task- and context-specific interventions at the complex activity level. Most therapy time was spent on 'Muscle Power' (all countries), 'Muscle Length' (Norway), 'Walking' (the Netherlands), and 'Transfers' (Australia). There were 13 categories for which the mean time spent per patient per week differed between the countries, controlled for type of SCI. We concluded that the SCI-ICS makes it possible to compare the contents of therapy between countries.

Chapter 7 presents the main conclusions of this thesis and a general discussion of our findings. Firstly, we successfully developed the SCI-ICS as an instrument to document treatment sessions by physical therapists, occupational therapists

and sports therapists for the main domains of spinal cord injury rehabilitation, namely mobility and self-care. The SCI-ICS is:
- sufficiently complete;
- quick and easy to use;
- a reliable instrument which can be used by different therapists from different settings and countries.

Second, we used the SCI-ICS to study spinal cord injury therapy programmes in different rehabilitation centers in different countries:
- The 3 centers in the Netherlands provided similar therapy.
- In all 5 settings of the 3 countries, most of the overall time was spent on mobility and self-care interventions, and on exercises.
- There were differences between the 3 countries in the time spent on treatments and in the therapy focus.
- There is a degree of overlap between treatments in physical therapy, occupational therapy and sports therapy for spinal cord injury rehabilitation.

This chapter also discusses the strengths of our study and presents methodological considerations, as well as suggestions for further development of the SCI-ICS, and implications for its use in clinical practice and future research. The SCI-ICS should be implemented in clinical practice. Team conferences can use SCI-ICS data on the contents of therapy over the period since the previous meeting as a guide to optimize individual therapy programmes, helping to achieve patients' rehabilitation goals, and to facilitate interdisciplinary communication and communication with patients. Direct electronic entry of therapy data would save therapists' time and reduce specific data entry costs. The scope of the SCI-ICS could be expanded to include cognitive therapy, communication and domestic life, and therapy provided by the nursing staff. This chapter recommends the use of the SCI-ICS in longitudinal cohort studies on spinal cord injury inpatient rehabilitation to investigate the relationships between patient characteristics, the therapy provided and the functional outcomes of rehabilitation of persons with spinal cord injury.

Nederlandse samenvatting

Hoofdstuk 1, de inleiding, beschrijft de aanleiding en de doelstellingen van dit onderzoek. Klinische revalidatie in gespecialiseerde revalidatie centra wordt wereldwijd gezien als de beste behandeling voor de complexe gevolgen van een dwarslaesie. Er is echter nog maar weinig bekend over de factoren die deze 'beste behandeling' bepalen. Eén van die factoren is de gegeven therapie. Tot op heden wordt in de dwarslaesie revalidatie de gegeven therapie alleen geregistreerd voor administratieve doeleinden: het aantal behandelingen en het soort discipline (zoals fysiotherapie en ergotherapie). De inhoud van de behandeling wordt niet vastgelegd en daardoor is het niet mogelijk om revalidatie behandelingen tussen patiënten, centra en landen te vergelijken.
Het onderzoek dat in dit proefschrift wordt beschreven is erop gericht om een helder, éénduidig, betrouwbaar en compleet classificatie systeem van fysiotherapie, ergotherapie en sport behandelingen te ontwikkelen en te evalueren, gericht op het verbeteren van mobiliteit en zelfverzorging van patiënten met een dwarslaesie. Met dit classificatie systeem kan de inhoud van behandelingen worden vastgelegd met als doel deze informatie te gebruiken voor het bevorderen van kwaliteit en doelmatigheid van klinische revalidatie van patiënten met een dwarslaesie.
Bij de aanvang van het onderzoek werd de keuze gemaakt om het onderzoek te beperken tot behandelingen ter verbetering van mobiliteit en zelfverzorging. Dit zijn de voornaamste behandelgebieden van de klinische revalidatie van patiënten met een dwarslaesie. Wij hebben ervoor gekozen om een classificatie systeem met drie niveaus van functioneren te ontwikkelen. Het niveau van basis functies omvat behandelingen die gericht zijn op functies en anatomische eigenschappen van het menselijk lichaam (bijvoorbeeld spierkracht). Het niveau van basis activiteiten omvat behandelingen die gericht zijn op het oefenen van een handeling door een individu (bijvoorbeeld transfers). Het niveau van complexe activiteiten omvat behandelingen die gericht zijn op het oefenen van een handeling door een individu als onderdeel van een betekenisvolle taak of in een betekenisvolle context (bijvoorbeeld rolstoel rijden in de stad). Elk niveau werd onverdeeld in een aantal exclusieve categorieën. In elke categorie werden verschillende therapeutische activiteiten gegroepeerd onder oefenen, onderzoeken, voorlichting en voorzieningen. Tot slot werd de keuze gemaakt het onderzoek te beperken tot behandelingen van fysiotherapeuten, ergotherapeuten en sport therapeuten waarbij de patiënt aanwezig is.

Hoofdstuk 2 beschrijft hoe de eerste versie van het classificatie systeem van behandelingen, het Spinal Cord Injury-Interventions Classification System (SCI-ICS), werd getest met een gemodificeerde Delphi consensus methode. Deze

methode bestond uit een bijeenkomst en 2 schriftelijke rondes waarbij de mening van 30 therapeuten uit 10 Nederlandse en Vlaamse gespecialiseerde dwarslaesie centra werd gevraagd over de inhoud van de SCI-ICS. Het doel van deze studie was om consensus te verkrijgen over de definities van de 3 niveaus, de categorieën en de behandelingen in de categorieën en om de SCI-ICS te verbeteren. Wij vonden een hoge mate van consensus ten aanzien van de definities van de 3 niveaus (range 87%-100%), de gebruikte terminologie en de compleetheid van de SCI-ICS (range 75%-100%). De mening over de categorieën voor de dagelijkse praktijk varieerde per discipline. Wij concludeerden dat de SCI-ICS een potentieel bruikbaar instrument is voor het registreren van klinische behandelingen van mensen met een dwarslaesie door fysiotherapeuten, ergotherapeuten en sport therapeuten.

Hoofdstuk 3 beschrijft het deelonderzoek naar de bruikbaarheid van de SCI-ICS. Zesendertig fysiotherapeuten, ergotherapeuten en sport therapeuten uit 3 Nederlandse gespecialiseerde dwarslaesie centra gebruikten de SCI-ICS om 856 behandelingen van 142 klinische en poliklinische patiënten gedurende 4 opeenvolgende weken te registreren. Bij elke behandeling beantwoordden deze therapeuten enkele vragen over het gebruik de SCI-ICS. Wij vonden dat 98% van alle gegeven behandelingen konden worden geregistreerd met de SCI-ICS. Bij 93% van de geregistreerde behandelingen gaven therapeuten aan weinig tot geen twijfel te hebben bij het classificeren van de behandelingen met het systeem. De therapeuten konden 45% van de geregistreerde behandelingen binnen 1 minuut registreren en 86% binnen 3 minuten. Indien therapeuten de handleiding geconsulteerd hadden, beoordeelden zij het algemene hoofdstuk van de handleiding (waarin structuur en definities van de SCI-ICS beschreven waren) als duidelijk tot zeer duidelijk (77%) en de gedetailleerde hoofdstukken (waarin de in- en exclusie criteria van de categorieën en behandelingen, en voorbeelden van behandelingen beschreven waren) ook als duidelijk tot zeer duidelijk (89%). De SCI-ICS werd als zinvol en bruikbaar beoordeeld. De bruikbaarheid studie leverde verschillende suggesties voor verbetering op welke werden gebruikt voor verdere ontwikkeling van het systeem. We concludeerden dat de SCI-ICS een bruikbaar instrument is voor het registreren van de inhoud van behandelingen van patiënten met een dwarslaesie.

In **hoofdstuk 4** wordt de betrouwbaarheid van de Nederlandse versie van de SCI-ICS onderzocht. Achtenveertig behandelingen werden random geselecteerd en opgenomen met video. Deze video behandelingen (12-20 per discipline) werden door 15 therapeuten uit 3 Nederlandse gespecialiseerde dwarslaesie centra 2 keer, met een tussentijd van 3 weken, geclassificeerd. Codes met 4 of 5 getallen uit het classificatie systeem werden gebruikt om het niveau van de

behandeling, de categorie en het soort therapie te identificeren. Wij vonden een sterke overeenkomst tussen de onderzoeker en de deelnemers op beide meetmomenten met een percentage van correct geclassificeerde behandelingen van ten minste 92%. De intrabeoordelaars betrouwbaarheid (vergelijking tussen de eerste en de tweede meting per therapeut) was hoog (91%). De interbeoordelaars betrouwbaarheid (vergelijking tussen therapeuten op zowel het eerste als het tweede meetmoment) was hoog voor fysiotherapeuten en ergotherapeuten (respectief 92% en 87%), maar lager voor sport therapeuten (69%). De resultaten leverden het eerste bewijs van betrouwbaarheid van het registreren van behandelingen met de SCI-ICS op.

In **hoofdstuk 5** vergelijken we de inhoud van alle klinische behandelingen van fysiotherapeuten, ergotherapeuten en sport therapeuten van patiënten met een dwarslaesie in 3 gespecialiseerde dwarslaesie centra in Nederland. Gedurende 4 opeenvolgende weken gebruikten 53 therapeuten de SCI-ICS om in totaal 1640 behandelingen van 48 klinische patiënten met een recent verworven dwarslaesie te registreren. Omdat er geen bewijs was dat mobiliteit en zelfverzorging de voornaamste behandel gebieden van klinische dwarslaesie revalidatie zijn, werd in dit deel en in het volgende deel van de studie, de mogelijkheid geboden om therapie gericht op andere domeinen van de ICF (zoals communicatie, huishouden) te registreren. De resultaten laten zien dat in alle centra de meeste tijd (94%) van de totaal geregistreerde tijd aan behandelingen gericht op mobiliteit en zelfverzorging werd besteed. Tussen de 3 centra werd er geen verschil in gemiddelde therapie tijd per patiënt per week (4.3 uur) gevonden. In alle centra werd de meeste therapie tijd besteed aan behandelingen gericht op basis functies en basis activiteiten en de minste therapie tijd aan complexe activiteiten niveau. De meeste tijd werd besteed aan behandelingen voor het verbeteren van spierkracht, lopen en handbewogen rolstoel rijden. Tussen centra werd voor 3 categorieën (gewrichts beweeglijkheid, handbewogen rolstoel rijden en toiletgang) verschil in het gemiddeld aantal minuten per patiënt per week gevonden. Alle disciplines in alle centra registreerden het hoogste percentage aan therapie tijd als oefeningen (84%). De resultaten laten zien dat er meer overeenkomsten zijn dan verschillen in therapie voor patiënten met een dwarslaesie in de 3 Nederlandse revalidatie centra.

In **hoofdstuk 6** vergelijken wij de inhoud van behandelingen van fysiotherapeuten, ergotherapeuten en sport therapeuten van patiënten met een dwarslaesie in gespecialiseerde dwarslaesie centra in Australië, Noorwegen en Nederland. Gedurende 4 opeenvolgende weken gebruikten 73 therapeuten de SCI-ICS om 2526 behandelingen van 79 klinische patiënten met een recent verworven

dwarslaesie te registreren (Nederland 48, Australië 20 en Noorwegen 11). Als onderdeel van de instructie procedure werd de betrouwbaarheid van de Engelse versie van de SCI-ICS door de Australische en Noorse therapeuten getest. Deze betrouwbaarheid was goed. In dit deel van de studie vonden wij dat in alle landen de meeste tijd (92%) van de totaal geregistreerde tijd aan behandelingen gericht op mobiliteit en zelfverzorging werd besteed. De gemiddelde tijd in minuten per behandeling (Nederland: 28, Australië: 43 en Noorwegen: 39) en de gemiddelde therapie tijd in uren per patiënt per week (Nederland: 4.3, Australië: 5.8 en Noorwegen: 6.2) verschilden tussen de landen. De voornaamste overeenkomst was de focus op oefeningen op basis functie en basis activiteiten niveau en de geringe hoeveelheid therapie tijd die besteed was aan taak- en context specifieke behandelingen op complexe activiteiten niveau. De meeste therapie tijd werd besteed aan spierkracht (alle landen), spierlengte (Noorwegen), lopen (Nederland), en transfers (Australië). Voor 13 categorieën werd een verschil in het gemiddeld aantal minuten per patiënt per week gevonden, gecorrigeerd voor het type dwarslaesie. Wij concludeerden dat de SCI-ICS het mogelijk maakt om de inhoud van therapie tussen landen te vergelijken.

Hoofdstuk 7 bevat de algemene discussie van dit proefschrift. In dit laatste hoofdstuk worden eerst de belangrijkste conclusies van de studie beschreven.
Wij zijn erin geslaagd een classificatie systeem van behandelingen gericht op de voornaamste behandel gebieden, mobiliteit en zelfverzorging, van patiënten met een dwarslaesie in klinische revalidatie te ontwikkelen. De SCI-ICS kan worden gebruikt als instrument door fysiotherapeuten, ergotherapeuten en sport therapeuten voor het registreren van de inhoud van therapie.
De SCI-ICS is:
- toereikend compleet;
- snel en gemakkelijk in gebruik;
- betrouwbaar: het kan gebruikt worden door verschillende therapeuten uit verschillende revalidatie centra en landen.

Daarnaast hebben wij de SCI-ICS gebruikt om therapie tussen verschillende revalidatie centra en landen te vergelijken. Hieruit concluderen wij:
- De 3 revalidatie centra in Nederland geven vergelijkbare therapie.
- In alle 5 centra in de 3 landen werd de meeste tijd besteed aan behandelingen ter verbetering van mobiliteit en zelfverzorging en aan oefeningen.
- Tussen de 3 landen zijn er verschillen in geleverde therapie tijd en in therapie focus.
- Er bestaat een overlapping van behandelingen tussen fysiotherapeuten, ergotherapeuten en sport therapeuten in klinische dwarslaesie revalidatie.

In dit hoofdstuk worden tevens de sterke en zwakke kanten van de studie besproken. Onze studie laat zien dat de uiteindelijke versie van de SCI-ICS (versie 1.0) adequaat is voor toekomstig gebruik om therapie gericht op mobiliteit en zelfverzorging te registreren. Wij bespreken ook de mogelijke aanvullingen voor het verder ontwikkelen van de SCI-ICS. Om het gebruik van de SCI-ICS te vergemakkelijken zou de inhoud van therapie elektronisch geregistreerd moeten kunnen worden. Dit vermindert niet alleen de tijd die therapeuten aan het registreren kwijt zijn maar ook de kosten voor gescheiden data verzameling en invoer. Uitbreiding van de SCI-ICS zou zich kunnen richten op cognitieve therapie, therapie gericht op communicatie en huishouden en therapeutische handelingen van verpleegkundigen. In dit hoofdstuk wordt de aanbeveling gedaan om de SCI-ICS in longitudinale cohort studies in klinische revalidatie te gebruiken om de relatie tussen patiënt karakteristieken, gegeven therapie en functionele uitkomstmaten in de klinische revalidatie van patiënten met een dwarslaesie te onderzoeken.
Tot slot worden aanbevelingen voor het gebruik van de SCI-ICS in de praktijk gegeven; het is belangrijk om het registreren van de inhoud van therapie met de SCI-ICS in de dagelijkse praktijk te implementeren. De gegevens verkregen door het registreren van therapie met de SCI-ICS kunnen worden gebruikt in de multidisciplinaire team besprekingen met de patiënt. Deze gegevens kunnen sturing geven aan het optimaliseren van individuele therapie programma's. Eveneens kunnen de gegevens gebruikt worden om de interdisciplinaire communicatie en de communicatie met de patiënt te verbeteren.

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- Vrijdagmiddag Primus 17.00 uur? (send/cc/reply) 1 biertje dan!
- Allemaal opletten Werfenweng inschrijving start. (send/cc/reply) Oude groep 1 die nu groep 2 is, toch? (send/cc/reply) Ja, en allemaal de arrenslee opgeven en paarse bandje aan!
- Wie rijdt nu met wie mee in deze zelfsturende groep? (send/cc/reply) Komt goed. Sloep is top. Ik zorg voor rosé!

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Lieve Pap, wat een geluk, vandaag ben je er bij,

Hora est!

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Curriculum Vitae

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Sacha van Langeveld is op 24 november 1962 te 's-Gravenhage geboren. Zij behaalde in 1981 haar Havo-diploma aan het Alfrink College te Zoetermeer. Van 1981 tot 1985 werd de opleiding fysiotherapie gevolgd aan de Stichting Paramedische Academie "De Uithof" te Utrecht. In 1986 behaalde zij het certificaat voor het Canadees Fysiotherapie Staatsexamen. Van 1985 tot 1988 was zij werkzaam als fysiotherapeut op verschillende locaties in Canada, Duitsland en Nederland.

Vanaf 1988 tot heden is zij werkzaam als fysiotherapeut op de dwarslaesie afdeling in Revalidatiecentrum De Hoogstraat te Utrecht. In de periode 1991-2007 heeft zij voor niet-gouvernementele organisaties in onder andere Armenië, China en Vietnam ontwikkelingswerk gedaan. Van 1992 tot 1994 deed zij onderzoek in het betrouwbaar meten van spierkracht met hand-held dynamometrie bij patiënten met poliomyelitis.

Van 2001 tot 2005 werkte zij als onderzoeksassistent mee aan het landelijke onderzoeksproject 'Functionele belasting, belastbaarheid en mechanismen van herstel in mobiliteit in de revalidatie van personen met een dwarslaesie' (beter bekend als 'het Koepelproject'). De auteur nam in 2004-2005 deel aan de opleiding Wetenschappelijke Vorming voor Revalidatie-artsen (VRA-SGO).

Naast haar werkzaamheden als fysiotherapeut, startte de auteur in 2004 haar promotie onderzoek, de ontwikkeling en evaluatie van een classificatie systeem van paramedische behandelingen voor patiënten met een dwarslaesie.

List of abbreviations

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ADL	activities of daily living
AIS	asia impairment scale
ANOVA	analysis of variance
ANZCoS	Australian New Zealand spinal cord scociety
ASCIR	Australian spinal cord register
ASIA	American spinal injury association
Bonferri correction	method used to address the problem of multiple comparisons
CLD	community integration and leisure department
FIM	functional independence measure
ICF	international classification of disability, functioning and health
ICIDH	international classification of impairments, disability and handicaps
ISCoS	International spinal cord society
IQR	interquartile range
LOS	length of stay
NDT	neuro developmental treatment
NTSCI	non traumatic spinal cord injury
NVDG	Nederlands-Vlaams dwarslaesie genootschap
OT	occupational therapist
PNF	proprioceptive neuromuscular facilitation
PT	physical therapist
RAP	rehabilitation activity profile
RC	rehabilitation center
RCT	randomized controlled trial
ROM	range of motion
SAMPC	somatisch-adl-maatschappelijk-psychisch-communicatief
SCI	spinal cord injury

SCI-ICS	spinal cord injury-interventions classification system
SCIM	spinal cord independence measure
SCIPA	spinal cord injury and physical activity
SD	standard deviation
SPSS	statistical package for the social sciences
TBI	traumatic brain injury
TSCI	traumatic spinal cord injury
VRA-SGO	vereniging revalidatie artsen - stimuleringsprogramma gezondheidsonderzoek
WHO	world health organization
ZonMw	zorgonderzoek Nederland medische wetenschappen

Revalidatiecentrum De Hoogstraat Utrecht