

ORIGINAL ARTICLE

International Spinal Cord Injury Skin and Thermoregulation Function Basic Data Set

A-K Karlsson¹, A Krassioukov², MS Alexander³, W Donovan⁴ and F Biering-Sørensen⁵

Objectives: To create an International Spinal Cord Injury (SCI) Skin and Thermoregulation Basic Data Set within the framework of the International SCI Data Sets.

Setting: An international working group.

Methods: The draft of the Data Set was developed by a working group comprising members appointed by the American Spinal Injury Association (ASIA), the International Spinal Cord Society (ISCoS) and a representative of the Executive Committee of the International SCI Standards and Data Sets. The final version of the Data Set was developed after review and comments by members of the Executive Committee of the International SCI Standards and Data Sets, the ISCoS Scientific Committee, ASIA Board, relevant and interested international organizations and societies, individual persons with specific interest and the ISCoS Council. To make the Data Set uniform, each variable and each response category within each variable have been specifically defined to promote the collection and reporting of comparable minimal data.

Results: Variables included in the present Data Set are: date of data collection, thermoregulation history after SCI, including hyperthermia or hypothermia (noninfectious or infectious), as well as the history of hyperhidrosis or hypohidrosis above or below level of lesion. Body temperature and the time of measurement are included. Details regarding the presence of any pressure ulcer and stage, location and size of the ulcer(s), date of appearance of the ulcer(s) and whether surgical treatment has been performed are included. The history of any pressure ulcer during the last 12 months is also noted.

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Keywords: spinal cord injury; International Data Set; thermoregulation; skin; pressure ulcer

INTRODUCTION

The loss of supraspinal control of the sympathetic nervous system and the loss of sensation may cause severe long lasting morbidity and might be life-threatening according to the effects on skin and thermoregulation.

The reduced ability to regulate body temperature puts the individual with spinal cord injury (SCI) at risk of both hyperthermia and hypothermia. Fever, hyperthermia and even hypothermia may accompany infections both in the acute and chronic phase of SCI; however, increased temperature without identified etiologies is also seen.^{1,2} Hyperthermia could be a risk following physical activity as well as during a stay in warm surroundings due to the impaired capacity to reduce body temperature by vasodilatation and sweating.³ The individual with SCI and especially those with cervical injury is poikilothermic and is at risk of developing hypothermia in low environmental temperature, even though hypothermia may also be seen in normal ambient temperature.⁴ It is known that body temperature differs according to methods of measurement.⁵

Hypohidrosis is usually seen below the level of lesion, whereas hyperhidrosis could be present above as well as below the level of lesion. It may be a sign of an ongoing pathological process such as syringomyelia, autonomic dysreflexia or dyspepsia and may accom-

pany micturition and defecation. Hyperhidrosis may also be present without any known cause.⁶

The newly injured as well as those with chronic SCI are at increased risk of developing pressure ulcers.^{7,8} Furthermore, a tendency towards increasing incidence and prevalence of pressure ulcers has been reported.⁹ Impaired sensation with loss of normal signals from the skin and underlying structures is the main risk factor for developing pressure ulcers. However, impaired vasoregulation below level of lesion probably contributes and makes the skin more sensitive to pressure.

In accordance with the goals of the International Spinal Cord Injury Data Sets,¹⁰ the aim of the Skin and Thermoregulation Function Basic Data Set for SCI is to standardize the collection and reporting of a minimal amount of information on these issues in daily practice. Furthermore, the International SCI Skin and Thermoregulation Function Basic Data Set will make it possible to evaluate and compare results from various published studies on skin and thermoregulation function after SCI.

The International SCI Skin and Thermoregulation Function Basic Data Set is applicable to adult individuals with traumatic or non-traumatic supraconal, conal or cauda equina lesions. To ensure that data are collected in a uniform manner each variable and each response category within variables have been specifically defined.

¹Institute of Neuroscience and Physiology, Sahlgrenska University Hospital, Göteborg, Sweden; ²International Collaboration On Repair Discoveries (ICORD), University of British Columbia and Vancouver Coastal Health, Vancouver, British Columbia, Canada; ³Renown Rehabilitation Hospital Reno, NV, USA; ⁴University of Texas Health Science Center, Baylor College of Medicine, Houston, TX, USA and ⁵Clinic for Spinal Cord Injuries, NeuroScience Centre, Rigshospitalet, and University of Copenhagen, Copenhagen, Denmark
Correspondence: Dr A-K Karlsson, Institute of Neuroscience and Physiology, Sahlgrenska University Hospital, S 413 45 Göteborg, Sweden.
E-mail: ann-katrin.karlsson@neuro.gu.se

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The International SCI Skin and Thermoregulation Function Basic Data Set will mostly be used in connection with the background information within the International SCI Core Data Set.¹¹ This specifically applies to the documentation of the level, completeness and time post spinal cord lesions, which have an important role on skin and thermoregulation parameters following injury. The International SCI Skin and Thermoregulation Function Basic Data Set may be used once yearly in chronic SCI individuals.

This document was produced under the umbrella of the American Spinal Injury Association (ASIA) and the International Spinal Cord Society (ISCoS).

MATERIALS AND METHODS

The first draft of the International SCI Skin and Thermoregulation Function Basic Data Set was made by a working group consisting of members appointed by the ASIA and the ISCoS, together with a representative of the Executive Committee of the International Spinal Cord Injury Standards and Data Sets. The developmental process for the International SCI Skin and Thermoregulation Function Basic SCI Data Set followed the steps given below:

1. The working group of the International SCI Skin and Thermoregulation Function Basic Data Set finalized the first draft during a 2 days meeting in Copenhagen in March 2007. This was further elaborated by frequent e-mail contacts between the group members.
2. The Data Set has been reviewed by members of the Executive Committee of the International SCI Standards and Data Sets.
3. The comments from the Committee members were discussed in the working group and appropriate responses were made to the Data Set.
4. Members of the ISCoS Scientific Committee and ASIA Board were also asked to review the Data Set.
5. The comments from the Committee and Board members were discussed in the working group and a response was made, and further adjustments of the Data Set were performed.
6. Relevant and interested scientific and professional international organizations and societies and individuals who were interested were also invited to review the Data Set. In addition, the Data Set was posted on the ISCoS and ASIA websites for over two months to allow comments and suggestions.
7. The comments were discussed and responded to by the working group and when appropriate, adjustments to the Data Set were made.
8. Final approval of the Data Set was performed by the ISCoS Scientific and Executive committees and the ASIA board.

RESULTS

The International SCI Skin and Thermoregulation Function Basic Data Set is structured according to established protocol for the International SCI Data Sets.¹⁰ The complete Data Set form is included in the appendix. The complete data syllabus, data sheet and training cases will be available at the respective websites of ISCoS (www.iscos.org.uk) and ASIA (www.asia-spinalinjury.org).

Date of data collection

As the collection of data on skin and thermoregulation functions may be carried out at any time following SCI, the date of data collection is imperative to compute time since the spinal cord lesion and to identify the data collected in relation to other data collected on the same individual at various time points.

Thermoregulation history after spinal cord lesion within the last 3 months

This variable will document the thermoregulation and sudomotor history after SCI within the last 3 months. The presence of hyperthermia usually defined as rectal temperature above 38.4 °C,¹² as well as

hypothermia defined as rectal temperature below 35 °C,¹² may be caused by an infection. Hyper and hypothermia may also be caused by non-infectious reasons as exercise or by increased or decreased environmental temperature; the individual with spinal cord lesion is prone to be poikilothermic.

Hyperhidrosis is defined as excessive sweating above or below level of injury in the absence of increased ambient temperature. Hyperhidrosis may be a sign of an ongoing pathological process, such as syringomyelia, autonomic dysreflexia or dyspepsia, or may accompany micturition and defecation. Hyperhidrosis may also be present without any known cause.⁶ Hypohidrosis is defined as a loss of ability to sweat and is normally seen below the level of injury due to disruption of sympathetic outflow. Hypohidrosis may be total or partial. Other thermoregulation and sudomotor findings (for example, subjective feeling of coldness) may be present and should be specified.

Temperature and time performed

This variable documents the body core temperature investigated rectally, orally, axillary or in the ear. It should be noted that rectal investigation of body core temperature is most reliable.⁵ Present body temperature at the day of investigation should be documented, and as temperature is affected by the circadian rhythm, the time of evaluation should be reported.

Any pressure ulcer at present

This variable documents presence of a pressure ulcer, the grade and location of the ulcer at the time of investigation. Other types of skin ulcers are not included here. A pressure ulcer could be present at any time post SCI. One diagram with the location and grade is to be filled in for each pressure ulcer. Pressure ulcers are usually seen on prominent body structures and caused by pressure on the region. The location of the pressure ulcer should be documented including right/left side of the body when applicable. A pressure ulcer is defined by different grades of skin involvement according to the definitions below.^{13–15}

Stage I: An observable pressure-related alteration of intact skin whose indicators as compared with an adjacent or opposite area on the body may include changes in one or more of the following: skin temperature (warmth or coolness), tissue consistency (firm or boggy feeling) and/or sensation (pain, itching). The ulcer appears as a defined area of persistent redness in lightly pigmented skin, whereas in darker skin tones, the ulcer may appear with persistent red, blue or purple hues.

Stage II: Partial-thickness skin loss involving epidermis, dermis or both. The ulcer is superficial and presents clinically as an abrasion, blister or shallow crater.

Stage III: Full-thickness skin loss involving damage to or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. The ulcer presents clinically as a deep crater with or without undermining of adjacent tissue.

Stage IV: Full-thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone or supporting structures (for example, tendon, joint capsule). Undermining and sinus tracts also may be associated with stage IV pressure ulcers.

Pressure ulcers do not progress from stage I to stage II to stage III and ultimately to stage IV. Rather, they begin deep inside the tissues, close to the bone, and erupt on the surface of the skin. Conversely, healing ulcers do not progress in reverse order of the stages. Muscle tissue is more sensitive than skin to pressure-induced ischemia.¹³

Unstageable: Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed. Until enough slough and/or eschar is removed to expose the base of the wound, the true depth, and therefore stage, cannot be determined.¹⁴

Stage I pressure ulcers are not always accurately assessed, especially in people with darkly pigmented skin.

Size: The size of the ulcer may be difficult to measure accurately, as the opening may be small, whereas there is undermining of the skin below. The ulcer may also be irregular in size. Therefore, we recommend that largest opening diameter, largest diameter, including undermining, smallest opening diameter and largest depth, should be measured, as the size of the pressure ulcer has influence on treatment and time to healing.

Date of appearance of the ulcer

This variable documents the date of appearance of the ulcer. A pressure ulcer usually presents with a minor alteration to the skin and progresses later. The date of appearance should be the date when the first alteration to the skin was observed. If the date is unknown this should be documented.

Surgical treatment

This variable documents if the ulcer has been surgically treated. Surgical treatment may include any treatment ranging from small debridement of the surface of the ulcer to rotation flaps. In this context the variable includes major surgical methods such as direct closure, skin grafting or rotation flaps. Minor debridement is defined as conservative treatment and should not be documented.

Any other pressure ulcer during the last 12 months

This variable documents presence of any pressure ulcers during the last 12 months. The location should be given for each pressure ulcer during the last 12 months. A pressure ulcer could have been present at any time post spinal cord lesion. This variable documents the presence and location of any other pressure ulcer(s) during the period of the last 12 months only.

Surgical treatment of any other pressure ulcer during the last 12 months

This variable documents if the ulcer has been surgically treated. In this context the variable includes major surgical methods such as direct closure, skin grafting or rotation flaps. Minor debridement is defined as conservative treatment and should not be documented.

DISCUSSION

The International Spinal Cord Injury Skin and Thermoregulation Function Basic Data Set is thought to be used in conjunction with the International SCI Core Data Set and other autonomic function Data Sets (Cardiovascular, Pulmonary, Endocrine/Metabolic Data Sets). The present Data Set will give additional important information of the effect of autonomic dysfunction on skin and thermoregulation function. The collection of data regarding thermoregulation and sudomotor history, including hyperthermia, hypothermia, hyperhidrosis and hypohidrosis as well as the present body temperature, is important because some of these conditions may be life threatening. The collection of data regarding presence, location, size, grade and surgical treatment of pressure ulcers gives important information regarding a condition that can result in high morbidity. The estimation of size of the ulcer is important as the time to healing depends on the total size including largest and smallest opening diameter, largest

diameter, including undermining and depth. However, the presence of a pressure ulcer may also be a sign of other disease and/or reduced capacity to take responsibility for the injured body.¹⁶ The risk of developing pressure ulcers persists life long, therefore the presence not only of a pressure ulcer today but also during the last 12 months should be noted.

It is extremely important that data be collected in a uniform manner. Furthermore, the use of a standard format is essential for combining and comparing the data from multiple sites. For these reasons, each variable and each response category within each variable have been specifically defined in a way that is designed to promote the collection and reporting of comparable minimal data. Although, the International SCI Skin and Thermoregulation Data Set has been revised by the international community it is expected that this Data Set will require periodic revisions and updates. Ideas for improvement of the Data Set are welcome and should be forwarded to corresponding author.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest

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APPENDIX 1

**INTERNATIONAL SPINAL CORD INJURY DATA SETS
SKIN AND THERMOREGULATION FUNCTION BASIC DATA SET
– DATA FORM (Version 1.0)**

Date of data collection: YYYYMMDD Unknown

Thermoregulation and sudomotor history after spinal cord lesion within the last three months:

- Hyperthermia
 - Non infectious
 - Infectious
 - Unknown
- Hypothermia
 - Non infectious
 - Infectious
 - Unknown
- Hyperhidrosis
 - Above lesion
 - Below lesion
- Hypohidrosis
 - Above lesion
 - Below lesion
- Other, specify _____
- Unknown

Objective measures:

Time performed: _____ HHMM Unknown

Temperature:

- Rectal _____ °C
- Ear _____ °C
- Oral _____ °C
- Axilla _____ °C
- Unknown

Any pressure ulcer at present: Yes No Unknown

If yes,
Fill in one diagram for each ulcer, by indicating the ulcer stage (I, II, III, IV, Unstageable)) at the appropriate location.

	Right	Mid-line	Left	Largest opening diameter mm	Largest diameter, incl. undermining mm	Smallest opening diameter mm	Depth mm
Occiput							
Ear							
Scapula							
Elbow							
Ribs							
Spinous process							
Iliac crest							
Sacral							
Ischial tuberosity							
Trochanter							
Genitals							
Knee							
Malleolus							
Heel							
Foot							
Other location							

Date of appearance of the ulcer: YYYYMMDD Unknown

Has the ulcer been surgically treated: Yes No Unknown
If yes, **date of last surgical intervention:** YYYYMMDD

Any other pressure ulcer during the last 12 months: Yes No
 Unknown

If yes,

Fill in one diagram for each ulcer, with tick of the location:

	Right	Mid-line	Left
Occiput			
Ear			
Scapula			
Elbow			
Ribs			
Spinous process			
Iliac crest			
Sacral			
Ischial tuberosity			
Trochanter			
Genitals			
Knee			
Malleolus			
Heel			
Foot			
Other location			

Has the ulcer been surgically treated: Yes No Unknown
If yes, **date of last surgical intervention:** YYYYMMDD