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ORIGINAL REPORT

LINKING THE KLEIN-BELL ACTIVITIES OF DAILY LIVING SCALE TO THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

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Objective: **The main objective of this study was to link the Klein-Bell Activities of Daily Living (KB) Scale to the International Classification of Functioning, Disability and Health (ICF), in order to validate the KB Scale content-wise.**
Design: **A qualitative approach was used with directed content analysis.**
Methods: **Concepts in the KB Scale items were linked to ICF categories according to established rules. This was followed by 4 analyses: examination of the linked categories' frequency distribution; comparison of these categories with Core Sets for spinal cord injury (SCI) and occupational therapists; calculation of content density, content diversity and range of linked categories; and calculation of agreement between two independent linkage versions.**
Results: **All except one identified KB Scale concept could be linked to ICF categories. The occupational therapists Core Sets were most consistent with linked categories in the KB Scale. Content density, content diversity and range varied between the different KB Scale dimensions. Agreement was reliable for the whole KB Scale and for 5 of 6 dimensions.**
Conclusion: **The ICF has provided a valuable reference to identify and quantify the concepts in the KB Scale. Furthermore, comparison between the KB Scale and ICF Core Sets provides insights into areas covered by these instruments.**

Key words: International Classification of Functioning, Disability and Health (ICF); activities of daily living; self-care; outcome measure.

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INTRODUCTION

A spinal cord injury (SCI) can dramatically change the lives of injured people (1), and rehabilitation after such an injury is often a lifelong process that requires reorientation in nearly every aspect of daily life (2). Standardized instruments are particularly useful for capturing any changes in activities of daily living (ADL) in this group over time (3). Today the use of standardized instruments (4) has become increasingly important for analysing how different interventions can affect different areas of life and environmental factors and improve performance (5). Over time, several ADL instruments have been developed, including the Klein-Bell ADL (KB) Scale (6, 7), a generic instrument that measures ADL, with a wealth of detail that other established instruments lack (8). However, the variety of content among ADL instruments requires the ability to judge which is the most appropriate in studying a particular clinical research question. To facilitate comparison of different ADL instruments at the item level, an external reference framework can be used that makes it possible systematically to identify the similarities and differences between the instruments. The International Classification of Functioning, Disability and Health (ICF), a dynamic interactive framework (9), offers such a comparative interface between all instruments. The ICF is increasingly being used in clinical practice and research and has gained acceptance worldwide (10). This framework has improved our understanding and interpretation of already existing instruments, and hence minimizes the need to develop new instruments (11). The greater understanding that can be obtained by connecting existing instruments to the ICF will facilitate the process of clarifying the questions of what and how to measure, and will influence the process of selecting an instrument (12). The instruments will be linked to codes in the ICF (13), and the interrelation in itself can provide a better understanding of existing instruments as a whole (14). It can also clarify the scale structure of the instruments, thereby increasing its applicability from the planning process to evaluating interventions of occupational therapy for persons with SCI (15). Furthermore, the linkage procedure is done such that these instruments can be related to the ICF on a comparable basis and hence to each other. In addition, ICF provides a scientific basis and can provide insight (9) for studies of ADL, as it can be difficult to explain and interpret scores and to be knowledgeable about the content of ADL instruments (16).

The objective of this study was to focus on the content aspects of validity and to systematically identify and compare

the concepts at the item level of the KB Scale with the ICF (9), and thereafter to compare and determine whether the linked concepts in the scale were covered in the ICF Core Sets for SCI in the early post-acute (17) and long-term contexts (18), and in the ICF Core Sets for SCI from the perspective of occupational therapy (10).

The specific aims were: (*i*) to determine whether all the concepts of the KB Scale can be linked to the ICF; (*ii*) to identify and explore whether the linked concepts were covered by the ICF Core Sets; and (*iii*) to identify and explore the categories of the ICF Core Sets not covered by the scale.

METHODS

Instrument

The KB Scale (7) can measure a patient's level of independence in basic ADL (self-care) in 170 items and is divided into 6 dimensions: dressing, elimination, mobility, bathing and hygiene, eating, and emergency telephone use. These 6 dimensions can be divided into 26 sub-dimensions (6). The KB Scale has been used in earlier studies, including in persons with SCI (7, 19). The reliability (7, 20, 21) and validity (7, 8, 21), as well as sensitivity toward small changes in ADL (20, 22) have been studied elsewhere. The KB Scale has been translated into Swedish, and this version was used during the linking procedure (23, 24).

Linking the KB Scale to the ICF

The procedure for connecting the KB Scale to the ICF was carried out using an individual perspective and was coded as activity (a), defined as "the execution of a task or action by an individual" (9, p. 10). The linking process was carried out by 4 senior occupational therapists (OTs) with clinical experience in SCI rehabilitation, reconstructive hand surgery and research. The OTs were divided into two groups. In the case of disagreement, discussions within the groups and between the groups continued until consensus was achieved (11).

A qualitative approach was used with directed content analysis (25), where the encoding began by identifying key concepts in the KB Scale. These concepts are meaningful text units that should convey a single theme and were based on the rater's judgement and expertise in ADL performance.

When the meaningful concepts were identified, discussion in the two groups was based on how the activity was carried out in each item in the scale. To illustrate the process, item 13 *pull sock over right foot with heel to heel* is used as an example where two meaningful concepts were identified that could be linked to two different ICF categories.

- Concept 1: Pull linked to a445 (arm and hand use)
- Concept 2: Sock linked to a5402 (putting on footwear)

If a single item were found to include several meaningful concepts, each concept was linked. Meaningful concepts are henceforth called concepts. The analysis thereafter continued by coding these concepts by means of predetermined codes, in this case the use of the most precisely corresponding categories in the ICF. These categories are identified as units in the classification. The ICF categories were linked on the third level when possible in order to maintain the level of detail in the KB Scale (6) (Fig. 1). The linking procedure was carried out according to established rules (14, 26). The results of the linking procedure are presented in total, second-level and third-level categories of the ICF.

Analysis

In the first analysis a frequency distribution of the categories was carried out among the linked categories. These linked categories were divided according to chapters and subheadings in the ICF (9) and thereafter subsequently identified in the KB Scale's 6 dimensions (7). This

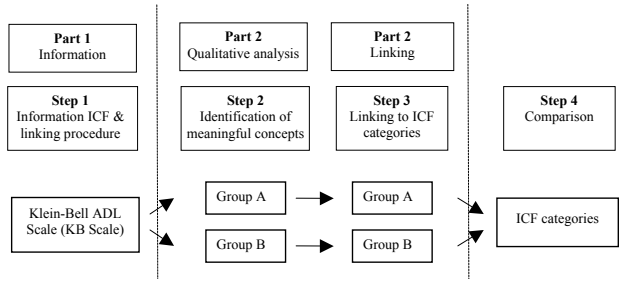

Fig. 1. Linking process of meaningful concepts into International Classification of Functioning, Disability and Health (ICF) categories. ADL: activities of daily living.

was followed by a second analysis divided into two parts. In the first part, each linked category was examined and compared as to whether the category was covered in the Core Sets for SCI (17, 18) that include self-care. In the second part of the analysis, each linked category was examined and compared with the ICF categories that reached a cut-off point of 75% or more that include self-care, as described by Herrmann (10), in the Core Sets for SCI from the perspective of OTs.

In the third analysis, the number of items in the KB Scale and concepts identified in the KB Scale and the numbers of ICF categories were counted, separated by component. Stamm et al.'s definitions (27) were used to calculate content density and content diversity. Content density is defined as the mean number of meaningful concepts per item. A value of 1 means that one concept is identified in each item. If the value exceeds 1, however, it means that more than one concept is identified in some items. Clinically, this means that a value over 1 might make an item difficult to score as it includes more concepts or activities, which may vary in their difficulty to perform. Content diversity is identified as the number of ICF categories per concept. A value of 1 means that each concept is linked to another ICF category, while a value below 1 means that several concepts are linked to the same ICF category. Clinically, this translates to a low diversity ratio being good if one wishes to assess specific problems, such as basic ADL, while a high diversity ratio is desirable when broader aspects regarding activity are to be assessed (27). The spread of concepts per item is reported as the range of concepts per item (28).

The fourth and last analysis included evaluation of reliability by means of the two independent linkage versions in which overall degree of agreement was calculated. The assumption is that no difference in linking on the second level occurs between the two pairs. The analysis includes 3 calculations: the KB Scale, the KB Scale excepting the sub-dimension of *additional devices* included in the dimension of *dressing*, and the dimension of *dressing* divided into the two sub-dimensions of *dressing and additional devices*. The calculation of agreement includes the percentage agreement (PA), the kappa correlation coefficient (29, 30) and the non-parametric bootstrapped confidence interval (CI) (31, 32). The kappa correlation coefficient adjusts the percentage of agreement to take into account the similarities in linking between raters due to chance (29). Kappa values range from 0 to 1, where 1 indicates perfect agreement and 0 indicates no additional agreement beyond what is expected by chance alone. Landis & Koch (30) describe the strength of the agreement of kappa as: 0–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1.00 almost perfect.

RESULTS

The results of the linking procedure showed that 385 concepts were identified in 170 items in the KB Scale. Of these, 384 concepts in 169 items could be linked to categories in the ICF. In one item, *for any other medically prescribed device which requires proper fastening and/or orientation to be functional,*

the meaningful concept that was identified could not be linked to any category in the ICF and was therefore linked as not covered (nc) in the classification.

The linked concepts display a span including categories concerning function and activity to environmental factors from the components of *body function, activity and participation and environmental factors*. The majority of concepts were linked to the ICF component *activity and participation, n* = 345 (90%), and e*nvironmental factors, n* = 31 (8%), and a few concepts were linked to *body functions, n* = 9 (2%). In the component of *activity and participation,* the 3 most frequently used categories were a445 *hand and arm use, n* = 60 (16%), a5400 *putting on clothes, n* = 35 (9%), and a440 *fine hand use, n* = 34 (9%). In the component of *environmental factors,* the category most used was a1201 *assistive products and technology for personal indoor and outdoor mobility and transportation, n* = 12 (3%). The component of *body function* contained only items that included *urinary* and *faecal function* and *ingestion function*.

The overall results are shown as an overview of the linkage where the 384 concepts identified in the KB Scale items were linked to 58 different ICF categories on the second- and third-level categories ordered by the ICF components and chapters, and among the 6 dimensions in the KB Scale (Fig. 2). The bars in Fig. 2 represent the frequencies of the ICF categories identified in the KB Scale. A higher number indicates that several concepts from the KB Scale were linked to the same ICF category. The chapter that was used most during linkage was *mobility* and, in the chapter, the categories *hand and arm use* A445, *fine hand use* A440, followed by *grasping* a4401, *pulling* a4450, *reaching* a4452, *lifting* a4300 were most used. This was followed by the chapter *self-care* and the categories of *eating* a550, *putting on clothes* a5400, *putting on footwear* a5402, *caring for hair* a5202 and *regulating urination* a5300 and *defecation regulating* a5301.

The overall results of the comparison between the linked categories and the ICF Core Sets for SCI and OTs are also shown in Fig. 2. The results of the comparison of linked categories on the same level in the KB Scale and the Core Sets for SCI post-acute and long-term care were *n* = 27 (47%) and *n* = 24 (41%) and for the Core Sets for SCI from the perspective of OTs were *n* = 38 (67%) and *n* = 30 (52%). Compared with the linked ICF categories in the KB Scale, only one (2%) category in the Core Sets for OTs was linked to a less detailed level while *n* = 23 (40%) and *n* = 26 (45%) in the Core Sets in the SCI were linked to a less detailed level. Both Core Sets for SCI and OTs lacked categories that were included in the linking of the KB Scale; these were *n* = 6 (10%) categories for both SCI Core Sets and *n* = 19 (33%) and *n* = 27 (47%) in the OT's Core Sets for SCI. Two (3%) categories were linked to a higher level in the SCI Core Sets compared with the KB Scale (Fig. 2).

Table I shows the total number of items, concepts and linked categories in the KB Scale and the range and ratios of content density and diversity. The dimensions of *use of telephone* and *elimination* showed the highest density ratio, which means that, in most items, more than one concept were identified and linked. The dimensions of *use of telephone* and *hygiene* showed the highest diversity ratio, indicating that most concepts were linked to different ICF categories. The highest number of ICF categories per components was obtained in the dimensions of *mobility* and *hygiene* in the component of *activity and participation*. The dimension of *elimination* has the highest range of concepts in the KB Scale (Table I).

Table II shows the results of a calculation of the linking procedure by overall PA, kappa statistics and non-parametric bootstrapped CI. The PA ranged from 0.33 to 0.69 and the estimated kappa values ranged from 0.25 to 0.62, a range from a level of fair to substantial level agreement. Five of 6 dimensions in the KB Scale and the overall KB Scale showed significant differ-

Table I. *Frequencies of Klein-Bell Activities of Daily Living (KB) Scale items, concepts and International Classification of Functioning, Disability and Health (ICF) categories in relation to each other*

	Dressing	Elimination	Mobility	Hygiene	Eating	Telephone
KB Scale						
Items, *n*	65	23	30	31	15	6
Concepts, *n*	143	62	65	69	30	17
Concepts per item, range	1–4	1–7	1–4	1–5	1–3	2–4
Content density, concepts/item	2.2	2.7	2.2	2.2	2	2.8
ICF						
Concepts linked to ICF component						
Body function, *n* (%)	0 (0)	5 (63)	0 (0)	0 (0)	3 (38)	0 (0)
Activities and participation, *n* (%)	132 (38)	53 (15)	53 (15)	67 (19)	27 (8)	14 (4)
Environmental factors, *n* (%)	10 (32)	4 (13)	12 (39)	2 (6)	0 (0)	3 (10)
Concepts not covered by the ICF, *n*	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Different ICF categories, *n*	15	18	23	24	9	9
Content diversity, categories/concept	0.10	0.28	0.36	0.38	0.30	0.53
ICF categories per component						
Body function, *n* (%)	1	4	0	0	2	0
Activities and participation, *n* (%)	11	11	22	22	7	8
Environmental factors, *n* (%)	3	3	1	2	0	1

The frequencies of the items and concepts from the KB Scale and ICF categories are reported in total numbers (percentages in brackets). The linking process total number included 386 ICF concepts, 385 linked categories and 1 concept identified as not covered. The 385 categories were made up of 345 categories in component activities and participation, 31 categories in component environmental factors, and 9 categories in component body function.

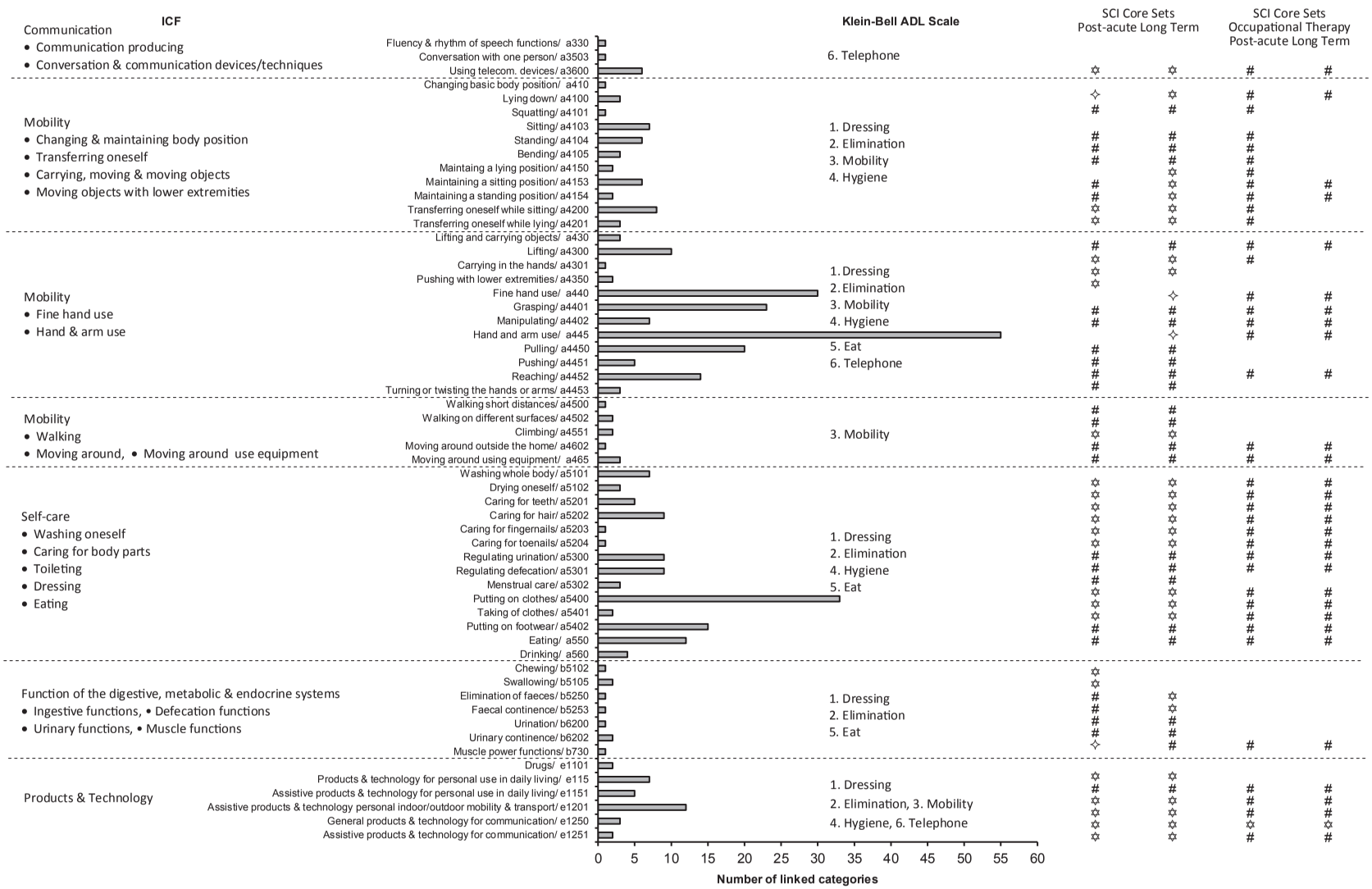

Fig. 2. The 384 concepts identified in the KB Scale items linked to 58 different International Classification of Functioning, Disability and Health (ICF) categories on second- and third- level categories ordered by the ICF components and among 6 dimensions in the KB Scale. Comparison between 58 linked categories and SCI Core Sets in post-acute and long-term care and from an occupational therapist perspective. # = ICF categories at the same level of detail in KB Scale and SCI Core Sets, ✡= ICF categories in KB Scale more detailed in KB Scale than in SCI Core Sets, ✧= ICF categories in SCI core sets more detailed in SCI Core Sets than in KB Scale.

Table II. *Overall percentage of agreement, kappa coefficient, and non-parametric bootstrapped confidence interval (CI) for Klein-Bell Activities of Daily Living (KB) Scale and 6 dimensions*

Scale/dimensions	Overall percentage of agreement (PA)	Kappa coefficient	Non-parametric bootstrapped CI
Dressing	0.69	0.62	(0.14 to 0.70)
Elimination	0.53	0.46	(0.28 to 0.59)
Mobility	0.36	0.29	(–0.00 to 0.40)
Hygiene	0.46	0.40	(0.04 to 0.47)
Eat	0.47	0.40	(0.24 to 0.57)
Telephone	0.33	0.25	(0.03 to 0.46)
KB Scale (total)	0.53	0.50	(0.09 to 0.53)

ences, while the dimension of mobility showed no significant difference (Table II). After splitting the dimension of dressing into the sub-dimensions of *dressing* and *additional devices*, a second calculation resulted in PA values of 0.81 and 0.31, kappa values of 0.75 and 0.29 and non-parametric bootstrapped CI values of (0.21–0.82) and (–0.09 to 0.41) for each sub-dimension. In the third calculation, without the sub-dimension of *additional devices* in the overall KB Scale, the results were PA, kappa value and non-parametric bootstrapped CI of 0.56, 0.52 and (0.12–0.58), respectively.

DISCUSSION

The linkage of the KB Scale, an already existing instrument, to the ICF as an independent reference has made it possible to interpret, detect and quantify concepts in the scale and thus highlighted and clarified the scale structure. It has also provided a comprehensive and systematic overview of the linked ICF categories and thus given a broader understanding of how the KB Scale items are constructed from body movements to basic ADL activities. The linkage of the KB Scale to the ICF has shown that different categories cover different levels of precision between categories and within the same category, for example within the category of *arm and hand use*. Meaningful concepts in the KB Scale concerning the component of *activity and participation* have been linked more to the third level than to the second level. The linkage has also shown that the categories including *self-care* in the ICF (9) do not contain the same level of detail as in the items in the KB Scale. For example, the categories included in the subheading of *dressing* do not distinguish between how the activities are carried out and the activity in itself. The level of detail of the KB Scale makes it possible to describe the procedures necessary to perform these activities. A further example is the categories for *bathing/showering* and *dressing*, which are not divided into lower and upper body as is the case for the corresponding activities in the KB Scale. On the other hand, the ICF includes more highly differentiated categories for *mobility* (body movements) than for *activity*. These categories cannot be measured in the KB Scale at present as the scale measures basic ADL. However, it may provide indirect knowledge of the motor requirements for arm function, fine motor skills, trunk balance, etc. needed to perform basic ADL. This knowledge, together with information obtained about basic ADL, could be used to determine the way in which the ability of persons with SCI in self-care can be enhanced, modified or adapted to improve the person's independence in daily life during rehabilitation in persons with SCI (33–35).

The linkage has shown that the ability to perform self-care according to the KB Scale includes categories such as mobility (*transfers, changing body position*, etc.) and *products and technology* such as assistive devices (*wheelchair, walking aids*, etc.). Five of 6 dimensions in the KB Scale cover environmental factors relevant to mobility and assistive devices. The above-mentioned category groups are linked primarily to the third level categories in the ICF. These categories can make it possible to examine how mobility and assistive devices, such as wheelchairs, could affect the degree of independence in individuals with cervical SCI. In several earlier studies (36–38), these categories have been demonstrated to be crucial in the process of obtaining and maintaining independence in individuals with SCI.

In two dimensions, *elimination* and *eat*, the majority of categories that include function primarily have been linked to the third level in the ICF. Items such as *chewing, swallowing, urination* and *elimination of faeces* are included in the KB Scale on the grounds that they were identified along with other activities in the scale when it was developed as critical and observable in almost all people (7). It is questionable whether it is important to assess all these functions for persons with cervical SCI. However, an earlier study (8, 34) showed that *urination* and *elimination of faeces* are issues because these impairments have a major impact on independence in these persons, which makes it important to assess them.

The KB Scale is a generic scale (6, 7), and this may question the validity of using it to measure self-care in persons with SCI. However, the comparison with the Core Sets of SCI (17, 18) and for OTs (10) has further demonstrated that the KB Scale encompasses a majority of problems concerning self-care in persons treated by OTs. Both the KB Scale and the Core Sets for OTs (10) contain more detailed ICF categories than 2 SCI Core Sets concerning self-care. This is likely to ensure a more comprehensive description of interventions relevant to clinical practice for OTs and to provide a useful basis for describing these treatments. On the other hand, the KB Scale and SCI Core Sets contain more categories for basic functions than the Core Sets for OTs. The inclusion of categories concerning body functions in the KB Scale is appropriate only as long as the assessment of these abilities is related to how the abilities interact with the environment and self-care to create activity limitations (34, 35).

Apart from providing insight into the scale structure, i.e. breadth and precision of the scale, the linkage can also detect problematic items in the scale (39). The dimensions of *telephone* and *elimination* have the highest content density ratio (concepts per item), which indicates that, on average, more than two concepts are included in each item. This may imply that the items in these dimensions are problematic and difficult

to assess, since more than one concept must be measured in one item. An example is the item describing the procedure in defecation: *be able to go from a standing or sitting position appropriate for defecation: toilet, raised toilet seat, commode (this includes emptying the pan into the toilet or the set up and clean up required for the bowel programme in bed)*. This item includes the following 5 concepts: *standing, sitting, transfer, toileting* and *assistive devices*. The person's answer must include change of body position and the abilities to transfer, use potential assistive devices and manage toileting. While these abilities might differ from each other, it is sufficient to give only one answer to this item. The range of concepts is highest in the dimension of *elimination*, which can be explained by the span of ICF categories, which include categories concerning bladder and bowel function and mobility to activities such as dressing. The dimension of *telephone* has the highest diversity ratio (linked ICF categories per concepts), indicating that half of the concepts were linked to a different ICF category. The KB dimension of *dressing* has a considerably lower content of diversity ratio. That is, more concepts were linked to the same ICF category. For example, in the dimension of *dressing* in the KB Scale, 33 concepts were linked to category a5400 *putting on clothes* and 15 concepts were linked to category a5402 *putting on footwear*. However, these linked items are a result of the KB Scale design (6). The dimension of *dressing* is the dimension that is the most precise and detailed of all the dimensions in the KB Scale. The other dimensions of the scale lack these features, and a review of these items may provide knowledge as to whether they should be divided in order to better determine how and what to measure in specific items. However, there is a limit to how many items that can be included in a scale. There must be a balance between the amount of data needed and the time required to obtain sufficient information. The challenge lies in finding a solution that provides as much data as possible without increasing the burden on the individuals that are being assessed (40).

The results of the linkage with respect to the linking methodology have shown that the agreement was significant in the overall KB Scale and in 5 of 6 dimensions in the scale. This shows that the linking procedure was reliable in this study. During the linking process of the dimension of *mobility*, the two groups of raters encountered problems linking concepts that include body movements and assistive devices for mobility. These problems were solved in the consensus discussion. However, the differences between the two groups were too great to be considered reliable. Further calculations with regard to the KB Scale and the sub-dimensions of *dressing* and *additional devices* have shown that the linkage has proven useful for gaining insight into both the concepts of the scale and other aspects of the contents of the scale. Several concepts can be included in one single item, and the result is that it is difficult to interpret to which of the concepts an item refers. One example is the concepts concerning the ICF categories of *arm and hand function* and *fine hand use* in the sub-dimension of *dressing*, where the discussion focused on linking both fine motor skills and arm movements that include a more unspecified grip function or only one of these categories. Another discussion concerned the types of categories to be used during the linkage process, more general ones that summarize an entire activity or categories that are more specific. Category a5300 *regulating urination* is a more general category that describes the entire process of toileting. Linking only this category instead of more specific categories in the ICF leads to a loss of information about the level of detail in the KB Scale items.

Despite the planning that included reviews and discussions of the ICF and the linkage process that was carried out before the study, a potential limitation is that there existed a difference in experience and knowledge of the ICF among raters. Although the raters have the same professional background and thus applied an occupational therapy perspective during linkage, there was a difference in how the linking process was performed. This is most evident when linking the dimensions of mobility and telephone, where the differences in linkage were greatest.

This study has shown that ICF can be used as an interface to explain to health professionals in a more common language the differences and similarities between the KB Scale and other ADL instruments when it otherwise might be difficult due to the scales' conceptual structure, items and scale steps (categories). This will make ADL scales more comprehensible and more user-friendly in teamwork. Furthermore, the linkage has also shown the complexity of factors needed to perform self-care that must be taken into account when planning and training individuals with SCI in self-care. The ICF has therefore the potential to support the clinical practice of OTs and can improve evaluation and efficiency in the rehabilitation of individuals with SCI from an occupational therapy perspective.

The present study has shown that it is possible to link the KB Scale, an existing ADL scale, to the ICF. This might be a preferable approach compared with developing and validating new instruments, as this is both time-consuming and expensive (41). However, linking instruments to the ICF should be seen as a complement and can never replace a study of the psychometric properties of the instrument in question.

In conclusion, the ICF has been a valuable reference to identify and quantify the concepts in the KB Scale. Furthermore, comparison between the KB Scale and ICF Core Sets has provided insights into areas covered by these instruments with respect to the breadth and precision of the linked categories. Furthermore, the linkage of the KB Scale to the ICF has provided information on which items in the scale might require more specification in a future revision of the scale.

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