Reliability and Validity of Spinal Cord Independence Measure of Mongolian Version (mSCIM)

Short title: Spinal Cord Independence Measure of Mongolian

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Abstract

Aims: To evaluate the reliability and validity of the Mongolian Version of the Spinal Cord Independence Measure (mSCIM).

Methods: Spinal cord independence measure III (SCIM III) was translated into Mongolian and data collected from 40 patients with spinal cord injury (SCI) were analysed. Reliability and validity were analysed in 30 patients, and the responsiveness was tested in 10 patients at admission to rehabilitation and discharge.

Results: Percent agreement and Kappa values between two raters were 83-100% and 0.70-1.00, respectively, in all mSCIM items. Intraclass correlations were shown to be above 0.99 within subscales and total score, and Cronbach's alpha was above 0.75 aside from the respiration and sphincter subscale. The correlation between mSCIM and motor parts of the Functional Independence Measure (mFIM) was above 0.86 in each rater. The mSCIM showed more responsiveness to functional changes for patients at discharge than mFIM.

Conclusions: The SCIM III scale was translated into Mongolian, high inter-rater reliability and validity was shown. In addition, more sensitive to changes in function compared with mFIM. Furthermore, we justified the use of mSCIM in the field of rehabilitation, which might be easier for rehabilitation staff to use, because it is in their mother language.

Key words: reliability, validity, Mongolian version of the spinal cord independence measure

1. Introduction

Mongolia is a country with ancient and nomadic traditions. Mongolian health care and human resources have been developing well since the 1990s, with a ratio of 3.94 doctors per 1,000 population in Ulaanbaatar (capital city). However, the number of rehabilitation staff is inadequate compared with the population, such as only over 200 rehabilitation doctors by the Mongolian Society of Physical Medicine and Rehabilitation,[1] and 198 physical therapists in Mongolia.[2] Moreover, Dorjbal et al. reported that people with spinal cord injury (SCI) had limited activities, community restrictions, and a lack of rehabilitation services in Mongolia.[3] Although, there is no definite statistical data has been observed for SCI patients. The disability prevalence rate is 3.9% in the population (108,071 individuals), and physical disability is more prevalent than mental disability.[4] SCI is a severe disease, leads to long-term disability. Before returning to community, prolonged stay in hospital and continued rehabilitation is necessary. However, the hospitalisation period in Mongolia is short, with an average of 8.7 and 7.6 days in urban and rural areas, respectively.[5] In addition, Mongolian version of activities of daily life (ADL) scales are few. Functional independence measure (FIM) and modified Barthel Index (MBI) are commonly used for SCI patients. However, the previous study reported that the MBI has been used in non-SCI populations and little validation in patients with SCI. The FIM was developed in 1980, since that it has been widely used including SCI patients. Validity and reliability of the FIM for measuring the burden of care is more and lack in evaluation of sphincter management and does not evaluate the respiratory management.[6,7] Currently, the Spinal Cord Independence Measure (SCIM) is a highly recommended to specialised functional scale for patients with SCI. Anderson K et al. reported that the SCIM represented the more sensitive than FIM scale and valid measure for individuals with SCI.[7] Revised two times, the last version of SCIM III is composed of 19 items in three subscales: self-care, respiration and sphincter management, and mobility.[8,9]

This scale has been translated into many languages such as Italian, Turkish, Brazil, Spanish, Thai, and Japanese. Also, those versions were studied reliability and validity, shown high results. [10-15] In the present study, we assessed the reliability and validity of the Mongolian version of the SCIM (mSCIM).

2. Materials and Methods

Ethical approval for this study was obtained from the Research Ethics Board of the Mongolian National University of Medical Sciences (No. 2019/5-06). We got permission from the copyright holder to reprint before translations.

Translation and cross-cultural adaptation of mSCIM followed a previous study.[16]

Translation into Mongolian: The English version of the SCIM III was translated into Mongolian by two physicians (D.Z and B.B) who were native Mongolian speakers and were fluent in English with many experiences that could be preferably translated into Mongolian. Translation was independently performed, and the results were then compared and discussed to final version was reached. Back translation from Mongolian to English: A native English translator (T.G) with 12 years of training and experience translated the Mongolian version back into the English version. The aim was to identify misunderstandings in the Mongolian translation, and improve the quality of the final version. In addition, the translator was not familiar with the original measurement scale. None of the items were excluded. Review of the Mongolian translation: The original and backward-translated versions were reviewed and compared by rehabilitation doctors, nurses, and physical therapists, which were not familiar with the scale. None of the items required changes. Finally, the scale was refined before data collection (Figure 1).

2.1 Subjects

In the present study, data were collected from four venues (two rehabilitation departments, the National Traumatology and Orthopaedics Centre and National Rehabilitation Centre; two non-government organisations, the Universal Progress Independent Living Centre and Mongolian National Wheelchair Users Association). Data collection was performed from June to October 2020. A total of 40 patients with SCI participated in this study. Eligible participants had any level of SCI, traumatic or non-traumatic origin, over 16 years of age, and did not have any cognitive impairment. Concomitant neurological diseases may alter the functional level previously established by SCI. Before assessment, the evaluators were explained about the study, and asked to participation in study. Then, participant or family member signed the consent form.

2.2 Procedure

First author of present study explained about the mSCIM scale to all evaluators before data collection. All evaluations were performed by three physical therapists. The reliability and validity were examined by two physical therapists in 30 patients with SCI (Group A). The evaluators have over 6 to 8 years of clinical experience. The evaluators made assessment independently within a day and blinded to the result of other assessment. Participants were assessed with mSCIM, and FIM as measured by observation and interviews with general information. The responsiveness was assessed by one of the three physical therapists at admission and discharge of the rehabilitation in 10 patients with SCI (Group B). As well, she has about 8 years' experience and who has mainly worked with orthopaedic patients.

2.3 Data analysis

Inter-rater reliability was evaluated by following methods: a) total agreement, kappa coefficient between two raters concerning each item, which confirm that the result is

independent of the rater and correlates with the patient's situation. To obtain total agreement, calculated the difference between raters then counted the number of zeros in the first. Secondly, dividing the number of zeros by number of items. The result is directly interpreted as the percent of data that are correct. Interpreted to Cohen's Kappa, 0.21-0.40 indicate fair agreement, 0.41-0.60 moderate agreement, 0.61-0.80 substantial agreement, and 0.81-1.00 almost perfect agreement.[17] b) intraclass correlation coefficient (ICC (3,1)), which estimated the proportion of variability between the participants within the total score variability. An ICC of excellent reliability above 0.90, high reliability 0.70-0.90, moderate reliability 0.50-0.70 and low reliability below 0.50.[18] Internal consistency was analysed using Cronbach's alpha. The desired Cronbach's alpha is above 0.70. Validity was tested using the Spearman's correlation coefficient calculated by matching each mSCIM subscale with FIM motor subscale (mFIM). The self-care, sphincter control, transfers and locomotion subscales are included in motor part of FIM. In detail by items in subscale, the eating, grooming, bathing, dressing-upper body, dressing-lower body, toileting items are in self-care subscale; the bladder and bowel management items are in sphincter control subscale; the bed/chair/wheelchair transfer, toilet transfer, tub/shower transfer items are in transfer subscale; walk/wheelchair, stairs items are in locomotion subscale. When correlation between mSCIM and mFIM was matched self-care of mSCIM to self-care of mFIM, respiration and sphincter management of mSCIM with sphincter control of mFIM, mobility (room and toilet) of mSCIM with transfers of mFIM, and mobility (indoors and outdoors) of mSCIM with locomotion of mFIM. [6, 19]

Responsiveness to change estimated by McNemar test comparing mSCIM subscales score to FIM items that match those subscales. The statistical analysis was performed with SPSS 25 for Mac OSX. The level of significant differences was set at $P<0.05$.

3. Results

3.1 Participants' characteristics

A total of 40 patients with SCI comprised the study participants (Table 1). The mean age was 38.2 and 35.4 years in each group, respectively. With respect to gender, males were more than females in each group, and 60% and 90% of groups A and B, respectively. Traumatic injury was the most leading cause of injury in both groups (76.7% and 100%, respectively). With respect to the level of injury, paraplegia (73.3%) was more than tetraplegia in the group A, and the same proportion was in the group B (Table 1). The mean days of hospitalisation and rehabilitation were 15.1 in the group A and 9.9 days in the group B, respectively.

3.2 Reliability, validity, and responsiveness

Inter-rater reliability was evaluated in 30 patients and was analysed using percent agreement and kappa values between raters. The total agreement values ranged from 83 to 100%, and kappa values ranged between 0.70 and 1.00 for all mSCIM items. The full agreement (100%) and kappa values (1.00) were shown in respiration, mobility indoors, mobility moderate distance, mobility outdoors, and stair management of mSCIM items (Table 2). ICC values were above 0.991 for the total score and for all subscales of mSCIM (Table 3).

Internal consistency was evaluated using Cronbach's α coefficient. Each subscale indicated above 0.75 and 0.78 by the first and second rater. On the other hand, the respiration and sphincter management subscales were 0.57 and 0.59, respectively (Table 4).

The mSCIM and mFIM correlations were measured using Spearman rho correlation coefficient to determine the validity. The results by each subscale were 0.86–0.94 and 0.84–0.91 for the first and second rater, respectively. In addition, total score correlation was 0.94 and 0.95 in first and second rater. By the score of each scale, mSCIM were 13.87 and 13.97, and the mFIM were 31.17 to 32.00 in the self-care subscale by each rater. In the respiration

and sphincter management subscale, mSCIM were 26.00 and 25.57, and the mFIM were 7.40 and 6.77 by each rater. In the mobility (room and toilet) subscale, mSCIM were 7.20 and 7.30, and mFIM were 3.77 and 3.80 by each rater. The total scores were 53.33 and 53.03 in mSCIM, and the mFIM were 55.47 and 55.93 by each rater (Table 5).

Further, Responsiveness to functional changes at admission to rehabilitation and discharge were analysed in 10 patients using McNemar's test. In the result, the mSCIM was found to be more sensitive than mFIM to changes in function for SCI patients. For example, mFIM showed changes in self-care, and mobility (room and toilet) whereas the mSCIM determined improvement in self-care, respiration, and sphincter management, and mobility (room and toilet) (Table 6).

4. Discussion

In Mongolia, medical care has been improving; however, the rehabilitation field has some complications that require more rehabilitation services for patients with SCI. The SCIM III, a specialised scale for SCI patients, was translated into Mongolian, and the final Mongolian version (mSCIM) was reviewed by the rehabilitation staff. Moreover, the reliability and validity for participants with SCI injury were evaluated. In the result, the total agreement and kappa values ranged between 83–100% and 0.70–1.00 for all items of the mSCIM between raters. Based on Cohen's kappa guideline, present study results were acceptable.[17] In the present study, all evaluators were physiotherapists. However, Catz A et al.[8], Itzkovich M et al.[9], and Anderson KD et al.[20] selected the evaluators by various professions such as physicians, occupational therapists, nurses, and the physiotherapists. In the comparison of total agreement result with those studies. Above 80% agreement was for 12 of the 16 items in the SCIM I,[8] 13 of the 19 items in the SCIM III,[9] 8 of the 19 items in the US multi-center study.[20] Our study indicated higher agreement compared with previous studies. Thai version reported that physical therapist might have difficulty in assessing respiration and sphincter management.[14]

The subjects of group A who had no problem of respiration received a full score for mSCIM. It might be related to result in the present study. As well, this scale presented high reliability when used by health professionals with different levels of experience and backgrounds.[12]

Regarding to ICC result, it was above 0.991(0.981–0.996, 95% CI) within subscales and total scores. In the previous study of SCIM III,[9] Thai,[14] Spanish,[13] Italian (at discharge),[10] and Brazilian[12] versions shown high ICC values greater than 0.91 for all subscales and total score. Morrow et al. reported that a small sample size has a large standard error and indicates an unacceptable level of measurement error.[21] Regarding to small sample size with previous

studies, Thai version was shown higher than 0.92 (0.815-0.970, 95% CI, n=16),[14] the Spanish version was ranged between 0.7-0.94 (n=35) at admission to rehabilitation and discharge,[13] and Japanese version was higher than 0.79 (n=12) in all subscales and total score.[19] From this, our study was higher than previously reported small sampled study.

In present study, each subscale of internal consistency resulted in over 0.75 Cronbach's alpha and approved accepted limit. Besides the respiration and sphincter management subscales, which had poor internal consistency 0.57 and 0.59 reported by each rater. Result of similar studies on internal consistency, the original study (SCIM III) demonstrated more than 0.70 Cronbach's alpha and other versions were ranged (Cronbach's alpha=0.50-0.65).[9, 11, 14, 19] Thai[14] and Turkish[11] versions ranged between 0.50 to 0.57, and Japanese [19] version was shown 0.63 to 0.65, respectively. It explained that despite the relevance of respiration assessment in patients with SCI, the results show that this item is not clearly related to the sphincter management subscale.[9, 22]

Regarding the validity result, mSCIM and mFIM showed high correlation. The similar result was shown with the previous studies.[10,13,19] The Italian and Spanish versions indicated the validity of FIM at admission to rehabilitation and discharge. The results ranged between 0.81 to 0.98 in Italian version, and 0.81 to 0.94 in Spanish version in each subscale.[10,13] In the present study, validity method was supported by previous study of Japanese version. The Japanese version showed correlation above 0.89 with mFIM in each subscale. In addition, correlation between mSCIM and mFIM subscale's score was reported to be widely different.[19] In the present study, self-care, and mobility (indoors and toilet) scores had observable differences between mFIM and mSCIM, too.

Secondly, the original version (SCIM III) showed high correlation with FIM suggesting that both FIM and SCIM could be appropriate for evaluation of SCI patients.[9] Nevertheless, there were differences in respiration and sphincter management and mobility indoors and

outdoors subscales it illustrated by responsiveness. We could not demonstrate this because validity and responsiveness targets were different in this study. In addition, most of the participants had paraplegia and period was long after injury. They had no problems in mobility in bed, and respiration management and did not use electronic wheelchairs.

Responsiveness was assessed in 10 patients with SCI. The results showed that the mSCIM had more changes in the respiration and sphincter management, and mobility in bed items than FIM. Moreover, most patients in this group had no changes in the function of mobility indoors and outdoors. The previous study, the original version (SCIM III) demonstrated responsiveness in the sphincter and mobility indoors/outdoors. US multi-center study reported that SCIM is more responsive to changes in respiration and sphincter management than FIM.[20] The sphincter and mobility indoor/outdoor areas might be high relative to in everyday tasks in functional areas for SCI patients.[9] The mean days of hospitalisation and rehabilitation were 15.1 and 9.9 days, respectively. Baast et al. reported that the mean day of hospitalisation in urban areas was 8.7 days, [5] whereas this study had a longer hospitalisation period, although the mean day of rehabilitation was 9.9 days, including weekdays. In addition, Mongolians had shorter hospitalisation period than other countries,[23] even in patients with SCI. For this reason, monitoring the significant changes in the function of mobility (indoors and outdoors) was not possible in the present study.

This study has a few limitations. In the translation procedure, there were no differences in content comparison between back translation of mSCIM and original version of SCIM III. Furthermore, reviewed by rehabilitation staffs but back translated mSCIM was not checked by copyright holder. Owing to the spread of COVID-19, data collection was delayed and impacted the sample size. Following the reduction in the number of contact patients, responsiveness was evaluated by one rater in acutely injured patients with SCI. The

evaluators were physical therapists, who further cooperated with other staff, such as nurses and rehabilitation physicians.

5. Conclusions

Good agreement and high inter-rater correlation was shown between raters. Additionally, mSCIM demonstrated its superior sensitivity to changes in function compared with FIM for SCI patients with short period hospitalisation. The findings of the present study supported the validity and reliability of mSCIM and justified the use of mSCIM in the rehabilitation field, which might be easier for rehabilitation staff to use, because it is in their mother language.

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Declaration of Interest Statement

The authors report no conflicts of interest.

References

1. Khan F, Amatya, Amatya B, Avirmed B, et al. World health organization global disability action plan: The Mongolian perspective. J Rehabilitation Med 2018; 50:358-366.
2. World Confederation for Physical Therapy, Mongolian Physical therapy Association 2020. (October 2010) Available from https://world.physio/membership/mongolia
3. Dorjbal D, Prodinger B, Zanini C, et al. Living with spinal cord injury in Mongolia: A qualitative study on perceived environmental barriers. The Journal of Spinal Cord Medicine 2020; 43:518-531.
4. United Nations Economic and social commission for Asia and the pacific. Disability at a Glance 2015: Strengthening employment prospects for persons with disabilities in Asia and the Pacific. Bangkok: ESCAP; 2015.
5. Baast G: Developments in the medical system and international exchange in Mongolia. J Int Univ Health Welf 2018; 23:86-94.
6. Putten JJMF, Hobart JC, Freeman JA, et al. Measuring change in disability after inpatient rehabilitation: comparison of the responsiveness of the Barthel Index and the Functional Independence Measure. J Neurol Neurosurg Psychiatry1999; 66:480-484.
7. Anderson K, Aito S, Atkins M, et al. From the 2006 NIDRR SCI Measures meeting functional recovery measures for spinal cord injury: An Evidence-based review for clinical practice and research. J Spinal Cord Med 2007; 31:133-144.
8. Catz A, Itzkovich M, Agranov E, et al. SCIM- Spinal Cord Independence Measure: a new disability scale for patients with spinal cord lesions. Spinal Cord 1997; 35:850-856.

9. Itzkovich M, Gelernter I, Biering-Sorensen F, et al. The spinal cord independence measure (SCIM) version III: Reliability and validity in a multicenter international study. Disability and Rehabilitation 2007; 29:1926-1933.
10. Invernizzi M, Carda S, Milani P, et al. Development and validation of the Italian version of the spinal cord Independence measure III. Disability and Rehabilitation 2010; 32:1194-1203.
11. Unalan H, Misirlioglu TO, Erhan B, et al. Validity and reliability study of the Turkish version of spinal cord independence measure-III. Spinal Cord 2015; 53:455-460.
12. Riberto M, Tavares DA, Rimoli JRJ, et al. Validation of the Brazilian version of the Spinal Cord Independence Measure III. Arq Neuropsiquiatr 2014; 72:439-444.
13. Zarco-Perinan MJ, Barrera-Chacon MJ, Carcia-Obrero I, et al. Development of the Spanish version of the spinal cord independence measure version III: cross-cultural adaptation and reliability and validity study. Disability and Rehabilitation 2014; 36:1644-1651.
14. Wannapakhe J, Saensook W, Keawjoho C, et al. Reliability and discriminative ability of the spinal cord independence measure III (Thai version). Spinal Cord 2016; 54:213-220.
15. Toikawa H, Kurokawa M, Ideta R, et al. New ADL scale for individuals with spinal cord injury- Spinal Cord Independence Measure-. Journal of Clinical Rehabilitation 2006; 15:952-957.
16. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measure: Literature review and proposed guidelines. J Clin Epidemiol 1993; 46:1417-1432.
17. McHugh ML. Inter-rater reliability: the kappa statistic. The journal of Croatian society of medical biochemistry and laboratory medicine 2012; 22(3):276-282.

18. Taherdoost H. Validity and Reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. International Journal of Academic Research in Management 2016; 5:28-36.
19. Kurokawa M, Toikawa H, Suzuki K, et al. Reliability and Validity of the Spinal Cord Independence Measure. Jpn J Rehabil Med 2007; 44:230-236.
20. Anderson KD, Acuff ME, Arp BG, et al. United states (US) multi-center study to assess the validity and reliability of the spinal cord independence measure (SCIM III). Spinal Cord 2011; 49:880-885.
21. Morrow JR, Jackson AW. How significant is your reliability? Research quarterly for exercise and sport 1993; 64:352-355.
22. Glass CQ, Tesio L, Itzkovich M, et al. Spinal Cord Independence measure version III: applicability to the UK spinal cord injured population. J Rehabil Med 2009; 41:723-728.
23. Burns AS, Santos Argelio, et al. Understanding length of stay after spinal cord injury: Insights and limitations from the access to care and timing project. J Neurotrauma 2017; 34:2910-2916.

НУГАСНЫ ГЭМТЛИЙН ДАРААХ БИЕ ДААХ ЧАДВАРЫН ҮНЭЛГЭЭНИЙ МОНГОЛ ХУВИЛБАР

Тасаг:		Эмч:
Үйлчлүүлэгчийн нэр:	**Дугаар:**	**Үнэлгээ хийсэн:**
Үндсэн оношт:	**Хагалгааны оношт:**	
Эмнэлэгт хэвтсэн өдөр		**Эмчилгээ эхэлсэн өдөр**
Оршин суугаа хаяг		

Үйл ажиллагаа тус бүрийн оноог зэргэлдээх дөрвөлжинд тэмдэглэнэ үү. Маягтыг 6 хүртэлх удаагийн үнэлгээнд ашиглах боломжтой.

Өөрийгөө арчлах

1. Хооллох (хэрчих, сав онгойлгох, аягалах, хоолоо амандаа хийх, шингэн зүйлтэй аяга барих)

0. Судсаар, ходоодны зондоор хооллох эсвэл амаар хооллоход бүрэн дэмжлэг шаардлагатай
1. Хоол идэх эсвэл уух эсвэл туслах хэрэгсэлээ өмсөхөд хэсэгчилсэн дэмжлэг шаардлагатай
2. Бие дааж хооллох чадвартай; туслах хэрэгсэл шаардлагатай эсвэл зөвхөн хоолоо хэрчих/аягалах/сав онгойлгоход дэмжлэг шаардлагатай
3. Бие дааж ууж, хоолох чадвартай; туслах хэрэгсэл болон хүний дэмжлэггүй шаардлагагүй

2.Усанд орох (савандах, угаах, толгой биеэ арчих, крант нээх, хаах). **А-биений дээд хэсэг; В-биений доод хэсэг**

А. 0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаардлагатай
2. Туслах хэрэгсэл эсвэл тусгай орчинд (сандал, бариул гэх мэт) бие даан усанд ордог
3. Бие даан усанд ордог; туслах хэрэгсэл болон тусгай орчин шаардлагагүй

В. 0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаардлагатай
2. Туслах хэрэгсэл эсвэл тусгай орчинд (сандал, бариул гэх мэт) бие даан усанд ордог
3. Бие даан усанд ордог; туслах хэрэгсэл болон тусгай орчин шаардлагагүй

3. Хувцаслах (хувцас, гутал, байгын ортез: өмсөх, зүүх, тайлах). **А-биений дээд хэсэг; В-биений доод хэсэг**

А. 0. Бусдаас бүрэн хамааралтай
1. **Т**овчгүй, **ц**ахилгаангүй, **у**дээсгүй(тцү-гүй) **х**увцас өмсөж тайлахад хэсэгчилсэн дэмжлэг шаардлагатай
2. Бие даан тцү-гүй хувцас өмсөж тайлахад **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**) шаардлагатай
3. Бие даан тцү-гүй хувцас өмсдөг; **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**)шаардлагагүй, тцү-нд туслах хэрэгсэл шаардлагатай
4. Бие даан хувцасладаг(ямар ч хувцас); **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**) шаардлагагүй

В. 0. Бусдаас бүрэн хамааралтай
1. **Т**овчгүй, **ц**ахилгаангүй, **у**дээсгүй (тцү-гүй) **х**увцас өмсөж тайлахад хэсэгчилсэн дэмжлэг шаардлагатай
2. Бие даан тцү-гүй хувцас өмсөж тайлахад **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**) шаардлагатай
3. Бие даан тцү-гүй хувцас өмсдөг; **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**)шаардлагагүй, тцү-нд туслах хэрэгсэл шаардлагатай
4. Бие даан хувцасладаг(ямар ч хувцас); **т**услах **х**эрэгсэл болон **т**усгай **о**рчин (**тхто**) шаардлагагүй

4. Ариун цэвэр (гар нүүрээ угаах, шүд угаах, үс самнах, сахал хусах, нүүрээ будах)

0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаардлагатай
2. Туслах хэрэгсэл ашиглан бие даан ариун цэврээ сахидаг
3. Туслах хэрэгсэлгүйгээр бие даан ариун цэврээ сахидаг

ХЭСГИЙН ОНОО (0-20)

Амьсгал, давсаг, гэдэсний менежмент

5. Амьсгал

0. Цагаан мөгөөрсөн хоолойд гуурс тавих болон байнгын эсвэл богино хугацааны дэмжих агааржуулалт шаардлагатай
2. Цагаан мөгөөрсөн хоолойн гуурстай бие даан амьсгалдаг; хүчилтөрөгч, ханиалгах болон байрлуулсан гуурсыг зохицуулах үед ихээхэн дэмжлэг шаардлагатай
4. Цагаан мөгөөрсөн хоолойн гуурстай бие даан амьсгалдаг; ханиалгах болон байрлуулсан гуурсыг зохицуулах үед бага зэрэг дэмжлэг шаардлагатай
6. Цагаан мөгөөрсөн хоолойн гуурсгүй бие даан амьсгалдаг; хүчилтөрөгч, ханиалгахад ихээхэн дэмжлэг шаардлагатай, богино хугацааны дэмжих агааржуулалт эсвэл маск шаардлагатай
8. Цагаан мөгөөрсөн хоолойн гуурсгүй бие даан амьсгалдаг; ханиалгахад бага зэргийн дэмжлэг болон сэдээлт шаардлагатай
10. Бусдын дэмжлэг эсвэл төхөөрөмжгүйгээр бие даан амьсгалдаг

6. Давсагны менежмент

0. Катетертай
3. Үлдэгдэл шээсний эзэлхүүн (ҮШЭ) >100мл; эсвэл байнгын катетер гуурсгүй эсвэл бусдын тусламжтай богино хугацааны катетер хэрэглэдэг
6. Үлдэгдэл шээсний эзэлхүүн(ҮШЭ) <100мл; эсвэл бие даан богино хугацааны катетер хэрэглэдэг; урсгуур хэрэгсэл байрлуулахад бусдын тусламж шаардлагатай
9. Бие даан богино хугацааны катетер хэрэглэдэг; гадуур урсгуур хэрэгсэл хэрэглэдэг; урсгуур байрлуулахад тусламж шаардлагагүй
11. Бие даан богино хугацааны катетер хэрэглэдэг; катетер хооронд тогтвортой; гадуур урсгуур хэрэгсэл хэрэглэдэггүй
13. ҮШЭ <100мл; зөвхөн шээсний гадуур урсгуур хэрэглэдэг; урсгуур байрлуулахад тусламж шаардлагагүй
15. ҮШЭ <100мл; тогтвортой; гадуур урсгуур хэрэгсэл хэрэглэдэггүй

7. Гэдэсний менежмент

0. Хүндээр бие засах нь хугацааны хувьд тогтвортой бус эсвэл маш цөөн давтамжтай (3 хоногт нэгээс цөөн)
5. Хугацааны хувьд тогтвортой хэдий ч тусламж шаардлагатай (лаа байрлуулах,г.м); санамсаргүй хүндрэх (сард 2-с цөөн удаа)
8. Хугацааны хувьд тогтвортой, тусламж шаардлагагүй; санамсаргүй хүндрэх (сард 2-с цөөн удаа)
10. Хугацааны хувьд тогтвортой, тусламж шаардлагагүй; санамсаргүй хүндрэх тохиолдол байхгүй

8. Бие засах өрөө ашиглах (анус, бэлэг эрхтэн орчмын ариун цэвэр, өмнөх/дараах үед хувцасаа янзлах, ариун цэврийн цаас, хэрэглэл, живх хэрэглэх)

0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаарддаг; анус, бэлэг эрхтэн орчмоо өөрөө цэвэрлэж чадахгүй
2. Хэсэгчилсэн дэмжлэг шаарддаг; бэлэг эрхтэн орчмоо бие даан өөрөө цэвэрлэдэг
4. Хүнд болон хөнгөнөөр бие засч чадна, тусгай орчинд эсвэл туслах хэрэгсэл ашиглана
5. Ямар ч нөхцөлд туслах хэрэгсэл ашиглахгүйгээр бие засч чадна

ХЭСГИЙН ОНОО (0-40)

Хөдлөх чадвар (өрөө болон бие засах өрөө)

9. Орон дээр хөдлөх болон арьсны цоорлоос сэргийлэх үйлдэл

0. Бүх үйл ажиллагаанд тусламж хэрэгтэй: биеийн дээд хэсгийг орон дээр эргүүлэх, биеийн доод хэсгийг орон дээр эргүүлэх,орондоо босож суух, тэргэнцэр дээр бие тулхэх болон , туслах багажтай эсвэл багажгүй, гэхдээ туслах багаж нь цахилгаан (автомат) биш байх
2. 1 үйл ажиллагааг бусдын тусламжгүйгээр гүйцэтгэдэг
4. 2-3 үйл ажиллагааг бусдын тусламжгүйгээр гүйцэтгэдэг
6. Биеийн дарагдлыг чөлөөлөх болон орон дээр гүйцэтгэх бүх үйл ажиллагааг бие даан гүйцэтгэдэг

10. Шилжих: орноос-тэргэнцэр (тэргэнцрээ түгжих, хөлийн тавиурыг өргөх, гарын тавиурыг салгах болон өөрт тааруулах, шилжих, хөлөө өргөх)

0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаардлагатай эсвэл зааварчилгаа, туслах хэрэгсэл (гулсах хавтан г.м.,)
2. Бие даан гүйцэтгэдэг (эсвэл тэргэнцэр хэрэглэдэггүй)

11. Шилжих: тэргэнцрээс-суултуур (хэрэв тэргэнцэртэй суултуур хэрэглэдэг бол: шилжин/буцаж суух; хэрэв энгийн тэргэнцэр хэрэглэдэг бол: тэргэнцрээ түгжих, хөлийн тавиурыг өргөх, гарын тавиурыг салгах болон өөрт тааруулах, шилжин суух, хөлөө өргөх)

0. Бусдаас бүрэн хамааралтай
1. Хэсэгчилсэн дэмжлэг шаардлагатай эсвэл зааварчилгаа, туслах хэрэгсэл хэрэгтэй (бариул г.м.,)
2. Бие даан гүйцэтгэдэг (эсвэл тэргэнцэр хэрэглэдэггүй)

Алхах чадвар (байшин дотор, гадна орчин, тэгш гадаргууд алхах)

12. Байшин дотор алхах

0. Бусдаас бүрэн хамааралтай
1. Цахилгаан тэргэнцэр эсвэл гар ажиллагаатай тэргэнцрийг удирдахад хэсэгчилсэн дэмжлэг шаардлагатай
2. Гар ажиллагаатай тэргэнцэр ашиглан бие даан хөдөлгөөн хийдэг
3. Алхах үед зааварчилгаа шаардлагатай (туслах хэрэгсэлтэй болон хэрэгсэлгүй)
4. Алхуулагч эсвэл суга таягтай (савлах) алхаа
5. Суга таягтай эсвэл 2 гар таягтай алхдаг (тэгш хэмт алхаа)
6. Нэг гар таягтай алхдаг
7. Зөвхөн хөлний ортез шаардлагатай
8. Алхааны туслах хэрэгсэлгүй алхдаг

13. Дунд зэргийн зайнд алхах (10-100 метр)

0. Бусдаас бүрэн хамааралтай
1. Цахилгаан тэргэнцэр эсвэл гар ажиллагаатай тэргэнцрийг удирдахад хэсэгчилсэн дэмжлэг шаардлагатай
2. Гар ажиллагаатай тэргэнцэр ашиглан бие даан хөдөлгөөн хийдэг
3. Алхах үед зааварчилгаа шаардлагатай (туслах хэрэгсэлтэй болон хэрэгсэлгүй)
4. Алхуулагч эсвэл суга таягтай (савлах) алхдаг
5. Суга таягтай эсвэл 2 гар таягтай алхах (тэгш хэмт алхаа)
6. Нэг гар таягтай алхдаг
7. Зөвхөн хөлний ортез шаардлагатай
8. Алхааны туслах хэрэгсэлгүй алхдаг

14. Гадна орчинд алхах (100 метрээс дээш зайд)

0. Бусдаас бүрэн хамааралтай
1. Цахилгаан тэргэнцэр эсвэл гар ажиллагаатай тэргэнцрийг удирдахад хэсэгчилсэн дэмжлэг шаардлагатай
2. Гар ажиллагаатай тэргэнцэр ашиглан бие даан хөдөлгөөн хийдэг
3. Алхах үед зааварчилгаа шаардлагатай (туслах хэрэгсэлтэй болон хэрэгсэлгүй)
4. Алхуулагч эсвэл суга таягтай (савлах) алхдаг
5. Суга таягтай эсвэл 2 гар таягтай алхдаг (тэгш хэмт алхаа)
6. Нэг гар таягтай алхдаг
7. Зөвхөн хөлний ортез шаардлагатай
8. Алхааны туслах хэрэгсэлгүй алхдаг

15. Шатаар өгсөх, уруудах

0. Шатаар өгсөж эсвэл уруудаж чадахгүй
1. Бусдын туслалцаа эсвэл зааварчилгаагаар хамгийн багадаа 3 шат өгсөж, уруудаг
2. Шатны бариул, суга таяг, гар таягны тусламжтай хамгийн багадаа 3 шат өгсөж, уруудаг
3. Бусдын туслалцаа, зааварчилгаагүйгээр хамгийн багадаа 3 шат өгсөж, уруудаг

16. Шилжих: тэргэнцрээс-машин (машин руу явах, тэргэнцрэ түгжих, гарын болон хөлийн тавиурыг авах, машинд суух болон буух, тэргэнцрээ машинд хийх, гаргах)

1. Хэсэгчилсэн дэмжлэг эсвэл бусдын зааварчилгаа эсвэл туслах хэрэгсэл шаардлагатай
2. Бие даан шилждэг, туслах хэрэгсэл (эсвэл тэргэнцэр шаардлагагүй)

17. Шилжих: газраас-тэргэнцэр

0. Тусламж шаардлагатай
1. Бие даан шилждэг; туслах хэрэгсэл (эсвэл тэргэнцэр шаардлагагүй)

ХЭСГИЙН ОНОО (0-40)

НИЙТ ОНОО (0-100)

Table 1. Participants' characteristics

Items		All subjects	
		Group A	Group B
Number		30	10
Age (years)		38.2±8.2	35.4 ±13.1
Gender (n, %)	Male	18 (60.0)	9 (90.0)
	Female	12 (40.0)	1 (10.0)
Cause of injury (n, %)	Traumatic	23 (76.7)	10 (100.0)
	Non-traumatic	7 (23.3)	-
Level of injury (n, %)	Paraplegia	22 (73.3)	5 (50.0)
	Tetraplegia	8 (26.7)	5 (50.0)

Group A: Reliability and validity were assessed; Group B: Responsiveness was assessed; n: number

Table 2. Total agreement and kappa coefficient between raters, n=30

Items	Total agreement (%)	Kappa values
Self -care		
Feeding	93	0.83
Bathing upper body	87	0.77
Bathing lower body	83	0.70
Dressing upper body	87	0.80
Dressing lower body	83	0.74
Grooming	90	0.80
Respiration and Sphincter management		
Respiration	100	-
Bladder management	90	0.85
Bowel management	90	0.86
Use of toilet	83	0.78
Mobility (room and toilet)		
Mobility in bed	93	0.86
Transfer from bed to wheelchair	93	0.89
Transfer from wheelchair to toilet	97	0.95
Mobility (indoors and outdoors)		
Mobility indoors	100	1.00
Mobility moderate distance	100	1.00
Mobility outdoors	100	1.00
Stair management	100	1.00
Transfer from wheelchair to car	87	0.80

Transfer from ground to wheelchair	93	0.86

Table 3. Intraclass correlation coefficient within mSCIM subscales and total scores, n=30

mSCIM subscales	ICC	95% CI
Self-care	0.993	0.984–0.996
Respiration and sphincter management	0.996	0.991–0.998
Mobility (room and toilet)	0.991	0.981–0.996
Mobility (indoors and outdoors)	0.999	0.999–1.000
Total	0.998	0.997–0.999

mSCIM: Mongolian version of the spinal cord independence measure; ICC: intra-class correlation coefficient; CI: confidence interval

Table 4. Internal consistency (Cronbach's α coefficient) within subscales, n=30

mSCIM subscales	Rater 1	Rater 2
Self-care	0.92	0.91
Respiration and sphincter management	0.57	0.59
Mobility (room and toilet)	0.75	0.78
Mobility (indoors and outdoors)	0.91	0.91
Total	0.75	0.76

Table 5. mSCIM and mFIM scores and the validity of mSCIM and mFIM subscales by Spearman correlation by each rater, n=30

Subscales	mSCIM score	mFIM score	Spearman	P value
Self-care 1	13.87±5.78	31.17±10.64	0.94	p<0.01
Self-care 2	13.97±5.77	32.00±10.75	0.84	p<0.01
Respiration and sphincter management 1	26.00±10.57	7.40±4.26	0.91	p<0.01
Respiration and sphincter management 2	25.57±10.53	6.77±4.17	0.86	p<0.01
Mobility (room and toilet) 1	7.20±3.54	13.13±6.89	0.87	p<0.01
Mobility (room and toilet) 2	7.30±3.47	13.37±6.85	0.91	p<0.01
Mobility (indoors and outdoors) 1	6.27±7.75	3.77±2.60	0.86	p<0.01
Mobility (indoors and outdoors) 2	6.20±7.76	3.80±2.91	0.84	p<0.01
Total score1	53.33±22.34	55.47±21.40	0.94	p<0.01
Total score 2	53.03±22.42	55.93±21.65	0.95	p<0.01

Mean±SD; mFIM: motor parts of the functional independence measure

1: first rater; 2: second rater

Table 6. Sensitivity to functional changes between admission and discharge, of mFIM and mSCIM within subsclaes n=10

		Changes identified by mSCIM		
	Changes identified by mFIM	No	Yes	Total
Self-care	No	6	0	6
	Yes	0	4	4
	Total	6	4	10
McNemar's test	P=1.00			
Respiration and sphincter management	No	6	4	10
	Yes	0	0	0
	Total	6	4	10
McNemar's test	P=0.13			
Mobility (room and toilet)	No	7	1	8
	Yes	0	2	2
	Total	7	3	10
McNemar's test	P=1.00			