A RETROSPECTIVE STUDY ON THE LEVEL OF INDEPENDENCE IN BLADDER AND BOWEL SPHINCTER CONTROL BETWEEN COMPLETE VERSUS INCOMPLETE SPINAL CORD INJURY PATIENTS DISCHARGED IN A PUBLIC ORTHOPEDIC SPECIALTY HOSPITAL FROM JANUARY 2019 TO JANUARY 2020

Airene G. Biaco-Nacion, MD[1],
Wilanie Romero-Dacanay, MD, FPARM[2],
Gilmore C. Senolos, MD, FPARM[2]

ABSTRACT

INTRODUCTION

Functional outcomes of spinal cord injury (SCI) patients showed that they remain dependent in terms of bowel and bladder management. The Spinal Cord Independence Measure (SCIM) was developed in response to the need to quantify the improvement of SCI patients. It includes all injuries and classifications including the sphincter subscales as it relates to sphincter control, hence, improving standards of care and quality of life.

OBJECTIVES

The primary objective is to compare the bladder and bowel independence between complete and incomplete SCI patients discharged in a public orthopedic specialty hospital from January 2019 to January 2020.

RESULTS

A total of 108 patients were included in the study. For bladder function, during admission, those with complete injuries had increased risk for assisted bladder function (OR=9.47, 95%CI=1.21 – 74.31, p=0.01), and upon discharge, those with complete injuries still had increased risk for assisted bladder function (OR=2.84, 95%CI=1.12 – 7.20, p=0.02). For bowel function, those with higher ASIA scores had less risk for assisted bowel function (OR=0.4, 95%CI=0.3-0.7, p=0.002), and upon discharge, those with complete injuries had increased risk for assisted bowel function (OR=3.66, 95%CI=1.26-10.61, p=0.013). The study also showed that spinal surgery has no significant correlation with bladder and bowel independence.

CONCLUSION

Patients with complete injury have increased risk of having assisted bladder and bowel function. Factors that contribute to bladder and bowel independence include patient's age, whether they have complete or incomplete injury, and their ASIA scores. Spinal surgery has no significant correlation with bladder and bowel independence in patients with SCI.

KEYWORDS

spinal cord injury, neurogenic bladder, neurogenic bowel, spinal cord independence measure

[1]**Principal Investigator**, Department of Rehabilitation Medicine, Philippine Orthopedic Center, Quezon City, Philippines
[2]Research Adviser, Department of Rehabilitation Medicine, Philippine Orthopedic Center, Quezon City, Philippines

INTRODUCTION

Spinal Cord Injury (SCI) causes disability, and patients with SCI face several complications, including bowel and bladder dysfunction, from the onset until reintegration into the community. Independence in bowel and bladder habits is tantamount to improving their quality of life, leading to fewer complications that warrant readmission. In response to the need to quantify the improvement of SCI patients, the Spinal Cord Independence Measure (SCIM) was developed (Appendix A). It focuses on their ability to perform everyday tasks and takes into consideration the comfort, medical condition, and economic burden of the disability. It is subdivided into three subscales: 'Self-care,' 'Respiration and sphincter management,' and 'Mobility.' The SCIM may encompass all kinds of injury and all SCI classifications and is more responsive than the Functional Independence Measure (FIM) especially in the sphincter subscales, since it attributes the everyday tasks relating to sphincter control[1]. Existing studies focusing on bladder outcomes also support using SCIM as an ideal tool for evaluating independence outcomes[2]. Likewise, there is a need to include bowel and bladder outcomes in patients who underwent surgery. Studies on SCI patients who underwent surgery, whether early or late, did not present any functional difference in neurologic and independence outcomes compared to those who did not undergo surgery[3]. However, there is little data on the relationship between surgery and bowel and bladder outcomes.

Despite studies supporting neurologic recovery in SCI patients regarding bladder and bowel management, not all patients achieve optimum independence.

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Earlier studies on their functional outcomes reported that they remain dependent on their bowel and bladder management[4]. Most acute SCI patients also present with at least one complication, regardless of their ASIA score, with varying severity[5]. They present with neurologic lower urinary tract dysfunction (NLUTD) and bowel dysfunction. NLUTD is due to the interruption of the neural connections between the pons and the sacral innervation responsible for bladder control[6]. At the same time, neurogenic bowel is defined as a colonic dysfunction resulting from a lack of central nervous control[7]. These eventually lead to genitourinary complications, commonly reported cause of rehospitalization[8], and problems in bowel management due to impaired colorectal motility, transit times, and emptying at defecation[9]. In terms of long-term bladder management, one factor considered would be the completeness of injury, wherein patients with intact perianal pinprick sensation (PPS) and bulbocavernosus reflex (BCR) on initial assessment may achieve the return of detrusor activity[2]. However, this is still inconsistent in predicting detrusor overactivity or detrusor sphincter dyssynergia[2]. As for bowel management, patients with upper motor neuron bowel (UMNB) are less problematic to manage than those with lower motor neuron bowel (LMNB)[10]. Also, bowel management in SCI patients varies depending on the level involved.

These outcomes preclude the likelihood of full bowel, bladder, and toileting independence in patients with complete SCI, hence, it may be inferred that patients with incomplete SCI are more likely to achieve independence in their bowel and bladder function than those with complete SCI. Despite the supporting studies for bladder and bowel independence in SCI patients, there are no local studies, and limitations include the absence of a national registry or database. A national registry with uniform methods and standardized procedures may be established and will be helpful in evaluating bowel and bladder outcomes[11], which in turn, may help develop standards of care to improve bladder and bowel management and prevent adverse outcomes and complications. In the Philippines, there is no established national database for SCI patients, and if there exists, is limited to institutions that cater to SCI patients who are capable of acute and chronic care.

This study compared the bladder and bowel independence between complete and incomplete SCI patients discharged in a public orthopedic specialty hospital from January 2019 to January 2020. We compared the bladder and bowel independence levels between complete and incomplete SCI patients from admission, rehabilitation, and discharge. The factors associated with bladder and bowel independence among SCI patients were also determined.

MATERIALS AND METHODS

STUDY DESIGN

This is a cross-sectional retrospective study which included SCI inpatient discharges in an orthopedic specialty hospital from January 2019 to January 2020. The data for functional assessment were retrospectively collected, and each patient had their SCIM scores tallied and compared during their stay from their date of admission, date of rehabilitation admission (defined as initiation of mobilization with a spinal orthosis and transfer to the Rehabilitation Ward) and date of discharge. Appendix B shows the institution-based SCIM used for this study.

The patients were subdivided into those with complete SCI and those with incomplete SCI, and the scores from the 'Respiration and sphincter management' subset were considered (Figure 1).

VARIABLES

Independent variables include the ASIA classification of patients upon admission, whether complete (defined as no sensory and/or motor function at the sacral segments) or incomplete (defined to have some preservation of sacral motor and/or sensory function)[12].

Dependent variables include the scores in the 'Respiration and sphincter management' subset of SCIM of the patients in the study, specifically the Sphincter Management-Bladder (Item 6) and Sphincter Management-Bowel (Item 7) sections.

Confounding variables include the following:

1. Presence of complications that limit the use of clean intermittent catheterization (CIC). These include the presence of an advanced sacral pressure sore, genito-urinary complications like urinary tract infection, urethral strictures, cystolithiases or renal problems, those with small bladder capacity; and

2. Patients who underwent hemicolectomy and on colostomy.

Background variables include the demographics namely age, sex, type of injury, ASIA scores upon admission, rehabilitation, and discharge, and whether they underwent spine surgery.

SELECTION AND DESCRIPTION OF PARTICIPANTS

Included in the study are newly admitted patients discharged from Philippine Orthopedic Center from January 2019 to January 2020.

Excluded in the study are readmitted SCI patients discharged from Philippine Orthopedic Center from January 2019 to January 2020.

Approximately 145 patients discharged during the set time frame (from January 2019 to January 2020) were included for screening. All patients identified by the inclusion criteria were part of the study.

The research entailed chart reviews in coordination with the Records Section of the Philippine Orthopedic Center. In each chart reviewed, an SCIM questionnaire was accomplished which was based on the attending Physiatrist's subjective notes on the patient's mobilization status. The patient's improvement on bladder and bowel management were measured using the 'Respiration and Sphincter Management' subset of the SCIM, which were accomplished by the attending Physiatrist upon admission, upon rehabilitation admission and upon discharge. Patient confidentiality was observed during chart review.

TECHNICAL INFORMATION

All patients were subjected to the current standard of care practiced by the institution for bladder management. This includes either insertion of an indwelling foley catheter for acute patients presenting with bladder distension and those who had grade 3 to 4 sacral pressure sores, those with known genitourinary complications during their hospital stay or those initiated with intravenous fluid therapy; or clean intermittent catheterization (CIC) for those without genitourinary complications and/ or sacral pressure sore. All patients on indwelling foley catheter are shifted to CIC once the patient and the relative are taught of the aseptic and proper techniques. CIC is initially done every 4 hours, and the volume of fluid intake, residual urine volume, free void and forced void are measured. Free void is defined as the volume of urine that the patient voluntarily voided, taking into consideration that the patient can recognize the urge to urinate, forced void is defined as the volume of urine voided after Valsalva or Crede's maneuvers for stimulation, and residual urine volume (RUV) is defined as the volume of urine voided after clean catheterization. CIC is being taught by bladder nurses assigned on each ward to the patient and relatives, in preparation for home setting.
As for bowel management, bowel protocols depend on whether the patient has an upper motor neuron bowel (UMNB) or a lower motor neuron bowel (LMNB). Generally, our SCI patients undergo a bowel habituation program during their hospital stay and referred to nutrition service for a high fiber diet. For those with UMNB, the bowel program includes the use of digital rectal stimulation and use of rectal stimulants or suppositories, while for those with LMNB, it includes bowel disimpaction, manual evacuation or use of cleansing enemas.

Statistical Methods

a. Sample Size

Openepi online was used to compute for the minimum sample size needed for this study. Based on an expected census of 145 patients, 95% confidence interval, and 5% margin of error, at least 106 samples are needed. This number is also sufficient to detect a risk ratio of at least 3.5 for the association between spine surgery and bladder/bowel independence outcomes with 95% confidence interval and 80% power.

b. Data Analysis

Analysis of data entailed the parameters for the inclusion and exclusion criteria. Those that meet the inclusion criteria were included and subdivided into those with complete and incomplete SCI, then whether they underwent spine surgery or not.

The statistical analysis used in this study is patterned from the study by Scivoletto, et. al. in 2018. As presented at the 'Respiration and Sphincter Management' subset of the SCIM, bladder independence outcomes (item 6 of SCIM III) were categorized depending on the patient's need for assistance. The scores on this subset were dichotomized: scales which warrant assistance (scores 0, 3 and 6) were scored with 0 and scales which do not need assistance (scores 9, 11, 13 and 15) were scored with 1. As for bowel independence outcomes (item 7 of SCIM III), the scores were also categorized depending on the patient's need for assistance. The scores on this subset were also dichotomized: scales which warrant assistance (scores 0 and 5) were scored with 0, and scales which do not need assistance (scores 8 and 10) were scored with 1[6].

The association between the kind of injury (complete vs. incomplete) and bowel and bladder independence outcomes were measured using Odds Ratio and its significance was assessed using Chi-square test. The effect of spine surgery to the bladder and bowel independence measures were also analyzed using Odds Ratio and Chi-square test to determine if undergoing spine surgery will improve the bladder and bowel independence outcomes of the sample population. The demographics of the included patients in the study (background variables) were reported as percentage for categorical variables and mean with standard deviation for continuous variables. Multivariate analysis was performed using logistic regression analysis.

F. Institutional Review Board Approval

Approval for this study was granted after the presentation of proposal with the Technical Review Board of the Philippine Orthopedic Center Department of Rehabilitation Medicine and Ethical Review Board of the Philippine Orthopedic Center (Appendix C).

RESULTS

PATIENT DEMOGRAPHICS

A total of 108 patients were included in the study. The summary of the demographics is presented in Table 1. The mean age was 38.6 ± 18.8 years old and majority were males (65.7%). More than half (61.1%) of the patients had T1-T12 level of injury. During acute admission, most patients presented with incomplete injury (73.1%) followed by complete injury (25.9%) and those with spinal shock (5.6%).

Upon admission, the severity of deficit was mostly under AIS-B (32.4%), upon rehabilitation mostly under AIS-B (26.9%), and upon discharge mostly under AIS-D (32.4%). Upon admission, majority had SCIM scores of 0-20 (41.5%), on rehabilitation, majority had SCIM scores of 21-40 (43.4%) and on discharge, majority had SCIM scores of 41-60 (33.0%). Only 20.4% of patients underwent spinal surgery.

BLADDER FUNCTION

Upon admission, 80.2% had assisted bladder function. During this period, ASIA classification was significantly associated with bladder function wherein those with complete injury had an increased risk for assisted bladder function (OR=9.47, 95%CI=1.21 – 74.31, p=0.01). Also, age was significantly associated with assisted bladder function. For every increase in age, there is a 1.04x increase in the risk for assisted bladder function (OR = 1.04; 95% CI: 1.00 – 1.07; p=0.02). On the other hand, higher ASIA scores were found to be associated with less risk for assisted bladder function (p<0.001). The following variables were not found to be significantly associated with assisted bladder function during admission: Sex (p=0.24), level of injury (p>0.05), and spine surgery (p=0.48) (Table 2).

After multivariate analysis using logistic regression, age, complete ASIA classification, and ASIA scores were found to be significantly associated with assisted bladder function upon admission. For every increase in age, there is a 1.04x increase in the risk for assisted bladder function (OR = 1.04; 95% CI: 1.00 – 1.07; p=0.03). The risk of patients with complete ASIA classification for assisted bladder function was 47x higher than those with incomplete ASIA classification (OR=47.07; 95% CI=4.38 – 506.02;p=0.001). Furthermore, ASIA scores were significantly associated with assisted bladder function (p=0.001). The risk of patients with AIS-A, AIS-B, and AIS-C for assisted bladder function were 47x (OR = 47.07; 95% CI: 4.38 – 506.02; p=0.001), 13x (OR = 13.10; 95% CI: 2.69 – 63.90; p=0.001), and 22x (OR = 22.48; 95% CI: 3.18 – 159.09; p=0.002), higher respectively than patients with AIS-D. Sex, level of injury, and spinal surgery were not significantly associated with assisted bladder function (p>0.05) (Table 2.1).

On discharge, 53.7% had assisted bladder function. During this period, ASIA classification was significantly associated with bladder function wherein those with complete injury had an increased risk for assisted bladder function (OR=2.84, 95%CI=1.12 – 7.20, p=0.02). On the other hand, higher ASIA scores were found to be associated with less risk for assisted bladder function (p<0.05). Older age was associated with higher risk for assisted bladder function (OR=1.04, 95%CI=1.01-1.06, p=0.002). The following variables were not found to be significantly associated with bladder function during discharge: sex (p=0.39), level of injury (p>0.05), and spine surgery (p=0.70) (Table 3).

After multivariate analysis using logistic regression, only age and ASIA scores were found to be significantly associated with assisted bladder function upon discharge. For every increase in age, there is a 1.04x increase in the risk for assisted bladder function (OR = 1.04; 95% CI: 1.01 – 1.07; p=0.007). Also, ASIA scores were significantly associated with assisted bladder function (p=0.002). The risk of patients with AIS-A, AIS-B, and AIS-C for assisted bladder function were 9x (OR = 9.02; 95% CI: 1.08 – 75,62; p=0.040), almost 11x (OR = 10.58; 95% CI: 3.06 – 51.58; p<0.001), and almost 6x (OR = 5.75; 95% CI: 1.53 – 21.66; p=0.010) higher respectively than patients with AIS-D and AIS-E. Sex, level of injury, ASIA classification and spinal surgery were not significantly associated with assisted bladder function (p>0.05) (Table 3.1).

BOWEL FUNCTION

Upon admission, 91.5% had assisted bowel function. During this period, higher ASIA scores was found to be associated with less risk for assisted bowel function. The following variables were not found to be significantly associated with bowel function during admission: age (p=0.488), ASIA classification (p=0.363), sex (p=0.918), level of injury (p>0.05), and spine surgery (p=0.50) (Table 4).

After multivariate analysis using logistic regression, only the ASIA score specifically AIS-B was found to be significantly associated with assisted bowel function upon admission. The risk of patients with AIS-B for assisted bowel function was almost 12x (OR = 11.76; 95% CI: 1.08 – 128.28; p=0.040) higher than patients

with AIS-D. Age, sex, level of injury, ASIA classification and spinal surgery were not significantly associated with assisted bladder function (p>0.05) (Table 4.1).

On discharge, 62.0% had assisted bowel function. During this period, those with complete injury had an increased risk for dependent bowel function (OR=3.66, 95%CI=1.26-10.61, p=0.013). On the other hand, higher ASIA scores were found to be associated with less risk for assisted bowel function (p<0.05). Older age was associated with higher risk for dependent bowel function (OR=1.02, 95%CI=1.01-1.05, p=0.021). The following variables were not found to be significantly associated with bowel function during discharge: sex (p=0.219), level of injury (p>0.05), and spine surgery (p=0.750) (Table 5).

After multivariate analysis using logistic regression, ASIA score was found to be significantly associated with assisted bowel function upon discharge. The risk of patients classified as AIS-B for assisted bowel function was almost 12x (OR = 11.66; 95% CI: 2.56 – 51.20; p=0.001) higher than patients with AIS-D. Similarly, the risk of patients with AIS-C for assisted bowel function was almost 7x (OR = 6.83; 95% CI: 1.70 – 27.39; p=0.007) higher than patients with AIS-D. Moreover, age and sex were also significantly associated with assisted bowel function. The risk for assisted bowel function upon discharge increases with every increase in age (OR = 1.05; 95% CI: 1.01 – 1.08; p = 0.004). A protective effect was noted for females than males as shown by the OR of <1 (OR = 0.29; 95% CI:, 0.09 – 0.91; p=0.034). Level of injury, ASIA classification and spinal surgery were not significantly associated with assisted bladder function (p>0.05) (Table 5.1).

DISCUSSION

The existing standard of care supports the predictive bladder outcomes observed in SCI patients, and the admitting ASIA classification (whether complete or incomplete) serves a potential basis for initial bladder management.

Upon admission, majority of the patients whether they have complete or incomplete injuries, have assisted bladder function, mainly by initiation of an indwelling foley catheter, or assisted clean intermittent catheterization by a nurse or caregiver. This is mostly due to the presentation of a neurogenic lower urinary tract dysfunction (NLUTD) upon admission, which most of the time presents as one of the reasons for their initial consult. Those who have complete injuries have a higher probability of having assisted bladder function, compared to those who have incomplete injuries. Correlating ASIA scores with bladder function, those with higher scores have a higher risk of independent bladder function. Upon discharge, there was a decrease in assisted bladder function, due to intensive bladder training during in-patient rehabilitation. Age is also a factor for assisted bladder function, wherein those in advanced age tend to have assisted bladder function compared to younger age groups.

The study showed that there is improvement in the bladder independence outcomes between acute admission and discharge in patients across all ASIA scores in the sample population. Factors that contribute to bladder independence include patient's age, whether they have complete or incomplete injury, and ASIA score. The results of this study in relation with bladder independence support the previous publications by Pavese et. al. in 2016 for traumatic SCI patents and Scivoletto et. al. in 2018 for patients with ischemic SCI, both of which used the SCIM subscale on respiration and sphincter management, that the SCIM is an ideal tool for predicting bladder function, however the results are based on a cohort assessed one-year post-injury, which is different to the methodology of our study.

For acute SCI patients, a history of bladder fullness or hypogastric distension warrants insertion of an indwelling foley catheter and evaluation of the lower urinary tract, including request for Urinalysis and Urine Culture and adequate fluid intake and output monitoring every eight hours. Once possible complications have been eliminated, a bladder scan is performed, and CIC is initiated, unless there are conditions that warrant the use of an indwelling foley catheter, such as presence of sacral ulcers, ureteral strictures, cystolithiasis, or a small bladder capacity. The challenge in providing a standard bladder independence protocol lies on the use of disposable diapers by patients during rehabilitation, since there is lack of a quantitative urine collection. This becomes a source of confusion between patients and healthcare providers, synonymously using the term "free void" with "diaper wetting". An ideal clean intermittent catheterization protocol should eliminate the use of disposable diapers and should elicit the patient's free void as to adequately score the patient's continence, which is part of the parameters in Item 6 of SCIM III (Sphincter Management-Bladder).

As for bowel function, most SCI patients present with neurogenic bowel symptoms, such as prolonged transit time, or feeling of fullness or bloatedness upon admission but due to the availability of over-the-counter medications to facilitate defecation, patient concerns about bowel function were less likely to be raised unless asked by the attending physician.

The study showed that those who have complete injuries have higher probability of having assisted bowel function compared to those who have incomplete injuries. Upon admission, those with higher ASIA scores

have lesser risk of having assisted bowel function, which can be attributed to the high probability of incomplete injuries or those with higher ASIA scores to have voluntary anal contraction and sacral sensation. Upon discharge, the study showed that completeness of injury is a predictive factor for assisted bowel function, with higher ASIA scores still have lesser risk of having assisted bowel function. Age also becomes a factor in bowel independence, where older patients needed assistance with bowel function compared to younger groups. It was also noted that females have a protective effect compared to males in terms of assisted bowel function. Overall, the study showed that there is improvement in the bowel independence outcomes between acute admission and discharge in patients across all ASIA scores in the sample population, and factors that contribute to bowel independence include ASIA Scores upon admission, completeness of injury and age.

Due to the complex nature of the gastrointestinal motility and the enteric nervous system, a multidimensional approach for neurogenic bowel management should be emphasized7 and should address achieving fecal continence and avoiding constipation13. An effective bowel program should be unique on each patient, and timing and frequency should be considered hence a dedicated caregiver should be present during in-patient rehabilitation. The patient and the caregiver should know the steps of their bowel program and ensure its continuity upon discharge.

The independence in bowel and bladder function of incomplete patients can be attributable to improvement of their ASIA Scores. From Table 1, we can note that the percentage of patients initially classified as AIS-B decreased from 32.4% to 22.2%, while those under AIS-D and AIS-E increased from 20.4% and 0% to 32.4 and 1.9%, respectively. This shows that the patients had significant improvement of their lower extremity motor scores, which in a study by Scivoletto, et. al. in 2018, can be a predictor for improvement of bladder outcomes.

The independence in bladder and bowel function can be correlated by the patient's ASIA scores during acute admission, and by completeness of injury during discharge. This is because during acute admission, some patients are categorized under spinal shock, in which the reflexes caudal to the level of injury is depressed, and there is a period of areflexia or hyporeflexia on days 0-1 post-injury, with initial reflex return after 1-3 days[14], hence classifying them whether they have complete or incomplete injuries is not feasible. For these patients, cutaneous reflexes such as the bulbocavernosus, anal wink and cremasteric reflexes should be re-evaluated once in a 24-hour period for 3 days until any of these reflexes can be observed. This study shows that upon admission, the ASIA scores can predict the type of bladder and bowel management during their course of admission and in-patient rehabilitation, and on discharge, completeness of injury can further predict the bladder and bowel independence outcomes of the patient at home. This may help the attending physiatrist to educate the patient and the relatives of tailor-fit interventions that they need to continue at home, especially regarding the bowel program, and with the advent of telerehabilitation, the physiatrist may be able to adjust, make suggestions, and provide possible interventions, or advise for prompt physical consultation or emergency referral.

The study also showed that spinal surgery has no significant correlation with bladder and bowel independence. As of date, there is no specific literature available regarding the effect of spine surgery in SCI patients in correlation with bladder and bowel independence. We also have limited data to support the outcomes since the spine surgeries on the sample population were done mainly for spinal stabilization, and not for immediate decompression, and is not included in the scope of the study.

SIGNIFICANCE OF THE STUDY

Establishing the relationship between the SCI classification of a patient upon admission to their bowel and bladder independence measures will be beneficial in the patient's goal setting. This will enable the attending physiatrist to pace the patient in terms of improving their bladder and bowel independence based on completeness of injury as early as during admission, and with their corresponding SCIM scores at a certain point in time.

OUTCOME MEASURE

The outcome measure are the scores of the Sphincter Management- Bladder and Sphincter Management-Bowel under the 'Respiration and Sphincter Management' subset of the SCIM, as they reflect the maximum bladder and bowel independence outcomes that the patient achieved during in-patient rehabilitation.

LIMITATIONS OF THE STUDY

The limitation of the study lies on further improvement of the patient after discharge since it can take until 2 years for SCI patients to improve their neurologic function. The study only included the SCIM scores of patients from admission until discharge, and for those who were discharged in less than 6 months, further improvement can be observed, and an SCIM upon out-patient follow-up will be helpful in establishing data.

The management for neurogenic bladder and bowel of SCI patients admitted are also determined and managed by different doctors, with different subspecialties, since SCI cases are co-managed primarily by Orthopedic Surgeons and Physiatrists. Furthermore, urodynamic studies are not readily available to further evaluate the bladder function of patients admitted, hence the bladder outcomes cannot be specifically quantified.

CONCLUSION

In this study, we can derive that SCI patients with complete injury or lower ASIA scores have higher probability of having assisted bladder and bowel functions compared to those with incomplete injuries or higher ASIA scores. This finding is important in planning the ideal bladder and bowel management for the patient from the time of admission, and to start them as early as possible. Factors that contribute to bladder and bowel independence include patient's age, whether they have complete or incomplete injury, and their ASIA scores. The study also showed that spinal stabilization surgery has no significant correlation with bladder and bowel independence in patients with SCI.

We can also derive that the SCIM-III is an ideal tool in predicting bladder and bowel outcomes during in-patient rehabilitation to further aid the attending physiatrist in creating a bladder and bowel program that will uniquely fit the patients.

FURTHER RESEARCH AND RECOMMENDATION

Further studies can be made in relation of the continuity of bladder and bowel programs in the SCI population upon discharge. The SCIM-III can also be answered upon out-patient follow-up 6 months to 1 year upon discharge, to broaden the data regarding the scope of recovery of SCI patients after discharge. Other parameters presented by various studies may aid in establishing a more accurate prediction of the bladder and bowel outcomes, namely the use of lower extremity motor score, which may be included in the next study to be applied in our setting.

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FIGURES

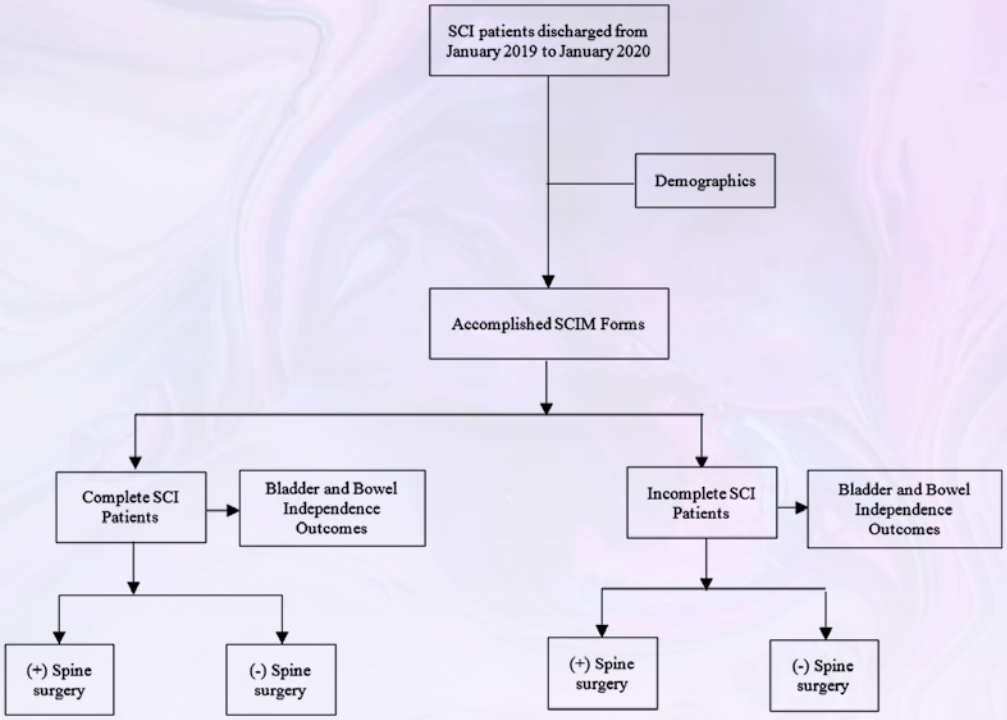

Figure 1. The Study Design

TABLES

Table 1. Patient Demographics.

Criteria	Admission	Rehabilitation	Discharge
	N=108, f (%)		
Age			
18 to <25	35 (32.4)		
25 to <45	30 (27.8)		
45 to <65	33 (30.6)		
65 and above	10 (9.3)		
Sex			
Male	71 (65.7)		
Female	37 (34.3)		
Neurologic Level of Injury			
C1-C8	31 (28.7)	29 (26.9)	27 (25.0)
T1-T12	66 (61.1)	66 (61.1)	66 (61.1)
L1-L5	10 (9.3)	10 (9.3)	10 (9.3)
S1-S5	1 (0.9)	3 (2.8)	5 (4.6)
ASIA Classification			
In Spinal Shock	1 (0.9)	1 (0.9)	1 (0.9)
Complete	28 (25.9)	28 (25.9)	28 (25.9)
Incomplete	79 (73.1)	79 (73.1)	79 (73.1)
Severity of Deficit			
In Spinal Shock	6 (5.6)	2 (1.9)	1 (0.9)
AIS-A	23 (21.3)	24 (22.2)	23 (21.3)
AIS-B	35 (32.4)	29 (26.9)	24 (22.2)
AIS-C	22 (20.4)	26 (24.1)	23 (21.3)
AIS-D	22 (20.4)	26 (24.1)	35 (32.4)
AIS-E	0 (0)	1 (0.9)	2 (1.9)
SCIM Scores			
0-20	44 (41.5)	15 (14.2)	8 (7.5)
21-40	41 (38.7)	46 (43.4)	21 (19.8)
41-60	11 (10.4)	25 (23.6)	35 (33.0)
61-80	9 (8.5)	15 (14.2)	22 (20.8)
81-100	1 (0.9)	5 (4.7)	20 (18.9)
Underwent Spine Surgery			
Yes	22 (20.4)		
No	86 (79.6)		

Table 2. Factors associated with assisted bladder function upon admission.

Parameters	**Independent Bladder Function** (n=21, 19.8%)	**Assisted Bladder Function** (n=85, 80.2%)	**Odds Ratio** (95% CI)	**p-value**
Age	32.5±20.0	40.5±18.3	1.04 (1.00 – 1.07)	0.02
Sex				
Male	16 (23.2)	53 (76.8)	Reference	-
Female	5 (13.5)	32 (86.5)	1.93 (0.65 – 5.78)	0.24
Level of Injury				
C1-C8	4 (19.0)	17 (81.0)	1.35 (0.34 – 5.39)	0.94
T1-T12	9 (19.1)	38 (80.9)	1.34 (0.44 – 4.11)	0.60
L1-L5	7 (24.1)	22 (75.9)	Reference	-
S1-S5	0 (0.0)	0 (0.0)	---	---
ASIA Classification				
Incomplete	20 (26.0)	57 (74.0)	Reference	-
Complete	1 (3.6)	27 (96.4)	9.47 (1.21 – 74.31)	0.01
ASIA Scores				
In Spinal shock	0 (0.0)	6 (100)	2.33E+9 (0.00)	0.99
AIS-A	1 (4.3)	22 (95.7)	31.78 (3.60 – 280.2)	0.002
AIS-B	5 (14.7)	29 (85.3)	8.38 (2.34 – 29.95)	0.001
AIS-C	2 (9.5)	19 (90.5)	13.72 (2.54 – 74.12)	0.002
AIS-D	13 (59.1)	9 (40.9)	Reference	-
Underwent Spine Surgery				
No	15 (71.4)	69 (81.2)	Reference	---
Yes	6 (28.6)	16 (18.8)	0.58 (0.19 – 1.73)	0.48

Table 2.1. Multivariate Analysis on the factors associated with assisted bladder function upon admission.

Parameters	**Odds Ratio (95% CI)**	**p-value**
Age	1.05 (1.00 – 1.09)	0.03
Sex (Female)	2.39 (0.56 – 10.27)	0.24
Level of Injury C1 – C8 T1 – T12 L1 – L5 S1 – S5	 2.14 (0.35 – 12.97) 1.98 (0.39 – 10.13) Ref ---	0.66 0.40 0.41 --- ---
ASIA Classification (complete)	47.07 (4.38 – 506.02)	0.001
ASIA Scores AIS-A AIS-B AIS-C AIS-D	 47.07 (4.38 – 506.02) 13.10 (2.69 – 63.90) 22.48 (3.18 – 159.09) Ref	0.001 0.001 0.001 0.002 ---
Underwent spinal surgery	1.04 (0.21 – 5.18)	0.96

Table 3. Factors associated with assisted bladder function upon discharge.

Parameters	Independent Bladder Function (n=50, 46.3%)	Assisted Bladder Function (n=58, 53.7%)	Odds Ratio (95% CI)	p-value
Age	32.2 ± 16.1	44.2 ± 19.4	1.04 (1.01-1.06)	0.002
Sex				
Male	35 (49.3)	36 (50.7)	Reference	-
Female	15 (40.5)	22 (59.5)	1.43 (0.64 – 3.19)	0.39
Level of Injury				
C1-C8	11 (50.0)	11 (50.0)	Reference	-
T1-T12	22 (45.8)	26 (54.2)	1.18 (0.43 – 3.25)	0.75
L1-L5	13 (44.8)	16 (55.2)	1.23 (0.41 – 3.74)	0.71
S1-S5	0 (0.0)	0 (0.0)	---	---
ASIA Classification				
Incomplete	42 (53.2)	37 (46.8)	Reference	-
Complete	8 (28.6)	20 (71.4)	2.84 (1.12 – 7.20)	0.02
ASIA Scores				
AIS-A	5 (21.7)	18 (78.3)	14.40 (3.96 – 52.30)	<0.0001
AIS-B	7 (29.2)	17 (70.8)	4.00 (1.38 – 11.62)	0.008
AIS-C	9 (39.1)	14 (60.9)	2.95 (1.00 – 8.66)	0.04
AIS-D	28 (80.0)	7 (20.0)	Reference*	-
AIS-E	1 (50.0)	1 (50.0)	---	---
Underwent Spine Surgery				
No	39 (45.3)	47 (54.7)	Reference	-
Yes	11 (50.0)	11 (50.0)	0.83 (0.33 – 2.12)	0.70

*AIS-D and AIS-E combined

Table 3.1. Multivariate Analysis on the factors associated with assisted bladder function upon discharge.

Parameters	Odds Ratio (95% CI)	p-value
Age	1.04 (1.01 – 1.07)	0.007
Sex (Female)	1.33 (0.46 – 3.80)	0.59
Level of Injury		0.76
C1 – C8	Ref	---
T1 – T12	1.03 (0.33 – 3.24)	0.96
L1 – L5	1.01 (0.27 – 3.75)	0.98
S1 – S5	---	---
ASIA Classification (complete)	1.32 (0.20 – 9.28)	0.78
ASIA Scores		0.002
AIS-A	9.02 (1.08 – 75.62)	0.040
AIS-B	10.58 (3.06 – 51.58)	<0.001
AIS-C	5.75 (1.53 – 21.66)	0.010
AIS-D	Ref	---
Underwent spinal surgery	0.72 (0.21 – 2.49)	0.60

Table 4. Factors associated with assisted bowel function upon admission.

Parameters	Independent Bowel Function (n=9, 8.5%)	Assisted Bowel Function (n=97, 91.5%)	Odds Ratio (95% CI)	p-value
Age	34.77±22.20	39.34±18.60	1.01 (0.98 – 1.05)	0.488
Sex				
Male	6 (8.7)	63 (91.3)	Reference	-
Female	3 (8.1)	34 (91.9)	1.08 (0.25 – 4.59)	0.918
Level of Injury				
C1-C8	1 (4.8)	20 (95.2)	2.31 (0.22 – 23.88)	0.87
T1-T12	5 (10.6)	42 (89.4)	0.97 (0.21 – 4.40)	0.99
L1-L5	3 (10.3)	26 (89.7)	Reference	---
S1-S5	0 (0.0)	0 (0.0)	---	---
ASIA Classification				
Incomplete	7 (9.1)	70 (90.9)	Reference	-
Complete	1 (3.6)	27 (96.4)	2.7 (0.32 – 22.99)	0.363
ASIA Scores				
In Spinal Shock	2 (33.3)	4 (66.7)	0.59 (0.08 – 89.83)	0.96
AIS-A	0 (0.0)	23 (100)	Undefined	0.04
AIS-B	1 (2.9)	33 (97.1)	9.71 (1.05 – 89.83)	0.05
AIS-C	1 (4.8)	20 (95.2)	5.88 (0.62 – 55.37)	0.20
AIS-D	5 (22.7)	17 (77.3)	Reference	-
Underwent Spine Surgery				
No	6 (7.1)	79 (92.9)	Reference	-
Yes	3 (14.3)	18 (85.7)	0.50 (0.10 – 1.99)	0.50

Table 4.1. Multivariate Analysis on the factors associated with assisted bowel function upon admission.

Parameters	Odds Ratio (95% CI)	p-value
Age	1.03 (0.98 – 1.09)	0.22
Sex (Female)	0.56 (0.08 – 3.77)	0.55
Level of Injury C1 – C8 T1 – T12 L1 – L5 S1 – S5	 Ref 0.86 (0.05 – 14.71) 0.44 (0.05 – 3.98) ---	0.72 --- 0.92 0.46 ---
ASIA Classification (complete)	5.36E+9	0.99
ASIA Scores AIS-A AIS-B AIS-C AIS-D	 --- 11.76 (1.08 – 128.28) 5.26 (0.48 – 58.14) Ref	0.002 --- 0.04 0.18 ---
Underwent spinal surgery	0.72 (0.21 – 2.49)	0.60

Table 5. Factors associated with bowel function upon discharge.

Parameters	Independent Bowel Function (n=41, 38.0%)	Assisted Bowel Function (n=67, 62.0%)	Odds Ratio (95% CI)	p-value
Age	33.56±19.32	41.70±18.00	1.02 (1.01-1.05)	0.021
Sex				
Male	24 (33.8)	47 (66.2)	Reference	-
Female	17 (45.9)	20 (54.1)	0.60 (0.28 – 1.35)	0.219
Level of Injury				
C1-C8	7 (31.8)	15 (68.2)	1.31 (0.41 – 4.22)	0.65
T1-T12	17 (35.4)	31 (64.6)	1.11 (0.43 – 2.90)	0.82
L1-L5	11 (37.9)	18 (62.1)	Reference	---
S1-S5	0 (0.0)	0 (0.0)	---	---
ASIA Classification				
Incomplete	35 (44.3)	44 (55.7)	Reference	-
Complete	5 (17.9)	23 (82.1)	3.66 (1.26 – 10.61)	0.013
ASIA Scores				
AIS-A	4 (17.4)	19 (82.6)	9.90 (2.75 – 35.56)	<0.001
AIS-B	5 (20.8)	19 (79.2)	7.92 (2.38 – 26.33)	0.001
AIS-C	6 (26.1)	17 (73.9)	5.90 (1.86 – 18.78)	0.003
AIS-D	24 (68.6)	11 (31.4)	Reference*	-
AIS-E	1 (50.0)	1 (50.0)	-	-
Underwent Spine Surgery				
No	32 (37.2)	54 (62.8)	Reference	-
Yes	9 (40.9)	13 (59.1)	0.86 (0.33 – 2.23)	0.750

*AIS-D and AIS-E combined

Table 5.1. Multivariate Analysis on the factors associated with assisted bowel function on discharge.

Parameters	Odds Ratio (95% CI)	p-value
Age	1.05 (1.01 – 1.08)	0.004
Sex (Female)	0.29 (0.09 – 0.91)	0.034
Level of Injury C1 – C8 T1 – T12 L1 – L5 S1 – S5	 1.52 (0.35 – 6.58) 0.75 (0.22 – 2.58) Ref ---	0.601 0.575 0.642 --- ---
ASIA Classification (complete)	6.57 (0.85 – 50.61)	0.071
ASIA Scores AIS-A AIS-B AIS-C AIS-D	 2.48 (0.28 – 21.66) 11.66 (2.56 – 51.20) 6.83 (1.70 – 27.39) Ref	0.005 0.411 0.001 0.007 ---
Underwent spinal surgery	0.85 (0.23 – 3.10)	0.802

Appendix B. Institution-Based Spinal Cord Independence Measure.

P H I L I P P I N E O R T H O P E D I C C E N T E R

DEPARTMENT OF REHABILITATION MEDICINE

SPINAL CORD INDEPENDENCE MEASURE

(Version III, 2002-2011)

Patient Name: _____ _____ Hospital Number _____

Examiner Name: _____ Assessment Date _____

Admission (A) _____ Re-Assessment (RA) _____ Discharge (DC) _____

Traumatic _____ NTSCI _____ Paraplegia _____ Tetraplegia _____ Complete _____ Incomplete _____

Self Care

	Item Score A	RA	DC
1. Feeding (cutting, opening containers, pouring, bringing food to mouth, holding cup with fluid)			
0. Needs parenteral, gastrostomy, or fully assisted oral feeding			
1. Needs partial assistance for eating, and/or drinking, or for wearing adaptive devices			
2. Eats independently; needs adaptive devices or assistance only for cutting food and/or pouring and/or opening containers			
3. Eats and drinks independently; does not require assistance or adaptive device			
2. Bathing (soaping, washing, drying body and head, manipulating tap water)			
A. Upper Body			
0. Requires total assistance			
1. Requires partial assistance			
2. Washes independently with adaptive device or in a specific setting (eg. bars, chair)			
3. Washes independently; does not require adaptive device			
B. Lower Body			
0. Requires total assistance			
1. Requires partial assistance			
2. Washes independently with adaptive device or in a specific setting (adss)			
3. Washes independently; does not require adaptive devices (adss) or specific setting			
3. Dressing (clothes, shoes, permanent orthoses; dressing, wearing, undressing)			
A. Upper Body			
0. Requires total assistance			
1. Requires partial assistance with clothes without buttons, zippers or laces (cwobzl)			
2. Independent with cwobzl; requires adaptive devices and/or specific settings (adss)			
3. Independent with cwobzl; does not require adss; needs assistance or adss only for bzl			
4. Dresses (any clothes) independently; does not require adaptive devices or any specific setting			
B. Lower Body			
0. Requires total assistance			
1. Requires partial assistance with clothes without buttons, zippers or laces (cwobzl)			
2. Independent with cwobzl; requires adaptive device and /or specific settings (adss)			
3. Independent with cwobzl without adss; needs assistance or adss only for bzl			
4. Dresses (any clothes) independently; does not require adaptive devices or specific setting			
4. Grooming (washing hands, and face, brushing teeth, combing hair, shaving, applying makeup)			
0. Requires total assistance			
1. Requires partial assistance			
2. Grooms independently without adaptive devices			
Self Care Subtotal (0-20)			

Respiration and Sphincter Management

5. Respiration

0. Requires tracheal tube (TT) and permanent or intermittent assisted ventilation (IAV)
2. Breathes independently with TT; requires oxygen, much assistance in coughing or TT management
4. Breathes independently with TT; requires little assistance in coughing or TT management
6. Breathes independently without TT; requires oxygen, much assistance in coughing, a mask (e.g. peep) or IAV (bipap)
8. Breathes independently without TT; requires little assistance or stimulation for coughing
10. Breathes independently without assistance or device

6. Sphincter Management- Bladder

0. Indwelling catheter
3. Residual Urine volume (RUV) > 100cc; no regular catheterization or assisted intermittent catheterization
6. RUV <100cc or intermittent self-catheterization; needs assistance for applying drainage Instrument
9. Intermittent self-catheterization; uses external drainage instrument; does not need assistance for applying
11. Intermittent self-catheterization; continent between catheterizations; does not use external drainage instrument
13. RUV <100cc; needs only external urine drainage; no assistance is required for drainage
15. RUV <100cc; continent; does not use external drainage instrument

7. Sphincter Management – Bowel

0. Irregular timing or very low frequency (less than once in 3 days) of bowel movements
5. Regular timing, but requires assistance (e.g. for applying suppository); rare accidents (less than twice a month)
8. Regular bowel movements, without assistance; rare accidents (less than twice a month)
9. Regular bowel movements, without assistance; no accidents

8. Use of Toilet (personal hygiene, adjustment of clothes before/after, use of napkins, diaper)

0. Requires total assistance
1. Requires partial assistance; does not clean self
2. Requires partial assistance; cleans self- independently
4. Uses toilet independently in all tasks but needs adaptive devices or special setting (e.g.bars)
5. Uses toilet independently; does not require adaptive devices or special setting

Respiration and Sphincter Management Subtotal (0-40)			

Mobility (room and toilet)

	Item Score A	RA	DC

9. Mobility in Bed and Action to Prevent Pressure Sore

0. Needs assistance in all activities; turning upper body in bed, turning lower body in bed, sitting up in bed, doing push-ups in wheelchair, with or without adaptive devices, but not with electric aids
2. Performs one of the activities without assistance
4. Performs two or three of the activities without assistance
6. Performs all the bed mobility and pressure release activities independently

10. **Transfers: bed-wheelchair** (locking wheelchair, lifting footrests, removing and adjusting arm rests, transferring, lifting feet)

0. Requires total assistance
1. Needs partial assistance and/or supervision, and/or adaptive devices (e.g. sliding bars)
2. Independent (or does not require wheelchair)

11. **Transfers: wheelchair-toilet-tub** (if uses toilet wheelchair: transfer to and from; if uses regular wheelchair: locking wheelchair, lifting footrests, removing and adjusting armrests, transferring, lifting feet)
    0. Requires total assistance
    1. Needs partial assistance and/or supervision, and/or adaptive device (grab-bars)
    2. Independent (or does not require wheelchair)

Mobility (indoors and outdoors, on even surface)

12. **Mobility Indoors**
    0. Requires total assistance
    1. Needs electric wheelchair or partial assistance to operate manual wheelchair
    2. Moves independently in manual wheelchair
    3. Requires supervision while walking (with or without devices)
    4. Walks with a walking frame or crutches (swing)
    5. Walks with crutches or two canes (reciprocal walking)
    6. Walks with one cane
    7. Needs leg orthosis only
    8. Walks without walking aids

13. **Mobility for Moderate Distances** (10-100 meters)
    0. Requires total assistance
    1. Needs electric wheelchair or partial assistance to operate manual wheelchair
    2. Moves independently in manual wheelchair
    3. Requires supervision while walking (with or without devices)
    4. Walks with a walking frame or crutches (swing)
    5. Walks with crutches or two canes (reciprocal walking)
    6. Walks with one cane
    7. Needs leg orthosis only
    8. Walks without walking aids

14. **Mobility Outdoors** (more than 100 meters)
    0. Requires total assistance
    1. Needs electric wheelchair or partial assistance to operate manual wheelchair
    2. Moves independently in manual wheelchair
    3. Requires supervision while walking (with or without devices)
    4. Walks with a walking frame or crutches (swing)
    5. Walks with crutches or two canes (reciprocal walking)
    6. Walks with one cane
    7. Needs leg orthosis only
    8. Walks without walking aids

15. **Stair Management**
    0. Unable to ascend or descend stairs
    1. Ascends and descends at tleast 3 stesps without support or supervision of another person
    2. Ascends and descends at least 3 steps with support of handrail and/or crutch or cane
    3. Ascends and descends at least 3 steps without any support or supervision

16. **Transfers:** wheelchair-car (approaching car, locking wheelchair, removing arm and footrests, transferring to and from car, bringing wheelchair into and out of car)
    0. Requires total assistance
    1. Needs partial assistance and/or supervision and.or adaptive devices
    2. Transfers independent; does not require adaptive devices (or does not require wheelchair)

17. **Transfers:** ground-wheelchair
    0. Requires assistance
    1. Transfers independent with or without adaptive devices (or does not require wheelchair)

Mobility Subtotal			

TOTAL SCIM SCORE (0-100)	Admission: _____ Re-assessment _____ Discharge _____
Clinician Signature	Date