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ARTICLE

Effective bowel management in spinal cord injury during inpatient rehabilitation: data from the Dutch spinal cord injury database

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STUDY DESIGN: Retrospective Observational Study.
OBJECTIVES: To describe bowel management in individuals with a recently acquired spinal cord injury (SCI) both at admittance and discharge from first inpatient rehabilitation, and to determine factors that contribute to effective bowel management (EBM) at discharge.
SETTING: Specialized rehabilitation centers in the Netherlands.
METHODS: Data from the Dutch Spinal Cord Injury Database (DSCID) collected between 2015 and 2019 was used. EBM was defined by the variables of stool frequency and fecal incontinence. After univariate analysis, a multivariate regression analysis was conducted.
RESULTS: Of 1,210 participants, 818 (68%) did not have EBM at admittance. At discharge, 308 (38%) did still not have EBM (in total 33% of all participants). The odds of having EBM at discharge was 2.82 times higher for participants with ASIA Impairment Scale (AIS) D compared to those with AIS-A (95% CI: 1.38–5.78). Participants with non-traumatic SCI had higher odds of having EBM than those with traumatic SCI (OR: 0.59, 95% CI 0.38–0.91). Use of suppositories, small enema, medication influencing bowel function, and oral laxatives at admittance did not influence EBM significantly at discharge.
CONCLUSIONS: Bowel management improves during first inpatient rehabilitation. However, realizing EBM after a recently acquired SCI is a challenge. This endorses the importance of bowel management during inpatient rehabilitation, especially for people with AIS-A and non-traumatic etiology.

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INTRODUCTION

Neurogenic bowel dysfunction (NBD) is one of the most important impairments caused by spinal cord injury (SCI) [1]. It can cause constipation, hemorrhoids, abdominal distension, diarrhea, fecal incontinence, and ileus [2, 3]. As such, NBD is significantly affecting daily life. Several studies showed that the prevalence of NBD in people with chronic SCI is high [4–8].

Pavese et al. [4] examined NBD in 2366 people with traumatic SCI between 2001 and 2012. At first assessment, within 40 days from the injury, an independent, efficient bowel management was found in only 13% of all participants. One year post SCI, 42% of the participants had still not achieved independent, reliable bowel management. In chronic SCI, severe NBD has been reported in 36% to 39% of all individuals [5, 6]. Severe bowel dysfunction is defined as a score of ⩾14 on the NBD score: a symptom-based questionnaire [9]. Severe NBD implies a major impact on quality of life [3]. Liu et al. [5] collected NBD scores amongst 254 people with an SCI for more than 1 year. Out of all respondents, 39% suffered severe NBD. Comparable results were reported by [6]. They described NBD in 258 people with acquired SCI between the age of 18 and 35 years. All participants had a SCI for at least 10 years. Overall, they observed severe NBD in 36% of the participants. Sixteen percent of the participants experienced fecal incontinence for at least once a month, and constipation was present in 25% [6].

Ineffective bowel management affects quality of life significantly. In people with SCI, Lynch et al. [7] found an affected quality of life due to incontinence in 289 participants (62%). Also, the unpredictability of incontinence affected quality of life. In this study, the mean age at injury was 29 years (range 4–81) and the mean TSI was 14 years (range 0.7–42.1). In a more recent study, 38% of the people reported a limited participation in daily life due to NBD [8].

Risk factors for developing severe NBD in chronic SCI include a combination of personal characteristics (lifestyle, dietary pattern, mobility, and age), medical factors (history of bowel problems, neurologic classification) and social factors (support system, access to resources) [10]. Pharmacological agents such as antibiotics, laxatives and opioids can cause fecal incontinence and constipation [11, 12]. The composition of the gut microbiota might be different in people with SCI compared to healthy people, which this could also affect bowel function [13]. In addition, effective bowel management (EBM) can improve quality of life, as it decreases urinary tract infections and hospitalizations [1, 14–16].

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Hence, it is important to have good, EBM as soon as possible preferably before discharge from the rehabilitation center.

To achieve this, a guideline for defecation management in the Netherlands has been compiled by a workgroup of health care professionals of Dutch specialized spinal cord rehabilitation centers and is used as best practice in all Dutch rehabilitation centers [17]. Defecation management differs from person to person and depends on the phase of SCI (spinal shock phase or chronic phase) and the presence of anal reflex. Management includes non-pharmacological interventions, like dietary recommendations, fluid consumption, routine bowel evacuations and timing the performance of the bowel routine with food intake. Other interventions include the use of abdominal massage, digital evacuation, pharmacological agents, or irrigation techniques.

There is sufficient knowledge of EBM in the subacute phase during inpatient rehabilitation [1, 2, 12, 17]. It is unknown how many people with SCI have ineffective bowel management due to NBD when admitted to the rehabilitation center, neither is it known which people with SCI are more prone to maintain ineffective bowel management practices after being discharged. It would be helpful to find out more about those people at risk of ineffective bowel management (no EBM) after being discharged. In this way, early treatment could lead to a more personalized approach. As such, the aim of this study is to describe the effectiveness of bowel management in people with SCI at admittance and discharge from the first inpatient rehabilitation, and to determine the factors that contribute to EBM after being discharged.

METHODS

In this retrospective observational study, data from the Dutch Spinal Cord Injury Database (DSCID) collected between 2015 and 2019 was used. The DSCID consists of the Dutch translations of the International SCI Datasets (ISCID) available in 2012 and is used to collect standardized information on patients with SCI who were admitted for their first inpatient rehabilitation to one of the specialized rehabilitation centers in the Netherlands [18]. All participants gave informed consent after verbal and written information was provided [19]. The study protocol was approved by the scientific board of the DSCID committee. Data used in this study included demographics, lesion characteristics (e.g., injury date, etiology, level and American Spinal Injury Association Impairment Scale (AIS)), mobility and bowel function. Bowel function aspects included gastrointestinal surgery, defecation method, time needed for defecation, frequency, fecal incontinence, oral laxatives perianal problems, urge sensation and medication that influences bowel function. Exclusion criteria were age <18 years, chronic SCI, or non-SCI-related gastrointestinal dysfunction (see Fig. 1). One of the included participants had bowel problems before SCI.

EBM is internationally known as a stable bowel management including a stable bowel medication scheme and evacuation method without incontinence or constipation [11]. In this study EBM is defined by the variables of incontinence and frequency of stool: a stool frequency of more than two times a week to a maximum of two times a day and fecal incontinence occurring less than once a month. These two variables were dichotomized into one variable. If all outcomes fell within the intended values, the person was subsumed as having EBM. If one outcome did not fall within the specified values, it was classified as no effective bowel management (no EBM). When the value "frequency of stool" was missing, but people suffered incontinence, they were scored as having no EBM. The examination findings of all participants supported NBD. They were therefore considered as having a neurogenic bowel disorder. AIS classification was used to describe the neurological level of our population. People were divided into two groups: group A (level C1 to T5), and group B (T6 to S5). The cut-off value of T6 was used for this study, as innervation of the small and large intestine are controlled by sympathetic innervation of the T6–T12 spinal segments [1]. Mobility was determined using an adapted version of the Hoffer classification for functional mobility, and distinguished whether participants were bedbound, used a wheelchair, or were able to walk [20].

Statistics

Descriptive statistics were used to describe characteristics of the participants, and compare bowel management at admittance and discharge, as well as differences in AIS classification, mobility, defecation methods, anal sensation and use of laxatives between participants with and without EBM at admittance. Chi-square test was used when comparing categorical variables, whereas normally distributed continuous variables were compared using independent t-test. A $p < 0.05$ was considered statistically significant.

Missing values in outcome measures were imputed by Multiple Imputation (MI) via the multiple imputation option in SPSS 26.0. Before imputation, 20% was lacking outcome on EBM at admittance and 29% at discharge. It is known that analyses of only the complete cases data may suffer more from chance variation than analyses with missing data replaced by multiple values [21]. As such, the pooled results are reported in the present study. Five imputed datasets are regarded a sufficient number, even with 50% of missing data [22].

In participants with no EBM at admittance, univariate logistic regression was used to determine the association between the various determinants and having EBM at discharge. Determinants were age, gender, etiology, AIS classification and mobility, urge sensation, main defecation method, oral laxatives, and medication with influence on bowel function.

All variables with a significance of p-value less than 0.200 in the univariate analysis were included in the multivariate logistic regression model using a manual backward-selection approach. In each step the variable with the lowest predictive value was eliminated. This procedure stopped when exclusion of the variable resulted in a significant decrement of fit of the model according to the likelihood ratio test ($p < 0.05$), or when the remaining variables were all significantly associated with EBM at discharge.

The associations between these variables and no EBM at discharge were calculated as odds ratio (OR) with 95% confidence intervals (CI). Variables with an OR > 1 have a higher likelihood of no EBM at discharge.

RESULTS

Participant characteristics

Of 2578 people present in the DSCID, 1210 were included in the study (Fig. 1). Characteristics of the participants and their SCI are presented in Table 1. The mean age at onset was 58 years and 64% was male. Of 1210 participants, 472 (39.0%) suffered a traumatic SCI. On average, participants were admitted to the rehabilitation center 38 days after SCI. A complete SCI, or AIS-A, was found in 163 participants (14%), an AIS-D in 743 (61%). Group A (level of injury between C2 and T5) was formed by 527 of the 1210 participants (44%), whereas group B (level of injury between T6 to S5) consisted of 638 participants (53%). At admittance, most of the participants were bedbound (11%) or used a wheelchair (37%), while 42% of the participants were able to walk (Table 1).

Description of bowel management

Description of bowel management at admittance and at discharge is reported in Table 2. At admittance, frequency of stool was normal in 88% (479 of 544 participants). At discharge, a normal frequency of stool was present in 97% (860 of 890 participants). Frequency of stool is considered normal when it does not exceed two stools a day and occurs at least twice a week. At admittance, 43% (522 participants) suffered never or less than once a month from fecal incontinence. At discharge this improved to 78% (698 participants). After a mean length of stay of 87 days, 33% of all participants still did not achieve EBM during inpatient rehabilitation.

The percentage of participants in which the defecation method was normal (without the use of suppositories, digital stimulation or enema) increased from 47% at admission to 57% at discharge. Use of suppositories (23%) and small enema (25%) were frequently applied defecation methods among participants at admittance. At discharge, small enema was used by 29%, whereas the percentage of participants using suppositories decreased to 2%. Use of osmotic laxatives decreased from 77% at admission to 47% at discharge, and the percentage of participants using other medication influencing bowel function like antibiotics, antispasmodic agents, statins, chemotherapy, antidiabetics, or opiates decreased from 46% at admission to 20% at discharge.

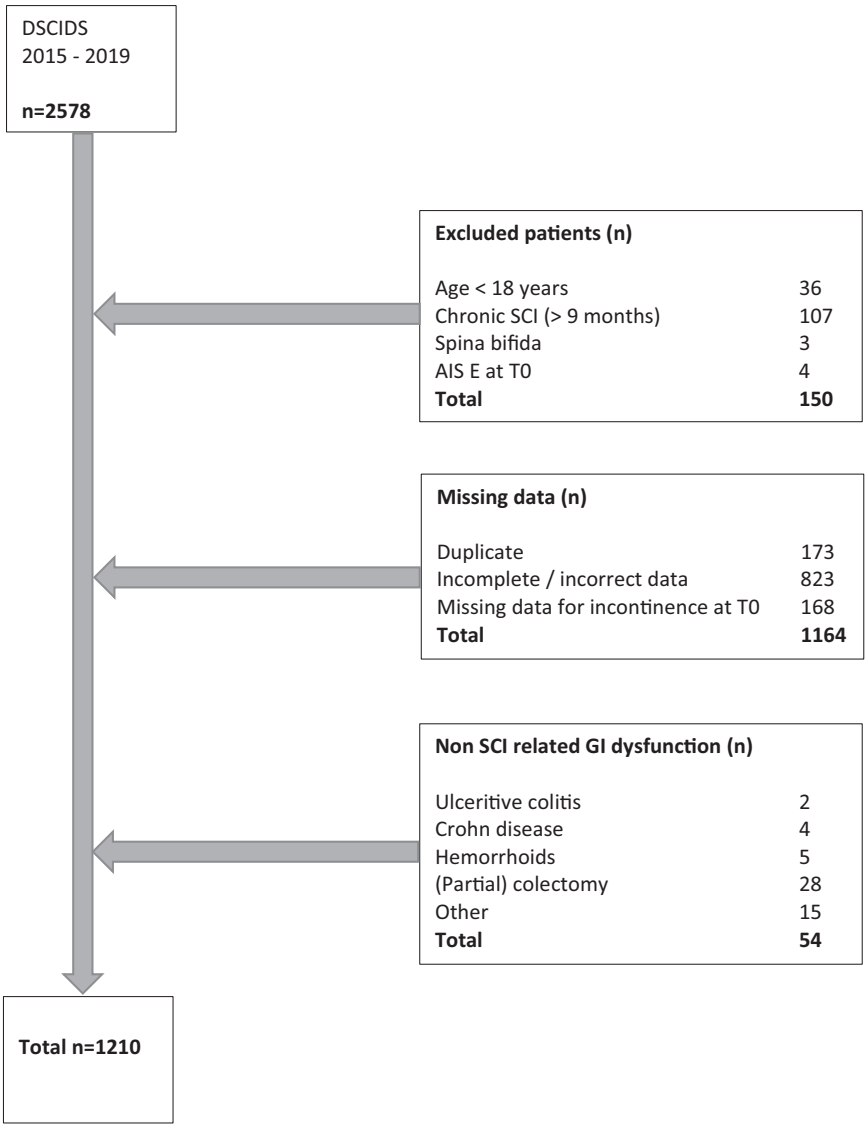

Fig. 1 Exclusion flowchart. Abbreviations: AIS-E ASIA Impairment Scale E; GI gastrointestinal; NDD Dutch Spinal Cord Injury Database; SCI Spinal Cord Injury; T0 date of admittance.

Differences between EBM versus no EBM at Discharge

Table 3 shows only the participants without EBM at admittance. This group was divided into 'EBM' and 'no EBM' at discharge. Participants without EBM at discharge were on average slightly older compared to those with EBM at discharge (60.1 (SD 16.2) years versus 57.2 (SD 16.3) years), although the difference was not statistically significant. In the no EBM group, participants with non-traumatic SCI accounted for 62%, versus 54% in the EBM group ($p = 0.12$). Participants with AIS-A had significantly more often no EBM at discharge compared to participants with AIS-D (AIS-A 24% no EBM versus 13% EBM; AIS-D 40% no EBM versus 58% EBM, $p = 0.01$). There was no significant difference in having EBM at discharge between Group A (level C1 to T5) and group B (T6 to S5) ($p = 0.58$). Of the participants who were bedbound or who used a wheelchair at admittance, 70% had no EBM at discharge, compared to 57% of participants who were able to walk at admittance ($p = 0.19$). Sensation of urge at admittance was predominantly abnormal (69% in the no EBM at discharge group, versus 57% in the EBM at discharge group, $p = 0.14$). Participants who had a normal defecation method at admittance more often reached EBM at discharge compared to participants with other than normal defecation methods at admittance (40% versus 26%, $p = 0.06$). Other reported defecation methods were predominantly the use of suppositories or (small) enema. The majority of the participants without EBM at admittance used oral laxatives when admitted for inpatient rehabilitation. Osmotic laxatives, contact laxatives and fibers were amongst the those reported the most. There was no significant difference in the percentage of participants using oral laxatives at admittance amongst those with EBM at discharge and those with no EBM at discharge (90% versus 87%, $p = 0.50$).

Multivariate model at admittance for no EBM at discharge

The first step in the construction of the prediction model was univariate logistic regression analysis of the variables included in Table 3. In the following step, all variables with a p-value less than 0.20 were included in the multivariate model. These variables were age, etiology, AIS, mobility, sensation of urge, and defecation method. At first, the variable with the lowest predictive value was removed, which did not lead to a significant decline of the model's fit. Removing the variables of mobility, age, or respectively defecation method in subsequent steps resulted in a significant decrease of the model's fit ($p < 0.05$). Therefore, these variables were not removed from the model despite their non-significant p-value. The final model

Table 1. Characteristics of the participants.

Participants characteristics	$n = 1210$
Gender *n* (%)	
Male	773 (64%)
Female	437 (36%)
Age in years mean (SD)	58.1 (16.0)
Days between onset sci and admission to RC median (25%–75%)	38 (15–40)
Length of stay in RC in days median (25%–75%)	87 (44–113)
Missing	638 (52%)
Etiology *n* (%)	
Traumatic	472 (39%)
Non traumatic	725 (60%)
Vascular	159 (22%)
Oncology	176 (24%)
Inflammation	114 (16%)
Degenerative	155 (21%)
Other	121 (17%)
Missing	13 (1%)
AIS classification *n* (%)	
AIS-A	163 (14%)
AIS-B	127 (11%)
AIS-C	177 (15%)
AIS-D	743 (61%)
Missing	0
Neurological level spinal cord injury *n* (%)	
Group A (C2 to T5)	527 (44%)
Group B (T6 to S5)	638 (53%)
Missing	45 (4%)
Mobility score *n* (%)	
Bedbound	134 (11%)
Wheelchair user	453 (37%)
Walker	508 (42%)
Missing	115 (10%)

Abbreviations: *AIS* American Spinal Injury Association Impairment Scale; *RC* Rehabilitation Center; *SCI* spinal cord injury.

Table 2. Description of bowel management at admittance and at discharge ($n = 1210$).

Bowel management	At admittance	At discharge
Frequency of stool *n* (%)		
≤2 times a week	14 (3%)	11 (1%)
>2 times a week to 2 times a day	479 (88%)	860 (97%)
≥3 times a day	51 (9%)	19 (2%)
Total	544 (100%)	890 (100%)
Missing	666 (55%)	320 (26%)
Fecal incontinence, frequency *n* (%)		
Never	450 (37%)	554 (61%)
Less than once a month	72 (6%)	144 (16%)
≥ Once a month	66 (5%)	96 (11%)
≥ Once a week	226 (19%)	80 (9%)
≥ Once a day	396 (33%)	27 (3%)
Total	1210 (100%)	901 (100%)
Missing	0	309 (25%)
Time for defecation *n* (%)		
0–30 min	316 (93%)	712 (95%)
31–60 min	12 (4%)	36 (5%)
>60 min	9 (3%)	1 (0%)
Total	337 (100%)	749 (100%)
Missing	868 (72%)	461 (38%)
Defecation method *n* (%)		
Normal	552 (47%)	543 (57%)
Abdominal massage	20 (2%)	7 (1%)
Digital anorectal stimulation / digital evacuation	7 (1%)	23 (2%)
Suppositoria	268 (23%)	23 (2%)
Small enema (<150 ml)	292 (25%)	277 (29%)
Enema (>150 ml)	41 (3%)	15 (2%)
Transanal irrigation	2 (0%)	58 (6%)
Sacral Anterior Root Stimulation	0 (0%)	1 (0%)
Colostomy	0 (0%)	0 (0%)
Total	1182 (100%)	947 (100%)
Missing	28 (2%)	263 (22%)
Oral laxatives *n* (%)		
Fibers	67 (6%)	120 (10%)
Osmotic laxatives	935 (77%)	566 (47%)
Contact laxatives	258 (21%)	141 (12%)
Prokinetics	1 (0%)	0 (0%)
Medication influence bowel function *n* (%)		
Anticholinergics	55 (5%)	88 (7%)
Narcotics	344 (28%)	140 (12%)
Other	162 (13%)	17 (1%)
Effective Bowel Management		
Yes	392 (32%)	810 (67%)
No	818 (68%)	400 (33%)

for factors contributing to EBM at discharge is presented in Table 4 and included the variables of defecation method, etiology, neurological level, mobility and age. As shown in Table 4, the odds of having EBM at discharge was 2.82 higher for participants with AIS-D compared to participants with AIS-A (95% CI: 1.38–5.78; $p = 0.01$). Furthermore, the odds of having EBM at discharge was significantly lower in participants with non-traumatic SCI than in participants with traumatic SCI (OR = 0.59; 95% CI: 0.38–0.91; $p = 0.02$).

DISCUSSION

Main findings and context of literature

Achieving EBM is a very important goal during clinical rehabilitation. To our knowledge, the present study is the first study which describes bowel management during the first inpatient rehabilitation at admittance and discharge. In addition, a model for contributing factors for EBM at discharge was developed.

Two out of three (68%) participants in this study had no EBM at admittance. Achieving EBM is one of the important goals during the first inpatient rehabilitation period and therefore consistency, frequency and duration of stool are closely monitored. Bowel management is based on the Dutch defecation guidelines. It requires constant education and clear directions from trained specialized medical personnel to people with SCI. In the present

Table 3. Differences between EBM versus no-EBM at discharge in people without EBM at admittance.

	No-EBM at discharge ($n = 308$)	EBM at discharge ($n = 510$)	*p*-value
Gender n (%)			
Male	188 (61%)	332 (65%)	0.47
Female	120 (39%)	178 (35%)	
Age in years mean (SD)	60.1 (16.2)	57.2 (16.3)	0.16
Aetiology at admittance n (%)			
Traumatic	114 (37%)	228 (45%)	0.12
Non traumatic	190 (62%)	276 (54%)	
Missing	4 (1.3%)	6 (1%)	
AIS classification at admittance n (%)			
AIS-A	75 (24%)	68 (13%)	
AIS-B	48 (16%)	61 (12%)	0.52
AIS-C	61 (20%)	83 (16%)	0.35
AIS-D	124 (40%)	298 (58%)	0.01
Neurological level SCI at admittance n (%)			
Group A (C2-T5)	169 (55%)	298 (58%)	0.58
Group B (T6 to S5)	126 (41%)	195 (38%)	
Missing	13 (4%)	17 (3%)	
Mobility at admittance n (%)			
Bedbound or wheelchair bound	218 (71%)	302 (59%)	0.19
Walker (from exercise to normal walker)	90 (29%)	208 (41%)	
Sensation of urge at admittance n (%)			
Normal	96 (31%)	221 (43%)	0.14
Not normal	212 (69%)	289 (57%)	
Defecation method (main method) at admittance n (%)			
Not normal	229 (74%)	304 (60%)	0.06
Normal	79 (26%)	206 (40%)	
Oral laxatives at admittance n (%)			
No	40 (13%)	52 (10%)	0.50
Yes	268 (87%)	458 (90%)	

Abbreviations: *AIS* American Spinal Injury Association Impairment Scale; *EBM* effective bowel management; *SCI* spinal cord injury.

study, bowel management improved in about half of the participants. Unfortunately, still one out of three participants (33%) did not achieve EBM at discharge.

Our clinical expert experience is that bowel management often deteriorates after discharge from the rehabilitation clinic, possibly due to environmental changes, such as changes in diet, daily structure or mobility. This is endorsed by several studies that examined the presence of severe NBD at least one year post injury, and reported higher percentages of severe NBD compared to our results at discharge. For example, in a study from [4], severe NBD one year post injury is reported in 42% of the participants. [4]. In a study from [5], severe NBD has been reported in 39% of participants with SCI for more than 1 year, and [6] reported severe NBD in 36% in participants with chronic SCI for more than 10 years. This emphasizes the importance of the achievement of EBM at discharge and knowledge of the risk factors of having no EBM.

Table 4. Multivariate logistic regression analysis on the factors associated with having EBM at discharge.

	OR	95% CI		*p*-value
		Lower	Upper	
AIS*				
AIS – B	1.43	0.50	4.06	0.48
AIS – C	1.7	0.64	4.56	0.27
AIS – D	2.82	1.38	5.78	0.01
Etiology	0.59	0.38	0.91	0.02
Normal defecation method	1.65	0.82	3.30	0.15
Age	0.99	0.97	1.01	0.16
Mobility	1.03	0.53	2.00	0.93

Abbreviations: *AIS* American Spinal Injury Association Impairment Scale.
* reference category AIS-A.

Our multivariate model for having EBM at discharge included the variables of neurological level, etiology, defecation method, age, and mobility. Participants with AIS-D had higher odds of having EBM at discharge than people with AIS-A. Participants with AIS-A were therefore more likely to have no EBM at discharge. Several other studies found a relation between neurological classification and NBD [4, 5]. The relation between neurological classification and constipation can be explained by the (partial) presence of rectal sensation and activity of abdominal muscles in incomplete lesions. Also, physical inactivity contributes to constipation and is more prone in AIS-A. In fecal incontinence this difference can be attributed to the (partial) presence of external sphincter control, rectal contractions and rectal sensation in incomplete SCI.

In our study, participants with non-traumatic etiology had lower odds for having EBM at discharge compared to those with traumatic etiology. It is not totally clear why people with a non-traumatic SCI are more at risk of not having EBM at discharge. An explanation could be that people with non-traumatic SCI have a more complicated and longer medical history, are more at risk of infections, and use more medication influencing bowel function compared to people with a traumatic SCI.

Non-significant factors in the multivariate model of factors contributing to EBM at discharge were age, mobility and having a normal defecation method at admittance. Age could be a confounder, as non-traumatic individuals were older than people with a traumatic SCI, and aging is associated with having bowel problems. It seems that people with no EBM at discharge are more often wheelchair users or were bedbound at admittance (70% versus 59%). This difference was, however, not statistically significant. We assume that mobility will improve relatively fast after admission, as it is one of the most important goals during clinical rehabilitation. As such, mobility at discharge might have a stronger relation with EBM at discharge. Furthermore, mobility is closely related to the AIS classification, which is possibly the reason why it is part of the final model.

A recent study showed that laxative use is correlated with an increase in fecal incontinence, and a higher dose of opioids is associated with more constipation at discharge [12]. In the current study, we did not find any impact of the use of opioids and laxatives on bowel management at discharge, and this does not appear to be a variable in the final model. A significant percentage of the people included in the study used medication influencing bowel function at admittance: 87% (no EBM group) and 90% (EBM group) used laxatives (see Table 3) and other medication affecting bowel function is often used at admittance as well (Table 2). One of the goals during rehabilitation is to reduce the use of this medication as soon as possible and therefore this medication will

not influence bowel function at discharge. Possibly, the use of oral laxatives or other medication influencing bowel function at discharge is a stronger predictor for EBM at discharge than the use at admittance. Moreover, in our study the dose of opioids and amount of laxatives used were unknown.

Strengths and limitations

The strength of this study is the large number of participants: a total number of 1210 participants have been included. Previous studies on NBD among people with SCI included smaller number of participants. Furthermore, to our knowledge this is the first study to evaluate bowel management in people with SCI both at admission and at discharge from the rehabilitation center.

A limitation is the large number of missing variables in the DSCID ($n = 666$). This might have introduced a bias. To reduce the risk of bias, multiple imputation has been used to replace missing values. When comparing analyses with and without imputation no significant differences in the distribution of EBM were found. Therefore, it is unlikely that the missing variables have a significant impact on our results. The reason for this lack of data could be to do with the extent of the DSCID resource and the time available to complete all the questions. It is known that the number of missing values does also occur in other DSCID datasets (e.g., bladder data).

Another limitation is the lack of registration of fiber and fluid intake, as diet is inextricably linked to bowel management. This information is also missing in other studies on NBD and including this in future research might be beneficial.

Clinical implications

NBD is very common among people with subacute SCI. During first inpatient rehabilitation, regulating NBD is a major challenge. We found that bowel management improves during first inpatient rehabilitation with current pharmacological and non-pharmacological interventions. Unfortunately. still 33% did not achieve EBM. This endorses the importance that healthcare workers, caregivers and people with SCI themselves, should monitor bowel function very closely during clinical rehabilitation, especially in people with an AIS-A and non-traumatic etiology. In addition to monitoring bowel management, we recommend education and individualized advice. As such, it is important to pay attention to (environmental) factors contributing to bowel function, for example diet and fiber intake. A systematic review showed that the alpha diversity of the gut microbiota might be lower in people with SCI compared to healthy subjects [13], which might lead to bowel problems. Studies showed that gut microbiome can be influenced by alterations in diet [23] and therefore attention to a well-balanced diet is indispensable.

Other ways of achieving EBM could also be considered sooner for those people with no EBM. Especially, no EBM with fecal incontinence has a high impact on the quality of life [7]. Therefore, in case of non-successful bowel management in the short or long term, treatment with colostomy should be considered. In our study we did not evaluate the clinical effect of colostomy treatment. But a recent study showed that 22 of the 23 participants experienced improvement in quality of life with a colostomy and 83% felt their stoma was placed too late [24].

NBD has an enormous impact on daily activities and quality of life in people with SCI. Therefore, severe NBD should be acknowledged early on after onset of SCI and should be closely monitored during clinical rehabilitation and beyond. It deserves lifelong attention and awareness for those at risk of severe NBD.

CONCLUSION

Among people with subacute SCI, bowel management is a major problem at admittance and still at discharge from first inpatient rehabilitation. Bowel management improves, but achieving EBM after recently acquired SCI is a challenge. This stresses the importance of bowel management during inpatient rehabilitation, and early detection of people at risk of persistent no EBM, especially for people with an AIS-A and non-traumatic etiology. Awareness and consideration of all treatment options during and after inpatient rehabilitation is recommended.

DATA AVAILABILITY

Additional data are available on request from the corresponding author.

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AUTHOR CONTRIBUTIONS

NV was responsible for writing the report, extracting and analyzing data and compiling the reference lists. JN contributed to data extraction, analyzing data and interpreting results, contributed to the design of the report and provided feedback on the report. WF and JS contributed to the design of the report and provided feedback on the report. BW provided feedback on the report.

COMPETING INTERESTS

The authors declare no competing interests.

ETHICAL APPROVAL

The board of the DSCID approved the study protocol.

ADDITIONAL INFORMATION

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