

# Level of Exercise Participation in Individuals with Traumatic Spinal Cord Injury During Inpatient Rehabilitation: A Cross-sectional Study

Shambhu P Adhikari,<sup>1,2</sup> Shraddha Adhikari,<sup>1</sup> Chanda Rana,<sup>3</sup> Rubee Dev<sup>4</sup>

<sup>1</sup>Department of Physiotherapy, School of Medical Sciences, Kathmandu University, Dhulikhel, Nepal, <sup>2</sup>Department of Physiotherapy, Dhulikhel hospital, Kathmandu University hospital, Dhulikhel, Nepal, <sup>3</sup>Spinal Injury Rehabilitation Center, Sanga, Nepal, <sup>4</sup>Sun Yat-sen University Global Health Institute, School of Public Health, San Yat-sen University, Guangzhou, China.

## ABSTRACT

**Background:** The outcome of exercises depends on participants' level of exercise participation. We aimed to investigate the level of exercise participation in individuals with traumatic spinal cord injury during inpatient rehabilitation.

**Methods:** All participants with traumatic spinal cord injury undergoing inpatient physiotherapy at a rehabilitation center were recruited. Participants with hearing/visual problems were excluded. Hopkins Rehabilitation Engagement Rating Scale and Pittsburgh Rehabilitation Participation Scale were used to evaluate exercise participation levels. One-way ANOVA and unpaired t-test were used to compare level of participation between groups. Pearson's correlation and Chi-square tests were used to evaluate correlation and association.

**Results:** Thirty-five participants with mean age  $37.1 \pm 11.7$  years completed the study. Hopkins Rehabilitation Engagement Rating Scale and Pittsburgh Rehabilitation Participation Scale demonstrated a low level of exercise participation in 31.4 % and 42.9 % participants respectively. Participants with an incomplete injury had high exercise participation levels compared to complete injuries. There were significant group differences ( $p < 0.001$ , effect size = 0.8) between complete and incomplete injuries and among various levels of injuries. The level of exercise participation was significantly associated with injury levels and type ( $p < 0.001$ , Phi = 0.7 to 0.9).

**Conclusions:** The exercise participation level was high for incomplete compared to complete injuries in Nepalese individuals with traumatic spinal cord injury. The demographic and socio-economical factors were not associated with level of exercise participation.

**Keywords:** Exercise participation; rehabilitation; spinal cord injury

## INTRODUCTION

Traumatic spinal cord injury (TSCI) results alteration in sensory, motor and autonomic functions.<sup>1</sup> The global incidence of TSCI is 13 to 53 cases per million,<sup>2,3</sup> which is increasing globally including Nepal.<sup>4,5</sup> Exercise participation (EP) is the extent to which participants engage in recommended exercises<sup>6</sup>, which is positively associated with functional recovery and quality of life.<sup>6,7</sup> Significantly large numbers of individuals (19.4%) do not participate fully in prescribed exercises.<sup>7</sup> Lack of supervised exercise program and socio-economic support, pain, fatigue, and infection are established

barriers to EP.<sup>8-10</sup> The evidence of EP in low-resource context is limited<sup>11</sup> and it has not been studied in Nepal. This study aimed to determine the level of EP among individuals with TSCI undergoing inpatient rehabilitation and compare two outcome measures; one used daily and another used once at the end of treatment sessions.<sup>12,13</sup>

## METHODS

This cross-sectional study was conducted in a rehabilitation center of Nepal after obtaining an ethical approval from Institutional Review Committee-Kathmandu University School of Medical Sciences (IRC-KUSMS, approval number: 133/19). Permission for the

**Correspondence:** Shambhu Prasad Adhikari, Department of Physiotherapy, School of Medical Sciences, Kathmandu University, Dhulikhel Hospital, Kathmandu University Hospital, Dhulikhel, Nepal. Email: [spsaur@gmail.com](mailto:spsaur@gmail.com). Phone: +9779860801047.

study has been obtained from the rehabilitation center as well. The eligibility criteria included individuals; a) with traumatic spinal cord injury at any AIS (ASIA Impairment Scale) grade b) any age c) either gender, and c) who were undergoing regular inpatient physiotherapy treatment at the rehabilitation center. Those who could not communicate verbally due to hearing or visual difficulty and those who were medically or surgically unstable were excluded from the study. The sample size includes all the patients of the center at that particular period of time (6 months) who met eligibility criteria. Therefore, 35 patients who a) met eligibility criteria and b) gave consent for participation were recruited purposively in the study. The Spinal Injury Rehabilitation center has been purposively selected for the study because a) it was the only one and well-established rehabilitation center particularly for spinal cord injury in the country and b) patients from different geographical regions, socio-economical status and injury level have easy and systematic accesses to the center. The study procedure has been described in Figure 1 in detail.

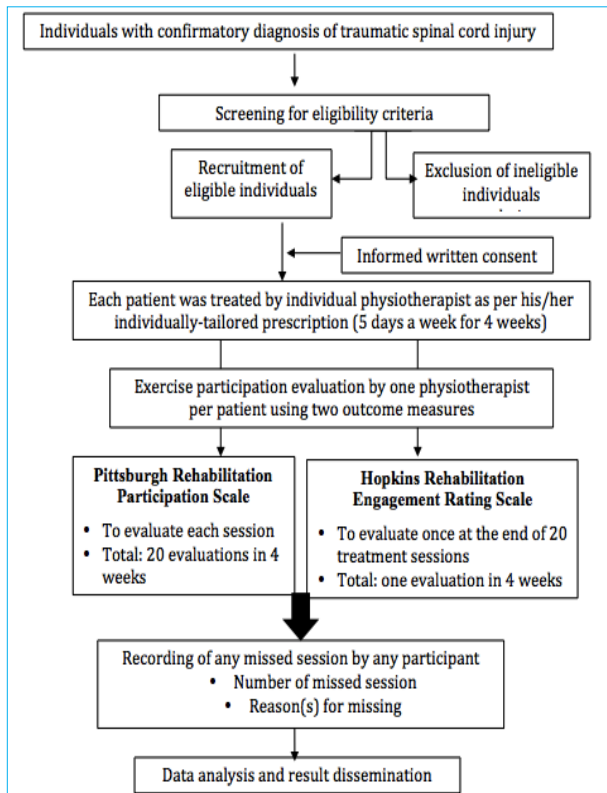


Figure 1. Flow chart of the study.

Two outcome measures were used in this study. The Hopkins Rehabilitation Engagement Rating Scale (HRERS) was one of the primary outcome measures, which is a clinician-administered scale for rating participation of TSCI patients in rehabilitation setting.<sup>13</sup> Each

participant’s engagement in the rehabilitation process is rated on the HRERS by a Physical therapist once at the end of treatment sessions. Thus, the rating represents therapist’s summary impression of the participants’ engagement during the interventions. There are five items in the scale and each item is measured in 6-point Likert scale. The item 2 of the HRERS (the patient required verbal or physical prompts to actively participate in my therapy/rehabilitation activity) is reversely scored. Scoring consisted of adding all of the ratings together. This scoring procedure yields a summary score that ranges from 5 to 30, a higher score representing greater engagement. Kortte et al., had divided the HRERS total score into three categories with the cutoff score, <20, 20-25, and >25.<sup>13</sup> We considered these cutoff scores for low, medium and high participation respectively. HRERS is administered only at the end of the therapy sessions. Psychometric properties of the tool (internal consistency: 0.91, intra-class correlation coefficient for inter-rater reliability: 0.73) were established.<sup>13</sup>

The Pittsburgh Rehabilitation Participation Scale (PRPS) was another primary outcome measure used which, was also a clinician-administered scale, that provides a temporal quantitative account for participation in each session and thus eliminates recall bias.<sup>12</sup> It only measures a single item i.e. motivation of participation. At the end of each session, the overall EP level is scored in 6-point Likert scale. Higher scores indicate better participation level in rehabilitation. Psychometric properties of this tool (intra-class correlation coefficient for inter-rater reliability: 0.91 to 0.96, good validity) were established.<sup>12</sup>

In this study, the process of rating every item and summarizing the total score was exactly followed as described in the HRERS and PRPS instructions.

Descriptive statistics were used to analyze participants’ demographic, clinical and baseline characteristics. Distribution of the data was checked using the Kolmogorov-Smirnov test. Since data were normally distributed, one-way ANOVA, paired t-test and unpaired t-test were used to compare the level of participation between four groups and two groups, within and between the groups respectively. An eta squared was calculated for the effect size.<sup>14</sup> The Chi square test and Pearson’s correlation analysis were done to evaluate the association between categorical variables and correlation between various continuous variables respectively. Significance level was set at  $p < 0.05$ . Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 21.

## RESULTS

Thirty-five participants were enrolled. As shown in Table 1, about two-thirds participants, 24 (68%) were female. The mean age of total participants was 37.1 years (SD: 11.7). In an average, the duration since injury and rehabilitation duration of total participants were 5.9 (8.1) and 2.0 (1.6) months respectively. The group wise mean (SD) on age, duration of injury and duration of rehabilitation have been shown in table 1. There were no group differences between complete and incomplete injury on age, duration of injury and duration of rehabilitation ( $p > 0.05$ ). Majority of the participants had injury in thoracic level (48.6%) followed by lumbo-sacral (28.6%) and cervical (22.9%). There were 14 (40.0%) participants who sustained complete injury (AIS A), whereas 21 (60.0%) participants sustained incomplete injuries (AIS B to D). There were 6 (17.1%) participants who were illiterate.

Based on PRPS and HRERS, 11 (31.4 %) and 15 (42.9 %) participants showed low level of EP respectively. Participants with incomplete injury had high EP level compared to complete injuries. Only 1 (7.1%) participant with complete injury had high level of EP on PRPS. There were no participants with a complete injury having a high-level of EP on HRERS (Table 1 and Figure 2).

**Table 1. Demographic and clinical characteristics of the participants (n = 35).**

Variables	Mean (SD) / Number (%)		
	Complete injury (n = 14)	Incomplete injury (n = 21)	All participants (n = 35)
Age (in year)	33.6 (11.1)	39.4 (11.8)	37.1 (11.7)
Duration since injury (in months)	6.1 (12.2)	5.7 (3.7)	5.9 (8.1)
Duration of rehabilitation (in months)	1.2 (0.7)	2.2 (1.7)	2.0 (1.6)
<b>Gender</b>			
Male	9 (64.3)	15 (71.4)	24 (68.6)
Female	5 (35.7)	6 (28.6)	11 (31.4)
<b>Neurological level</b>			
Cervical	2 (14.3)	6 (28.6)	8 (22.9)
Thoracic	9 (64.3)	8 (38.1)	17 (48.6)
Lumbosacral	3 (21.4)	7 (33.3)	10 (28.6)
<b>Exercise participation based on PRPS</b>			
High participation (average: > 4/6)	1 (7.1)	19 (90.5)	20 (57.1)

Low participation (average: $\leq$ 4/6)	13 (92.9)	2 (9.5)	15 (42.9)
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### Exercise participation based on HRERS

High participation (> 25/30)	0	13 (61.9)	13 (37.2)
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Medium participation (20 to 25/30)	3 (21.4)	8 (38.1)	11 (31.4)
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Low participation (< 20/30)	11 (78.6)	0	11 (31.4)
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### Literacy

Literate (able to read and write)	10 (71.4)	19 (90.5)	29 (82.9)
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Non-literate (unable to read and write)	4 (28.6)	2 (9.5)	6 (17.1)
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PRPS: Pittsburgh Rehabilitation Participation Scale, HRERS: Hopkins Rehabilitation Engagement Rating Scale, AIS: ASIA (American Spinal Injury Association) Impairment Scale, Incomplete injury: AIS B: 4 (19.0%), AIS C: 15 (71.4%), AIS D: 2 (9.5%)

As depicted in Table 2, significant differences were found between the group of complete and incomplete injury both on PRPS and HRERS with effect size of 0.8. Analyzing the various levels of AIS, ANOVA revealed significant differences among the groups with an effect size of 0.8 on both outcome measures. In post-hoc analysis, only AIS A demonstrated a significant difference ( $p < 0.001$ ) with AIS B, AIS C, and AIS D on both PRPS, and HRERS.

Level of EP based on both PRPS and HRERS did not reveal any significant association ( $p > 0.05$ ) with age, gender, marital status, literacy, neurological level, rehabilitation duration and duration since injury. The level of EP based on PRPS showed significant association with AIS levels ( $p < 0.001$ ,  $\Phi = 0.8$ ) and with type of injury ( $p < 0.001$ ,  $\Phi = 0.8$ ). Similarly, the level of exercise participation based on HRERS showed significant association with AIS levels ( $p < 0.001$ ,  $\Phi = 0.7$ ) and with type of injury ( $p < 0.001$ ,  $\Phi = 0.9$ ).

Though the PRPS score for the first two weeks showed significant differences compared with the score of second two weeks ( $t = -2.9$ ,  $p = 0.006$ ,  $n = 35$ , effect size: 0.5), the total PRPS score of four weeks was significantly correlated with HRERS score obtained at the end of four weeks (Pearson's coefficient: 0.98,  $p < 0.001$ ).

Table 2. Comparison of exercise participation in individuals with complete versus incomplete injury (n = 35).

Variables	Mean (SD)					Unpaired t-test (Comparison between complete and incomplete injury)			One-way ANOVA (Comparison among AIS levels A, B, C and D)			
	Complete injury - AIS A (n = 14)	Total (n = 21)	AIS B (n = 4)	AIS C (n = 15)	AIS D (n = 2)	t	p-value	95% CI	Effect size	F	p-value	Effect size
PRPS score of first two weeks	29.4 (7.4)	48.2 (8.3)	41.5 (2.9)	48.7 (8.4)	57.5 (3.5)	7.2	< 0.001*	-24.4 to -13.2	0.8	19.9	< 0.001*	0.8
PRPS score of second two weeks	28.8 (10.0)	52.8 (7.4)	49.5 (4.2)	52.7 (8.0)	60.0 (0.0)	6.9	< 0.001*	-30.0 to -18.0	0.8	22.7	< 0.001*	0.8
PRPS score of total four weeks	58.1 (16.7)	100.7 (15.2)	91.00 (6.98)	98.67 (20.94)	115.00 (7.07)	7.2	< 0.001*	-53.7 to -31.5	0.8	15.2	< 0.001*	0.8
HRERS score at the end of four weeks	17.4 (3.3)	26.1 (3.2)	24.00 (1.41)	25.80 (4.30)	29.00 (1.41)	6.9	< 0.001*	-10.9 to -6.4	0.8	15.8	< 0.001*	0.8

In the table: \* p < 0.01. PRPS: Pittsburgh Rehabilitation Participation Scale. HRERS: Hopkins Rehabilitation Engagement Rating Scale. AIS: ASIA (American Spinal Injury Association) Impairment Scale. SD: standard deviation.

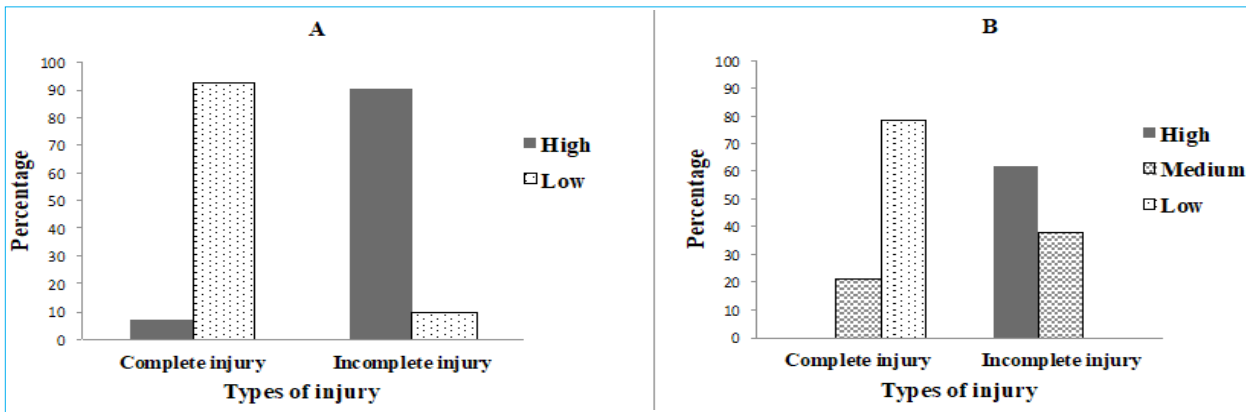


Figure 2. Level of exercise participation. A: Based on Pittsburgh Rehabilitation Participation Scale. B: Based on Hopkins Rehabilitation Engagement Rating Scale.

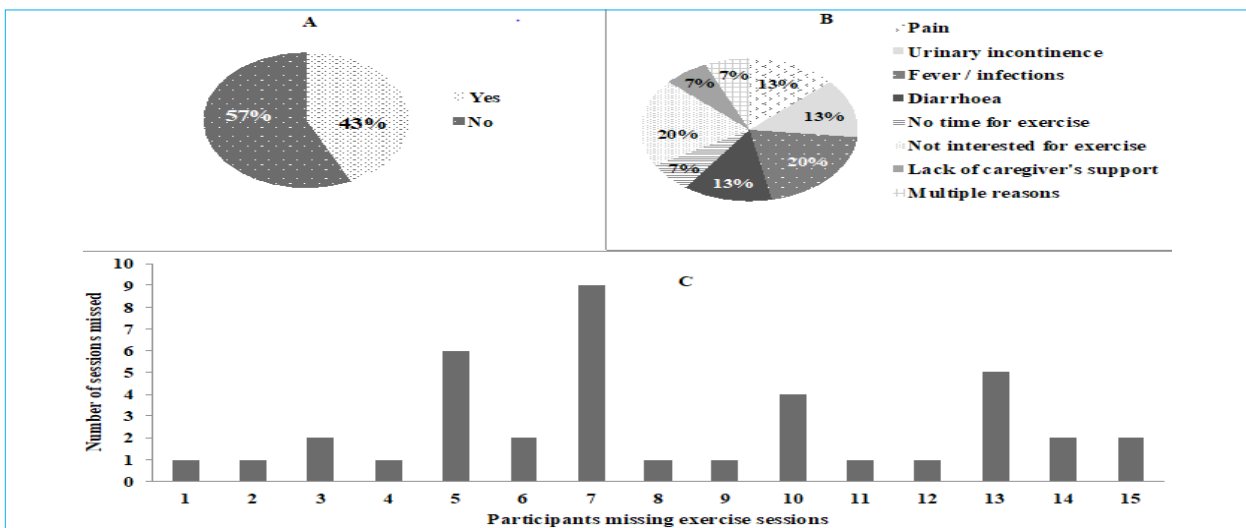


Figure 3. Missed exercise sessions. A) Missed percentage. B) Reasons for missing exercises, C) Number of exercise sessions missed by different participants.

As presented in Figure 3, 43% of participants missed some exercise sessions. Seven and four participants missed one and two sessions respectively. Three participants missed 4, 5 and 6 sessions each. One participant missed 9 sessions of exercises. The reasons for missing exercise sessions have been shown in Figure 2 B. There were multiple reasons stated by the participants who missed 9 sessions of exercises.

## DISCUSSION

Findings of this study showed that the exercise participation level was high for incomplete injuries and low for complete injuries in individuals with TSCI during inpatient rehabilitation. The level of exercise participation was associated with levels of AIS. Two outcome measures used to evaluate exercise participation, one on a daily basis and another once at the end of the treatment session were highly correlated.

More than two-third of the participants demonstrated low exercise participation level in this study, which was consistent with the findings of earlier studies conducted in the United States and Italy.<sup>15,16</sup> The literacy rate in the United States and Italy is much higher and resource context could be much better compared to Nepal. We evaluated exercise participation level in participants during inpatient rehabilitation. Our findings were in line with the findings from a study by Paolucci et al., in Italy<sup>16</sup> where exercise participation was assessed among hospitalized patients. A study by Ditor et al., reported that exercise participation level decreased only after nine months of follow-up.<sup>6</sup> This finding was in contrast to the findings of present study in which exercise participation levels were decreased even after two months of rehabilitation.

Participants demonstrating low level of exercise participation did not report any barriers in the present study. This finding was consistent with the findings of Scelza et al., in a study done in the United States,<sup>15</sup> where more than half of the participants demonstrated low exercise participation in spite of no single perceived barrier. These findings suggested that there could be low exercise participation level without obvious barriers whether in high or low resource context. The level of exercise participation was assessed using two outcome measures in the present study, and both measures demonstrated similar findings. Therefore, measuring outcomes using two different tools might have strengthened the validity of our findings.

Studies have reported several barriers of EP including, fear of leaving home, lack of exercise knowledge, fear of injury, public exposure,<sup>15</sup> lack of transportation,

cost of the exercise program,<sup>15,17</sup> lack of energy, lack of motivation, lack of time, unwillingness to do exercise, difficulty of exercise, and lack of interest.<sup>17,18</sup> The participants in the present study were living in a rehabilitation center to whom individually tailored and structured exercises were administered directly by the physiotherapist at a specific site. Therefore, transportation, fear of living home, lack of time, exercise difficulty should not be barriers in our study. However, lack of interest, lack of motivation, unwillingness, fear of injury, and lack of energy might have contributed towards low exercise participation. Consistent with the findings of a study by Lundstrom et al., in 2017,<sup>19</sup> secondary health complications might have reduced EP in present study, which could also be the major reason for missing exercise session.

The EP level was associated with AIS levels. The higher the level of AIS ('A' to 'D'), the higher was the EP level. Participants with AIS grade 'D' and AIS grade 'A' engaged in exercises to maximum and minimum level, respectively. The mean data demonstrated that there was much variation in participation level from AIS grade 'A' to 'B' and from 'C' to 'D'. This could be because patients having a higher level of mobility demonstrated higher participation levels, which was consistent with the findings of other studies.<sup>15,16,20</sup> Positive association with AIS levels indicated that participation level was high for AIS 'C' and 'D' but low for AIS 'A' and 'B' levels. The higher the ability of the participants to actively and independently move all body parts and exercise, participation levels were increased. This finding was consistent with the findings of a study by Crawford et al., who assessed EP using a participation survey/mobility tool and found that participants in the high mobility group had higher participation levels.<sup>20</sup> Scelza et al., in 2005 found that a greater number of concerns were associated with perceived stress.<sup>15</sup> Low participation levels in participants with AIS 'A' in the present study could be due to increased stress because of complete paralysis and more dependency on ADLs. Approximately 69% of the participants in our study were greater than 30 years of age and married. Family and socio-economical responsibility might be additional factors resulting in stress to influence EP. Associated impairments could be another factor for lower exercise participation in the present study as Scelza et al., described that increased health related concerns due to increased impairment may lower EP.<sup>15</sup>

A high correlation between HRERS and PRPS scales ( $\rho$ : 0.98) indicated that EP level assessed on each session for four weeks using PRPS and once at the end of 4-week treatment using HRERS remained similar.

Therefore, the EP level may be evaluated once at the end of a treatment session rather than on each session, which saves time and will be very practical for therapists. Paullucci et al., in their study used PRPS for each session evaluation at the beginning and at the end of two weeks in late phases as well and demonstrated valid findings.<sup>16</sup> However, single assessment at the end of the treatment session may be influenced with recall bias.<sup>12</sup> Our study demonstrated significant differences with the PRPS score of first two weeks and second two weeks. Therefore, weekly evaluation could be a good option either using PRPS or HRERS to provide a summary rating. The HRERS is more useful to capture multiple elements of EP.<sup>13</sup>

This study did not demonstrate association between level of EP with age, gender, marital status, literacy, neurological level, rehabilitation duration and duration since injury. The average duration of rehabilitation in the present study was about 2 months, which was not too long in the course of TSCI rehabilitation. That could be the reason for not showing an association in the present study. Ditor et al., in 2003<sup>6</sup> demonstrated that EP level may get reduced with a longer duration of rehabilitation. The type of exercises may also influence EP level. Rauch et al.,<sup>21</sup> found gender differences, in which women were more interested for less competitive, more recreational and group oriented activities. The treatment in present study was individually tailored, one-on-one therapy, which might have yielded to contrast findings from that of study by Rauch et al. Since present study was conducted during inpatient rehabilitation, physiotherapist and enriched environment might have supported and motivated to engage in the exercises based on individual's need and interest. Therefore, further studies are warranted to explore association between the level of EP and clinic-demographic characteristics as well as socio-economical burden of the individuals with TSCI living in the community.

Though fifteen patients reported missed treatment sessions in the present study, the majority of them missed just one or two sessions. One patient who missed nine sessions had multiple reasons at different points of time. Lack of interest for exercise (30%) and fever or infection (30%) were major reasons for missing exercises. Lack of interest, no time and lack of a caregiver's support, all together represented 34% of the missed sessions, which could be truly minimized during physiotherapy treatment to improve the outcome. The reasons for missed sessions were similar with the barriers of EP.<sup>15,17,18</sup> Therefore, barriers have to be addressed to improve EP level and minimize number of missed sessions.

This study has specific clinical significance. The EP level is high in Nepalese individuals with incomplete injuries compared to complete injuries during inpatient rehabilitation. This finding provides evidence to physiotherapists for exercise prescription to Nepalese individuals in Nepali cultural context and background during day-to-day clinical practice. Since there was high correlation between the HRERS (which is used to assess individual's exercise participation level at the end of the treatment sessions) and PRPS (which is used to assess individual's exercise participation level in each session), the EP level may be evaluated once at the end of a treatment session, which saves time and will also be very practical for therapists in the clinical practice. Though demographic and socio-economical factors vary at different cultural context and background, these factors were not associated with EP level in Nepalese participants. The EP is associated with type of injury as well as level of injury in Nepalese individuals.

Selection of single center in the study is one of the limitations. However, with respect to the nature of the service, facilities, access and location, the selection of the rehabilitation center for this type of study could be an ideal. Though we recruited all the eligible patients of the center during the study time, the sample size is still small.

## CONCLUSIONS

The EP level was high for incomplete injuries and low for complete injuries in Nepalese individuals with TSCI during inpatient rehabilitation. The HRERS, which is used to assess individual's exercise participation level at the end of the treatment sessions and the PRPS, which is used to assess individual's exercise participation level in each session were correlated each other, The EP level was associated with types of injury as well as AIS levels. Though demographic and socio-economical factors were not associated with the level of EP in individuals receiving inpatient rehabilitation, further study is recommended to explore the association in individuals with TSCI living in the community.

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