

## To measure the normative values of four functional tasks in patients with spinal cord injury who use a self-propel manual wheelchair

Jayshree Manish Sutaria<sup>1\*</sup>, Anjali Bhise<sup>2</sup>

<sup>1</sup>Ph. D. Scholar in Gujarat University, Lecturer, <sup>2</sup>Ph. D. guide in Gujarat University, I/C Principal and Senior Lecturer, <sup>1,2</sup>Government Physiotherapy College, Government Spine Institute Civil Hospital Campus, Ahmedabad, Gujarat, India

\*Corresponding Author: Jayshree M. Sutaria

Email: jayshreemsutaria@gmail.com

---

### Abstract

**Introduction:** To function independently, manual wheelchair users must possess a variety of wheel-chair skills to be able to deal with the physical barriers they will encounter in various environments in daily life. Four functional tasks is a reliable wheelchair skill set test which works as a guiding instrument in the rehabilitation process of people with spinal cord injury.

**Objective:** The aim of this study was to measure the normative values of 4 functional tasks for patients with spinal cord injury who used to self-propel a manual wheelchair.

**Materials and Methods:** 50 spinal cord injury self-propel manual wheelchair users patients. Data was collected for time taken and distance covered for four functional tasks which included: timed forward wheeling and ramp ascent; distance covered during forward vertical reach and 1-stroke push.

**Result:** Data derived included descriptive data values of 4 functional tasks.

**Keywords:** Four functional tasks, Wheelchair mobility, Spinal cord injury, Self-propelled wheelchair, Normative values.

---

### Introduction

Spinal cord injury (SCI) is the injury of the spinal cord from the foramen magnum to the cauda equine which occurs as a result of compulsion, incision or contusion. Spinal cord injury is a traumatic and life changing event, which leads to neurological deficits and disabilities, because of the loss of mobility and sensation. The mobility associated with SCI is a major contributing factor influencing inactivity in people with SCI. The incidence of SCI in developing country is 25.5 per million per year. The majority of SCIs are due to trauma; the most common causes of traumatic SCIs are motor vehicle accidents or motor-bike accidents, followed by falls, violence, and sports accidents.<sup>1</sup> There is strong relationship between functional status and whether the injury is complete or not complete, as well as the level of the injury. The majority of people with a spinal cord injury (approximately 80%) are dependent on a wheelchair for their mobility for the rest of their lives.<sup>2</sup> To function independently, manual wheelchair users must possess a variety of wheelchair skills to be able to deal with the physical barriers, they may encounter in various environments of daily life.<sup>3</sup> 'Wheelchair skill performance' is defined as; the ability to move around and overcome obstacles encountered when carrying out daily activities and social roles in self-propelled wheelchair.<sup>2</sup> Four functional tasks are reliable (r=0.99) wheelchair skill test which works as a guiding instrument in the rehabilitation process of people with spinal cord injury.<sup>4</sup> Four functional tasks include,<sup>4,5</sup> timed forward wheeling, ramp ascent, forward vertical reach and One stroke push. No studies have been done yet to find the normative values of four functional tasks for spinal cord injury patients in Indian population. Thus, the aim of this study was to quantify the functional ability of wheelchair users with chronic spinal cord injury and provide normative values by using four functional tasks

tool in individuals with spinal cord injury who self-propel wheelchair.

### Materials and Methods

This study was conducted at physiotherapy college and government spine institute and was approved by the institutional ethics committee. 50 self-propelling, manual wheel chair users were recruited. A sample of convenience was chosen with the following inclusion criteria 1) Age group above 18 years of age 2) Both genders 3) Ability to self-propel a manual wheelchair 4) Duration of spinal cord injury  $\geq$  6 months, 5) Both traumatic and non-traumatic origin of SCI patients, 6) The level of lesion at or below D6 level, 7) complete / incomplete lesion and classified as A or B on the American Spinal Injury Association (ASIA) Impairment Scale. The exclusion criteria were 1) Patients with upper limb fractures and injuries 2) Patients with cervical injuries and fractures 3) participants with psychosomatic disorders and any serious co-morbidity. Written informed consent was taken from the participants before participation in study. Four functional tasks were developed incorporating propulsion speed, strength and trunk stability. 1. Timed forward wheeling (Fig. 1): Time in seconds (sec) was recorded from the moment there was first movement of the casters and ceased when the most posterior aspect of the rear wheels crossed the finish line. The wheeling distance is of 23 metres (m) (plus length of the wheelbase). The time taken to complete the 23 m distance was measured using a stop watch. 2. Ramp ascent (Fig. 2): Participant was allowed a moving start of 4.5m on a level surface to gather momentum. Time was recorded when the front casters crossed the start line at the beginning of the incline and continued till the most posterior aspect of the rear wheels crossed the finish line at the top of the ramp (distance 10.3m, grade 1:13). The time taken to ascend the

ramp was measured using a stop watch. 3. Forward vertical reach (Fig. 3): The wheelchair was positioned parallel to a marking board, and participants held the stick, independently (palms down). Participants were instructed to keep the stick level and to avoid excessive backward arching. The distance from the floor to the mark was measured in centimetres (cm). 4. One Stroke Push (Fig. 4) was taken with all 4 wheels of the wheelchair positioned on the carpeted or grass surface (1.5-cm pile); the participant propelled the wheelchair forward by pushing once with maximal effort. Once the wheelchair rolled to a stop, the most posterior point of the rear wheels was marked to indicate the completed distance pushed. If the push was asymmetrical, the mark was recorded for the most posterior wheel. The distance (cm) between the 2 marked points was recorded. This task was selected because wheeling on carpet or uneven surface is a common everyday activity requiring strong effective propulsion. Two trials for each task were taken and average score was recorded and documented. Maximum rest period of 30 seconds was allowed in between the test. All testing was completed without any incident and there were no complaints of fatigue during testing.



Fig. 3: Vertical reach



Fig. 1: Forward wheeling

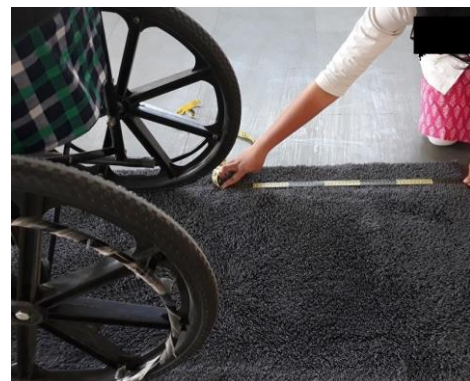


Fig. 4: One stroke push test



Fig. 2: Ramp ascending

**Results**

In this study, the participants performed both timed and distance-rated tasks. The statistical analysis of the present observational study was done using Microsoft Office Excel 2007. Descriptive data analysis of all measurements including demographics and duration of injury were calculated for normative data (Table 1 and Table 2).

**Table 1: Demographic data and anthropometric data of the subjects**

Characteristics	N	Min	Max	Mean±SD
Age(year)	50	18	65	33.80±12.81
Height(cm)	50	134	182	160.82±10.43
Weight(kg)	50	35	75	53.82±9.53
Duration(months)	50	6	36	9.36±6.79

Min: minimum; Max: maximum

N =Number of subjects

**Table 2: Normative data of four functional tasks in 50 patients with spinal cord injury**

Four Functional Tasks	Mean $\pm$ SD	Min	Max
Forward Wheeling(sec)	20.86 $\pm$ 8.56	11.50	60
Ramp Ascent (tsec)	15.60 $\pm$ 6.13	6.30	37.87
One Stroke Push(cm)	101.582 $\pm$ 21.35	50	169
Forward Vertical Reach (distance in cm)	152.183 $\pm$ 13.75	93	175

## Discussion

The present study done on 50 spinal cord injury patients to measure the normative values of four functional tasks.

The present study describes how 4 functional tasks relevant to wheelchair postural support comparison were developed; All the tasks are representative of daily activities encountered by manual wheelchair users. The task represents both static and dynamic activities. The forward wheeling task was selected because it represents the routine pathway in any community. The ramp ascent task was selected because ramps are a common environmental barrier encountered everywhere. One stroke push task was selected because wheeling on carpet or uneven surface like grass is a common everyday activity requiring strong effective propulsion. The forward vertical reach task represented the postural balance in manual wheelchair users.

The 4 tasks were simple and meaningful with respect to daily activities. Within a clinical setting, issues of time and equipment often limit the ability to obtain objective data. Approximately 30 minutes was required to complete 2 trials of the 4 functional tasks with adequate rest periods included. These findings of normative values of time and distance of four different functional tasks indicate the usefulness in evaluation of the functional capacity with minimal equipment during rehabilitation after spinal cord injury who self-propel a manual wheelchair to predict prognosis and to design wheelchair skill training programs.

The results of this study may be used as reference data in future studies. The efficacy of four functional tasks in acute and sub-acute cases of spinal cord injury can be further studied. The correlation of various factors like age, BMI, duration of injury, level of injury and types of wheelchairs with the values of four functional tasks may also be determined. It can help in evaluating the present status of functional ability of the patients and help in documenting the progress after providing wheelchair training interventions. The four functional tasks are realistic to use in clinics, as they require no special equipment and can be performed in a reasonable amount of time. Time and distance measurement reduces the possibility of subjective interpretation, which can influence the overall scoring.

Limitations include the convenience sampling method and low sample number.

## Conclusion

This study has provided the normative values of four functional tasks that are safe and practical to measure wheelchair propulsion speed on flat and inclined surfaces, overhead reaching abilities and maximal distance the patient can travel using only one stroke on a carpet. These functional tasks provide objective information, are simple to

perform, and do not require excessive time or equipment. These results are primarily limited to wheelchair-dependent individuals with spinal cord dysfunction, although these tests may be useful with other patient populations who self-propel a manual wheelchair. Repeat measurement studies would also help to determine the ability of these tests to detect changes over time.

**Conflict of Interest:** None.

## References

1. Nas K, Yazmalar L, Şah V, Aydın A, Öneş K. Rehabilitation of spinal cord injuries. *World J Orthop* 2015;6(1):8-16. DOI: <http://dx.doi.org/10.5312/wjo.v6.i1.8>
2. Post MWM, Asbeck van FW, Dijk van AJ, Schrijvers AJ. Services for spinal cord injured: availability and satisfaction. *Spinal Cord* 1997;35:109-15.
3. Gouvier WD, Cottam G, Webster JS, Beissel GF, Wofford JD. Behavioral interventions with stroke patients for improving wheelchair navigation. *Int J Clin NeuroPsychol* 1984;6:186-90.
4. May LA, Butt C, Minor L, Kolbinson K, Tulloch K. Measurement reliability of functional tasks for persons who self-propel a manual wheelchair. *Arch Phys Med Rehabil* 2003;84:578-83.
5. May LA., Butt C. Wheelchair back-support options: functional outcomes for persons with recent spinal cord injury. *Arch Phys Med Rehabil* 2004;85(7):1146-50.

**How to cite this article:** Sutaria JM, Bhise A. To measure the normative values of four functional tasks in patients with spinal cord injury who use a self-propel manual wheelchair. *J Soc Indian Physiother* 2019;3(1):6-8.