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Manual wheelchair longevity and related factors among spinal cord lesion patients

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Abstract

The wheelchair is an essential mobility tool for paraplegic or tetraplegic patients. The wheelchair longevity and related factors among spinal cord lesion patients in Thailand has not been reported. The objectives of the current study were to determine the longevity of manual wheelchairs and the related factors among spinal cord lesion patients. Spinal cord lesion patients who received treatment at the In-and/or Out-patient Rehabilitation Medicine Department were interviewed for demographic data and factors related to wheelchair use. Data were analyzed for means, medians, and negative and positive factors related to wheelchair usage and life expectancy. Sixty patients were included in the study. The respective mean and median manual wheelchair lifetime was 4 years and 4 months (52.3 ± 28.7 months) and 4 years. Most participants required their first wheelchair repair within the first 2 years. Survival analysis revealed that after 4 years of use, 50% of wheelchairs were still functioning. The negative factor significantly affecting lifetime was navigating the wheelchair on a lawn ($p = 0.003$) while the positive factor was navigating on smooth concrete ($p = 0.006$). Participants who navigated the wheelchair on a lawn surface had greater chance of getting early wheelchair replacement.

Keywords: wheelchair, broken, repair, wheelchair lifetime, spinal cord lesion patients

1. Introduction

The wheelchair is an important mobility aid for disabled patients. In 2014, 6.8 million Americans used an assistive device for mobility, of which 1.7 million used a wheelchair or scooter [1]. Spinal cord lesion (paraplegia and quadriplegia) is the leading disorder among those between 18 and 64 years of age needing a wheelchair or scooter [1]. The number of spinal cord injury patients in the USA in 2014 was 240,000 and < 1% have full recovery at discharge from hospital [2]. McClure et al. (2009) reported that 70% of patients with such an injury used a wheelchair [3].

There are many types of wheelchairs, including the manual and electrical wheelchair. The majority of patients (90%) who depended on wheelchairs or scooters used a manual wheelchair, particularly those living in a low family income [1]. The durability of a wheelchair is influenced by how it is used and the quality of manufacture. Chen et al. and Oyster et al. determined that the factors affecting performance, breakage and accidents were: (i) personal factors (i.e., body weight, level of spinal cord injuries, duration of daily use, characteristic of use, maintenance, career, duration of disease); (ii) environmental factors (i.e., type of surface); and, (iii) wheelchair factors (i.e., brand, type, material composition) [4-5].

In Thailand, the 2012 National Disability Survey revealed that the number of disabled persons was 1.48 million or 2.0 percent of the population [6]. One-third (34.4%) had difficulty walking and 11.8% could not walk at all [6]. Patients who could not ambulate and required a wheelchair was about 600,000 persons. Most wheelchair users in the younger group were paraplegics or tetraplegics requiring a wheelchair for independence and the majority used a manual standard wheelchair just as in developed countries.

The aims of this study were to determine (a) the average lifespan of a manual standard wheelchair and (b) the related factors affecting the longevity of manual wheelchairs used by the patients with spinal cord disorders. The benefits of this study are to provide (a) evidence-based recommendations to the Thai government on the timing

of subsidies to replace broken wheelchairs, and (b) information to wheelchair users on the proper operation and maintenance of a wheelchair.

2. Materials and Methods

This study included spinal cord disorder patients between 18 and 70 years of age who required a wheelchair. All patients received treatment from the Department of Rehabilitation Medicine, KhonKaen University between November 1, 2012 and September 30, 2013. The patients had all used at least one wheelchair until it failed. The patients gave written informed consent before entering the study. The included patients were interviewed and recorded their (a) demographic data, (b) level and severity of spinal cord disorders, (c) duration of wheelchair usage (the duration from start using a new wheelchair until stop using due to wheelchair broken and unrepairable), and (d) related factors (i.e., frequency of use, activities, maintenance program and breakage). The patients who changed the wheelchair from other reasons before the wheelchairs were broken, non-communicative patients or patients with complications that obviated wheelchair use (i.e., having pressure sores) were excluded. The Human Ethics Committee of KhonKaen University (HE561422) approved the study protocol.

Descriptive statistics for the lifetime of each wheelchair were calculated, including: means, standard deviations (mean \pm SD) and median. A univariate analysis for related factors (continuous data) was done using an ANOVA, while the categorical data were analyzed using the Wilcoxon-Mann-Whitney test and the Kruskal-Wallis test. A multivariate analysis was performed using multiple linear regression. The probability of wheelchair survival (long-term durability/usage) was reported using a Kaplan-Meier survival curve. Statistical analyses were conducted using STATA version 10. The p-value was accepted at < 0.05 .

3. Results

The data were collected from the interviews of 60 patients (48 males and 12 females; 50 paraplegics, 10 tetraplegics; average age 40.1 ± 10.3 years, BMI 21.6 ± 4.5 kg·m⁻²). Lesions included 9 cervical, 42 thoracic and 9 lumbar. The respective severity of disability was: 32 ASIA A, 16 ASIA B, 9 ASIA C and ASIA D (ASIA stand for The American Spinal Injury Association Impairment Scale). The causes of spinal cord injury included: accident (n=43), spinal cord tumor (n=4), degenerative spine (n=1), and other medical conditions (n=12). The cost of treatment was paid by: Universal Health Care Scheme (n=42), Social Security Scheme (n=16) and Civil Servants Medical Benefits Scheme (n=2). Thirty-three patients were able to maintain their job while using a wheelchair. The baseline data are presented in Tables 1 and 2.

Table 1 Patient characteristics

Characteristic	N = 60 (%)
Sex	
Male	48 (80)
Female	12 (20)
Age (years)	
Mean	40.06 \pm 10.32
BMI (kg·m ⁻²)	
Mean	21.6 \pm 4.5
Cause	
Trauma	43 (71.7)
Medical disease	12 (20)
Spinal cord tumor	4 (6.7)
Degenerative disease	1 (1.7)
Type of disability	
Paraplegia	50 (83.3)
Quadriplegia	10 (16.7)
Neurological level	
Cervical	9 (15)
Thoracic	42 (70)
Lumbar	9 (15)

Table 1 Patient characteristics(Continue)

Characteristic	N = 60 (%)
ASIA classification	
ASIA A	32 (53.3)
ASIA B	16 (26.7)
ASIA C	9 (15)
ASIA D	1 (1.7)
Unknown	2 (3.3)
Comorbidity	
Asthma	1 (1.7)
Diabetes	4 (6.7)
Hepatitis	1 (1.7)
Hypertension	2 (3.3)
Thalassemia	1 (1.7)
Valvular heart disease	1 (1.7)
No underlying disease	50 (83.3)
Occupation	
No	27 (45)
Self-employed	2 (3.3)
Government service	9 (15)
Freelance	17 (28.3)
Agriculture	3 (5)
Student	2 (3.3)
Sponsorship	
Universal Health Care Scheme	42 (70)
Social Security Scheme	16 (26.7)
Civil Servants Medical Benefits Scheme	2 (3.3)
Broken part	
Handles	1 (0.4)
Backrest	14 (5.4)
Armrests	25 (9.6)
Frame	15 (5.8)
Clothing guards	6 (2.3)
Seat cushion	24 (9.2)
Heel loop	8 (3.1)
Brakes	38 (14.6)
Foot plates	22 (8.3)
Casters	10 (3.8)
Caster housings	42 (16.1)
Push rims	10 (3.8)
Rear wheel	8 (3.1)
Rear wheel housing	4 (1.5)
Tyres	21 (8.0)
Pneumatic tyres	13 (5.0)
What happen after broken wheelchair?	
Self-payment for new wheelchair	
Continue using broken wheelchair	8 (12.3)
Stop using broken wheelchair	26 (40)
Received new wheelchair from government (broken after 5 years)	4 (6.2)
	22 (36.7)

Table 2 Wheelchair use and repair characteristics

Characteristic	Number (%)
Floor	
Concrete	45 (36.3)
Lawn	11 (8.9)
Sand	13 (10.5)
Impacted soil	6 (4.8)
Gravel	25 (20.2)
Tile	24 (19.4)
Independent	58 (96.7)
Dependent	2 (3.3)
Activity	
Community (≥ 50 m)	38 (26.0)
Household	55 (37.7)
Using during shower	24 (16.4)
Sports and exercise	14 (9.6)
Cause	
Accident	8 (13.3)
Deliberately damage	1 (1.7)
Stolen	1 (1.7)
Not specified	50 (83.3)
Maintenance program	
Check up	2 (3.3)
First repaired	
Never	16 (26.7)
< 6 months	7 (11.7)
6-12 months	8 (13.3)
1-2 years	22 (36.7)
>2 years	7 (11.7)
Method of repair	
Owner	35 (40.2)
Bicycle shop	14 (16.1)
Dealer	0 (0)
Hospital	20 (23.0)

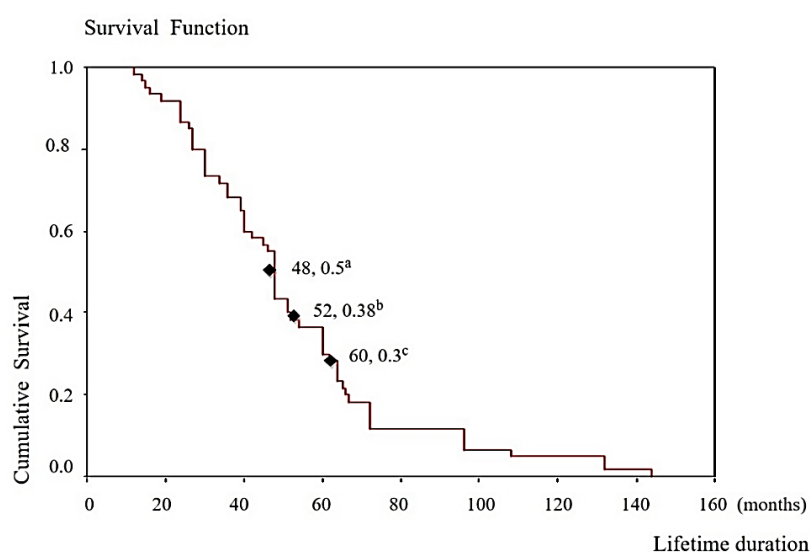


Figure 1. Survival analysis of wheelchair lifetime (a = 50% of patients without broken wheelchair at 48 months; b = 38% of patients without broken wheelchair at 52 months; c = 30% of patients without broken wheelchair at 60 months).

The average wheelchair lifetime was 4.3 ± 2.4 years (median, 4 years). Daily use averaged 7.4 ± 5.0 h/day. The types of floor on which the wheelchair was used included smooth concrete floors (36.3%), compacted soil (4.8%), lawn (8.9%), sand (10.5%), gravel (20.2%), and tile (19.4%). Most (96.7%) of the patients operated their wheelchair for independent mobility. Community navigation (> 50 m) was 26.0% vs. 37.7% who had only household use. Sport activity and taking a shower both accounted for 16.4% of use.

The causes of damage were accidental (13.3%), deliberate or someone broke (1.7%), vandalism (parts stolen) (1.7%) and non-specified from routine use (83.3%). The most common broken parts were the front wheel bearing (16.1%), brakes (14.6%), arm rests (9.6%), seat (9.2%), foot rest (11.4%), tyres (13.4%), metal frame (8.1%), back rest (5.6%), front wheel (3.8%), rear wheel (3.1%) and rear wheel bearings (1.5%). Broken wheelchairs were repaired by: (a) the owner (40.2%), (b) a bicycle shop (16.1%), or (c) a hospital (23.0%): none was repaired by a wheelchair dealer.

One-third (36%) of wheelchairs were broken within 2 years. A large number (40%) of patients with a broken wheelchair did not receive support for a new wheelchair. Factor analysis revealed the negative factor limiting wheelchair lifetime was handling it on lawns ($p = 0.003$, 95%CI -44.32 to -9.57) while the positive factor was handling on smooth concrete ($p = 0.006$, 6.12 to 35.02). Body weight, level of injury, usage per day, occupation, duration of disease and brand of wheelchair had no significant impact.

Survival analysis revealed that 50% of wheelchairs had a 4-year life expectancy, 62% were not working after 4.3 years (on the average wheelchair lifetime), and 70% of wheelchairs were broken by 5 years (Figure 1).

4. Discussion

The study revealed the median wheelchair lifespan was 4 years, while the average was 4.3 ± 2.4 years. Survival analysis showed that 50% of wheelchairs were working for the median and 38% for the average lifetime. The significant beneficial factor was driving on smooth concrete and the harmful factor was driving on lawn.

Survival analysis revealed that 50% of wheelchairs had a 4-year lifetime, which means that half of the patients suffered from limitations to community mobility after 4 years if they were unable to afford a new wheelchair. If they continued to use a broken wheelchair, accident or injury was a real possibility. Patients who have broken wheelchair should receive a replacement as soon as possible; however, this is not always feasible in developing countries where budgets are limited. This study, therefore, suggested the most appropriate time for the government to subsidize a new wheelchair (replace a broken one) should be after not more than 4 years of use.

The current study found that the type of surface where the wheelchair was used affected its lifespan. Use on smooth concrete lengthened wheelchair longevity, while use on lawn or earth shortened it. Chen et al. (2011) confirmed that use of a wheelchair on a rough or uneven surface was related to accidents and damage [4]. Factors not significantly related to wheelchair lifespan included body weight, level of injury, occupation, duration of disease, and usage per day. Sooksomporn and Poosiripinyo (2014) reported that the greater the distance (> 50 m/day), the more potential for significant damage [7]. Stated otherwise, the driving impact distance has more than duration of use per day. Previous studies suggested that the type of wheelchair (manual or power) and type of frame (standard, lightweight or ultralight weight) are related to lifespan [8-10]. All patients in the study used the same standard, manual wheelchairs but different brands. The study did not find any significant difference among the different brands. The results indicate wheelchair quality by manufacturer in Thailand were comparable.

Our study, as with that of Sooksomporn and Poosiripinyo [7], demonstrated that the commonly broken parts were the wheel bearings and brakes. Fitzgerald et al. (2005) found that the most commonly broken part was the tyre, but they did not confirm the finding of damage to the wheel bearings or brakes [11]. For the most part, our patients used the wheelchair for indoor activities (37.7%). The brakes of the wheelchair may frequently be used for short distance, indoor activities. Patients need to be taught how to operate and maintain a wheelchair correctly.

There are three systems of social welfare to support new wheelchair in Thailand. The Civil Servants Medical Benefits Scheme provides only one wheelchair for lifetime. The Social Security Scheme subsidizes new wheelchair for every 5 years. The Universal Health Care Scheme currently supports new wheelchair every 3 years. The results of this study suggested that the Civil Servants Medical Benefits Scheme and the Social Security Scheme should support new wheelchair similar to the Universal Health Care Scheme.

The limitation of the current study was the generalizability of the results. We included only patients in the rehabilitation program at Srinagarind Hospital: the people are not necessarily representative. Additionally, the data were collected through interviews with potential for a recall bias.

5. Conclusion

The average lifespan of a wheelchair was 4.3 ± 2.4 years: the median lifetime was 4 years. Since 50% of wheelchairs were broken before 4 years, the government should consider that the most appropriate time for

supporting a new wheelchair be not greater than 4 years of use. Giving information such as how to operate a wheelchair and using it on a smooth surface are recommended for extending wheelchair life expectancy.

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