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AN ANALYSIS OF PATIENTS' SPINAL INJURY COSTS AT THE NATIONAL SPINAL INJURY HOSPITAL IN NAIROBI COUNTY, KENYA

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**KeyWords**

Cost of Illness, Friction Cost Method, Gross Domestic Product, Koninklijke Nederlandse Chemische Vereniging, Kenya National Survey of People Living with Disabilities, Magnetic Resonance Imaging, Non-Traumatic Spinal Cord Injury, National Hospital Insurance Fund, Spinal Cord Injury, Traumatic Spinal Cord Injury, World Health Organization, Willingness to Pay

**ABSTRACT**

Global statistics indicate that based on the extent of spinal cord injury, the first-year cost ranges between \$300,000 and \$1,000,000. [1]. A review of 68 studies [2], indicated the cost of injury varied widely with mean costs ranging from \$14 to \$17, 400 and the cost per disability-adjusted life year averted for injury-prevention interventions ranged from \$10.90 for speed bump installation to \$17,000 for drunk driving and breath testing campaigns in Africa. Health economists are interested in evaluating spinal cord treatment interventions as economic investments. For these stakeholders, a key question is the relationship between the reduction of spinal cord injuries and national income growth as measured by GDP metrics. Public health officials are more focused on promoting health, preventing spinal injuries and related mortalities as well as reducing their health and social burden. The general objective of this study was to analyze the patient costs of spinal cord injury at the National Spinal Injury Hospital, Nairobi County, Kenya. The four specific objectives of the study were to determine the total costs of spinal cord injury in the first year of diagnosis and treatment at the National Spinal Injury Hospital, to determine the variations in total costs of spinal cord injury due to ownership of health insurance, to establish the variations in total costs of spinal cord injury based on extent of the injury and to establish the variations in total costs of spinal cord injury based on the employment status of the patients at National Spinal Injury Hospital. This was an analytical cross-sectional study utilizing quantitative methods on a sample of n=169. Purposive sampling was also employed to recruit participants comprising spinal injury patients in the first year of diagnosis and data were collected using structured questionnaires and secondary data review. Data was analyzed using SPSS version 25 where descriptive statistics were used to show frequencies and percentages for variables. ANOVA test was used to test the statistical mean differences in the total SCI costs among the SCI patients at NSIH based on their employment status and extent of the spinal injury while paired t-test was used for health insurance status. Findings indicate that it average costs the spinal cord injury patient KSh. 928,326.73 in treatment costs in the first year of diagnosis. The average of sum of the annual direct medical costs, direct non-medical costs and indirect costs of productivity losses for the 169 patients was KSh 187,048, KSh 173,541 and KSh 567,738 per patient respectively. Further, it shows that the employment status of the patients do result in significant differences in the total SCI costs among the different groups ( P=0.000) while the extent of injury and health insurance status does not result in significant differences in the total SCI costs( P=0.6617 and t=-0.6129 respectively). This study will inform the National Spinal Injury Hospital on the importance of health economic studies in the management of SCI patients.

**INTRODUCTION**

Spinal cord injury (SCI) can lead to a reduction in individual satisfaction or utility and societal well-being in various ways; this could be direct since one prefers better health as opposed to ill health and also in an indirect direction by decreasing the utility related to goods and services consumption which are not related to health, and by interfering with other fiscal goals such as income generation that in turns lets one access other market goods.[3]. In the event of an injury, there are two likely outcomes; one is that the injured person's

normal production levels may have to reduce (whether paid or unpaid), and the other is that there is a high probability of an increase in the household's uptake of goods and health services at the cost of other services and goods.

Kenya just like most middle-income countries has a majority of its health costs handed to the citizens. However, efforts have been made to reduce this problem through cost-sharing measures with employers, insurance firms and the National Hospital Insurance Fund (NHIF). Patients accessing public hospitals such as the National Spinal Injury Hospital pay for healthcare services received using the user fee system, however, this system also has equity implications as a significant percentage of the citizens cannot afford these fees. In reference to the Kenya National Survey of People with Disabilities (KNSPWD) Report dated November 2008, 4.6% of Kenyans suffer from various cases of disability. The report indicated that diseases are a cause of 19% of disabilities in the country, other causes of disability are congenital (14%) followed by accidents (12%), however, close to 25% of disabilities in Kenya have unknown causes. Disabilities as a result of accidents are mainly as a result of spinal cord injuries and orthopaedic injuries.

The World Health Organization defines spinal cord injury (SCI) as "any damage to the spinal cord that causes temporary or permanent changes in its function" [4]. Spinal cord injuries could also be caused by falls, illnesses such as poliomyelitis or spina bifida (a birth defect due to incomplete development of the spinal cord), road traffic accidents, injuries from sports, accidents in industries, shootings, as well as physical attacks (6). Spinal cord trauma may also result from slight injuries if one has a fragile or weak spine due to conditions such as arthritis. Some of the symptoms of SCI include cessation or reduction of muscle function, autonomic, and sensation function in the parts of the body served by nerves beneath the site of injury. These symptoms and medical imaging form the basis of the diagnosis of SCI. Some of the efforts that can avert SCI are individual oriented such as appropriate use of safety gear, community or societal involvement such as policies and laws enacted on road traffic safety and emphasis on safety during the manufacture of equipment. The first step of treatment is limiting additional movement of the spine and striving to maintain acceptable blood pressure levels. Other interventions may vary from bed rest, surgery, physiotherapy and occupational therapy, especially in situations where the SCI interferes with activities of daily living depending on the severity of the injury [6]. Injuries such as spinal cord injuries contribute to increasing the disease burden which includes costs related to life years lost, treatment and ongoing healthcare costs. Apart from disability or death, spinal-related injuries also lead to emotional as well as psychological suffering for the victims and their relatives [7] Spinal cord injury (SCI) being a highly incapacitating injury can result in a reduction or cessation of motor and sensory function and can also cause several organ dysfunctions. Though some treatment procedures such as cell therapy have led to significant clinical effects, there is no effective procedure to completely cure SCI. Due to its high treatment costs, lengthy recovery process and the loss of labor force, SCI eventually exerts a great economic impact to the victims and families thus an economic burden [8]

According to World Health Organization, the global annual incidence rate of SCI is between 250,000 and 500,000 people. Many causes of SCI can be avoided or averted such as road traffic accidents, physical falls or assaults. SCI can lead to secondary health complications which could be incapacitating while some could be life-threatening such as deep vein thrombosis, osteoporosis, urinary tract infections, respiratory complications, chronic pain, muscle spasms pressure ulcers and depression. To manage and avert some of these complications, rehabilitative services and acute care is vital. SCI victims may be rendered totally dependent on family members thus technological aid is needed to ease communication, mobility or household chores.

## MATERIALS AND METHODS

### 2.1 Research design

### 2.2 study variables

S No.	Variable name	Type of variable	Measurement
1.	Health insurance status	Independent variable	Variance of the means
2.	Employment status	Independent variable	Variance of the means
1.	Extent of injury	Independent variable	Variance of the means
2.	Total costs of SCI treatment	Dependent variable	Sum of direct medical, direct non-medical and productivity losses

### 2.3 study area

This study was conducted at the National Spinal Injury Hospital located in Kilimani area in Nairobi county, Kenya. According to the Ministry of Health website, it is the only referral hospital for spinal cord injuries in Kenya. The

hospital was started by the Cheshire family to serve, rehabilitate and resettle soldiers who returned from the Second World War with spinal cord injuries but after independence, the government took over and renamed it. It has a 40-bed capacity with a waiting list of over 100 at any given time from its catchment zone. Data maintained by NSIH indicated that it attends to an average of 205 spinal injury patients (inpatients) and 6,812 outpatients annually (MOH 2015). Most SCI patients are victims of road accident injuries, falls from heights, gunshots and assaults.

## 2.4 study population and target population

Since this study looked at SCI costs from the perspective of the patient, the target population of the study was SCI patients seeking treatment at National Spinal Injury Hospital in the month of 11<sup>th</sup> January 2021 to 2<sup>nd</sup> April 2021. It focused on both inpatient and outpatient patients. The focus of the outpatient clinic was on those attending physiotherapy as well as the specialized diabetes clinic. These patients had undergone diagnostic procedures that indicated any form of spinal injury for the past year

## 2.5 inclusion and exclusion criteria

All Spinal cord injury patients seeking treatment at the National Spinal Injury Hospital

Inclusion criteria included;

- 1) Patients between the age of 18 years – 65 years
- 2) Patients who were willing to participate in the study and sign an informed consent document.
- 3) Patients diagnosed with spinal cord injury for at least one year.

Those that were excluded were:

- 1) Patients below the age of 18 years
- 2) Patients unwilling to sign consent document.
- 3) Patients who were too ill to talk or in an unconscious state and the caregiver was also unwilling to divulge any information.
- 4) Patients who had not undergone the full confirmatory tests.

## 2.6 sampling technique

Purposive sampling was employed first in the selection of the hospital as it is the only referral hospital in East Africa for SCI cases.

Secondly, this sampling was used to select the Spinal cord injury inpatients that meet the inclusion criteria as it is a 40-bed capacity hospital thus very few SCI inpatients. The outpatient clinic serves a wide range of patients other than SCI patients therefore the focus was on SCI patients booking in for physiotherapy and here consecutive sampling was used to select the participants who had met the inclusion criteria until the sample size was attained.

## 2.7 sample size determination

Since the study population was not static, the research applied the formula by Fischer et al (Mugenda, 2003) since the study focused on sampling respondents who had been diagnosed with spinal cord injury.

$$n = (z^2 pq) \div d^2$$

## 2.8 data collection tools

Primary data was collected using the Koninklijke Nederlandse Chemische Vereniging (KNCV) questionnaire tool for estimating patient costs attached. This was used to collect data on the indirect costs or productivity losses due to SCI. The information captured on patient files during their routine visits formed part of the tool. This tool was administered by the main researcher assisted by one research assistant. The parameters that were measured included productivity losses in terms of the percentage decrease of productivity due to SCI, annual income loss due to the spinal cord injury and the relatives' foregone income as a result of taking care of the SCI patient. The secondary data review from the hospital finance department and the hospital records department were the main sources of data for the direct medical costs. The data was recorded on an excel worksheet template. Records on the percentage of medical costs covered by insurance as well as waived costs were also noted. These were drawn from patient files

of patients interviewed using the structured questionnaire using the inpatient/outpatient number as the tracing tool.

## 2.9 Pretesting

The KNCV questionnaire tool was tested at the National Spinal Injury Hospital physiotherapy clinic on 5 SCI outpatients. Adjustments were made to improve the validity and reliability of the tool. The 5 respondents who participated in the pre-test of the tool were excluded from the study. Reliability is the degree to which the data collection tools yield the same results if repeated by two different researchers on the same study population. The consistency of the data collection tools was established by the Cronbach's alpha test, by use of standardized test, quote test and existing validity and reliability levels

## 2.10 data analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics such as mean, mode and standard deviation were used to describe the demographics as well as the baseline data. Data on the first objective on direct medical costs and the second objective on the direct non-medical costs such as transport were analyzed by measures of central tendency of the total, mean, mode and standard deviation. The data on the costs due to productivity losses were summed up; the mean indirect costs were analyzed from the data. Regression analysis: ANOVA and T-tests were done using the same SPSS, and were also used to describe and evaluate the statistical differences in the economic burden of the SCI patients at NSIH based on health insurance ownership, the extent of injury and employment status of the patients.

## 3.0 Results

### 3.1 Summary of the total SCI costs at NSIH.

The direct medical, direct non-medical and the indirect costs were determined using structured questionnaires and secondary data review of the treatment sheets and patient finance records. The table below gives a summary of the costs of SCI at NSIH.

**TABLE 3.1: SUMMARY OF THE COSTS OF SCI AT NSIH.**

Type of costs	Sum (KSh.)	Mean (KSh)	Percentage
Direct medical costs (n=106)	19,539,434	187,047.73	20.15
Direct nonmedical costs (n=169)	30,061,516	173,540.59	18.69
Indirect costs (n=169)	90,594,351	567,738.41	61.16
<b>Total</b>	<b>140,195,301</b>	<b>928,326.73</b>	<b>100</b>

This indicates that it averagely costs the SCI patient KSh. **928,326.73** in treatment costs in the first year of diagnosis.

### 3.2 The variations on the total spinal injury costs of SCI patients at NSIH based on health insurance ownership.

The table below gives a summary of the independent t-test used to analyze the statistical difference the health insurance coverage has on the economic burden of SCI at NSIH.

**TABLE 3.2 : THE DIFFERENCE IN MEANS BY OWNERSHIP IN HEALTH INSURANCE (INDEPENDENT T-TEST)**

Group	obs	Mean	std err	std dev	95%confidence interval	
					Upper.	Lower
Without cover	20	710995.4	121278.7	542374.7	457156.2	964834.6
with cover	148	782516.8	39671.75	482627.2	704116.1	860917.4
Combined	168	774002.3	37720.93	488919.1	699531	848473.7

Diff		-71521.38	116696.9		-301922.8	158880
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diff = mean(0) - mean(1)

t = -0.6129

H0: diff = 0

Degrees of freedom = 166

The above t-test used for the data indicated that the t value as -0.6129. This being more than 0.05 implies acceptance of the null hypothesis that there is no significant difference in the total SCI costs among SCI patients at NSIH based on the health insurance ownership status.

### 3.3 The variation in SCI costs based on employment status

The table below gives a summary of the regression analysis using ANOVA test to analyze the statistical difference the employment status had on the economic burden of SCI at NSIH. There were four categories of this status: employed, unemployed, self-employed and those with casual jobs.

**TABLE 3.3 : ANOVA RESULTS FOR VARIATION OF SCI COSTS DUE TO EMPLOYMENT STATUS**

Source of Variation	SS	df	MS	F	P-value
Between Groups	7.6565e+12	4	1.9141e+12	9.67	0.0000
Within Groups	3.2263e+13	163	1.9794e+11		

The tests of difference in means of SCI due to employment status given as unemployed, employed, self-employed, casual and retired produced an F value = 9.67. This value was statistically significant at 5 percent level given P value =0.0000. This result implies that there were differences in the mean SCI costs when patients were categorized by employment status. Post hoc analysis was done using Scheffe's method to establish the significant differences in the SCI means amongst the four groups as shown in Table 3.4.

**TABLE 3.4: THE POST HOC COMPARISON OF TOTAL SCI COSTS BY EMPLOYMENT STATUS (SCHEFFE'S METHOD)**

Row mean Col mean	Unemployed (1)	Employed (2)	Self-employed (3)	Casual (4)
Employed (2)	775423 0.000			
Self-employed (3)	121654 0.640	-653769 0.000		
Casual (4)	577606 0.182	-197818 0.961	455952 0.410	
Retired (5)	103811 0.965	-671612 0.005	-17842.7 1.000	-473795 0.485

The comparisons between groups of the mean SCI costs that were statistically significant were between the employed and unemployed group (KSh 775423 at 0.0% level), self-employed and employed (KSh 653769 at 0.0% level) and the retired and employed (KSh 671612 at 0.5% level).

The comparisons of the mean SCI costs between other groups showed no statistical differences, that is between unemployed and self-employed (KSh 121654 at 64% level), unemployed versus casual (KSh 577606 at 18.2% level) unemployed versus retired (KSh 103811 at 96.5% level), employed versus casual (KSh 197818 at 96.1% level), self-employed versus casual (KSh 455952 at 41.0% level), self-employed versus retired (KSh 17842.7 at 100% level) and lastly casual vs retired at KSh 473795 at 48.5% level.

### 3.4 The variation in SCI costs due to extent of injury

The table below gives a summary of the regression analysis using ANOVA test to analyze the variation in the SCI costs based on extent of injury. There were three categories of this status: cervical who ranked highest in the severity of the injury followed by Thoracic and finally lumbar/sacral who ranked lowest in terms of severity of injury.

**TABLE 3.4 : ANOVA RESULTS FOR VARIATION IN SCI COSTS DUE TO EXTENT OF INJURY**

Source of Variation	SS	df	MS	F	P-value
Between Groups	1.9928e+11	3	9.9641e+10	0.41	0.6617
Within Groups	3.9721e+13	165	2.4073e+11		
Total	3.9920e+13	167			

The tests of difference in means of SCI due to extent of injury given as cervical, thoracic, lumbar/sacral produced an F value = 0.41. This value was not statistically significant at 5 percent level given P value =0.6617. This result implies that there were differences in the mean SCI costs when patients were categorized by extent of injury. Therefore, there is no significant variation in the SCI costs based on extent of injury.

### 4.0 discussions

The study's findings established that the average patient cost in the first year of SCI diagnosis is KSh. **928,326.73** with the indirect costs consuming the largest percentage of the costs at 61.16% followed by direct medical costs at 20.15% and the least being direct non-medical costs at 18.69%.

According to the WHO report on Spinal Injuries, the first year of injury incurs the highest direct costs and then reduces significantly with time while the indirect costs such as income losses often surpass direct costs over the subsequent years. It costs an average of 105,000 USD to rehabilitate one SCI victim which is way expensive for the common citizen. (WHO 2013). In this study the indirect costs consumed the largest percentage of the costs followed by direct medical costs therefore diverging from the WHO

report of 2013.

The regression results for the ANOVA indicate that employment status ( $F= 9.67, P=0.0000$ ) was a significant factor in causing variations in the SCI costs at NSIH, since the p-value was less than 0.05. The extent of injury ( $P=0.6617$ ) and health insurance status ( $t=-0.6129$ ) did not cause significant variations in the SCI costs. These results on the extent of injury do not agree with the study by Villines et.al 2016 that states the more severe the injury, the more costly it is to manage with high tetraplegia in C1-C4 being the most expensive to treat at about \$1,023,000.00 during the first year.

Employment status is frequently a factor in options for health insurance. Spending on outpatient healthcare could be influenced by financial health, which leads to choices about where to seek care (Mwenda et.al 2021) This study showed there was a significant difference in the total costs based on employment status of the SCI patients. A post-hoc comparison between the different groups indicated the most significant differences were between the employed and unemployed group at  $p=0.000$ . Therefore agreeing with the study by Mwenda et.al 2021 that employment status leads to higher outpatient healthcare costs.

## 5.0 Conclusion

The study concluded that the average patient costs in the first year of SCI diagnosis is KSh. 928,326.73 with the indirect costs consuming the largest percentage of the costs at 61.16% followed by direct medical costs at 20.15% and the least being direct non-medical costs at 18.69%. Based on the statistical analysis carried out using ANOVA, the study analysis led to the acceptance of one null hypothesis and rejection of two as follows:

- There is a significant difference in the total SCI costs among the SCI patients based on health insurance ownership.
- There is a significant difference in the total SCI costs among the SCI patients based on employment status
- There is no significant difference in the total SCI costs among the SCI patients based on extent of injury.

Therefore health insurance ownership and employment status of a patient are significant factors in causing variations in the spinal cord injury costs at the National Spinal Injury Hospital, while the extent of injury is not a significant factor in causing variations in the spinal cord injury costs.

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