



## Original Article

## Economic burden of stroke

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Received: February 29, 2016 Accepted: May 11, 2016 Published online: June 03, 2017

### ABSTRACT

**Objectives:** This study aims to estimate the annual economic cost per hemiplegic patient in Turkey.

**Patients and methods:** Between September 2014 and December 2014, a total of 84 hemiplegic patients (53 males, 31 females; mean age 61.4±13.5 years; range 28-89 years) with stroke for 12 months were included in the study. Type of cerebrovascular accident and complications were evaluated. Hospital records and data from the relatives of the patients were used to calculate the cost. Annual costs were evaluated starting from first hospitalization. Direct costs were calculated with the sum of hospital care (acute care, diagnostic investigations, treatment and rehabilitation), medications, medical visits, outpatient rehabilitation and orthopedic aids. Indirect costs were calculated by taking the income loss due to absence from work into consideration. Prices of medical resources were obtained from the 2014 Healthcare Implementation Notification payment list.

**Results:** At the end of the study, the average direct cost and indirect cost per patient were calculated respectively as 10,594.90±6,554.20 Turkish liras and 9,357.10±10,195.60 Turkish liras (4,606.47±2,849.65 USD and 4,068.30±4,432.86 USD). We found a negative correlation between total cost and age (p=0.001), and a positive correlation with duration of hospitalization (p=0.001) and number of complications (p=0.049). We were unable to find any relation of cost with sex and cerebrovascular accident type. Spasticity (p=0.028) and epilepsy (p=0.037) being among the complications were observed to increase the cost.

**Conclusion:** Stroke is an important economic burden for Turkish population. Preventive social measures are necessary to reduce this cost.

**Keywords:** Cost of illness; economics; stroke.

Stroke is the major cause of disability and the second most common cause of mortality and a costly disease.<sup>[1-3]</sup> The economic aspects of stroke are evaluated through a cost-of-illness (COI) studies. Stroke is a global epidemic and by no way a problem limited to western or high-income countries.<sup>[4]</sup> Cerebrovascular diseases are the second most common cause of death in Turkey. Based on disability adjusted life year (DALY) estimations, cerebrovascular diseases rank third among 10 diseases that account for the total disease burden in Turkey.<sup>[5]</sup> Ten-year risk of stroke was estimated at 17% in our country in a study involving 39 centers.<sup>[6]</sup> Given that old age is a real risk factor for stroke, the increased aging of the world population means a growing number of persons are at risk.<sup>[2]</sup> Increased incidence of stroke and decreased morbidity owing to newer therapies resulted in an increase in

the prevalence of stroke.<sup>[7]</sup> A substantial number of stroke survivors are left with physical or cognitive impairment and require care. In addition to the direct costs of hospitalization, emergency care, rehabilitation and cost of illness, indirect costs related to the loss of productivity and long-term care further increase the overall cost of stroke.<sup>[2]</sup>

A review on the costs of stroke showed that the expenditures for stroke accounted for about 3% of total health care expenditures in eight countries. This means that on average, 0.27% of the gross national product was spent on stroke.<sup>[4]</sup> Concerning the cost of stroke in Turkey, only one study is available which evaluated the cost of treatment for patients staying in a rehabilitation center.<sup>[8]</sup> Data on disease costs can be a helpful guide while planning and budgeting healthcare expenditures. In the present study, our purpose was to

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Cite this article as:

İçağasıoğlu A, Baklacioğlu HŞ, Mesci E, Yumuşakhuylu Y, Murat S, Mesci N. Economic burden of stroke. Turk J Phys Med Rehab 2017;63(2):155-9.

obtain national data on estimated cost of hemiplegia per patient and draw attention to the economic aspect of hemiplegia in Turkey.

## PATIENTS AND METHODS

The study was conducted on patients with a history of hemiplegia for at least one year who were being followed at Physical Therapy and Rehabilitation outpatient clinics of three state hospitals in Istanbul. Data for hemiplegic patients retrieved from hospital registers and information obtained from patients and their relatives were included in the analysis. Concomitant illnesses and disease related complications, medications and devices used by patients and expenditures of rehabilitation were recorded.

Cost of illness studies were conducted using two methods: (i) Top-down method: This method calculates the national costs of a disease using data banks such as those provided by the National Office of Statistics. (ii) Bottom-up method: A group of patients with a certain disease were asked what the costs of their disease were.<sup>[4]</sup> The results of this questionnaire are extrapolated to a population level. In the present study, we conducted a cost analysis with the bottom-up method using hospital registers and information obtained from stroke survivors.

### Cost analysis (Direct and indirect costs)

Cost-of-illness studies generally involve two separate cost analyses including direct costs and indirect costs. Direct costs refer to all the goods, services and other resources that are consumed during the provision of a health intervention for a certain illness. This includes the money spent on hospital and nursing home care, on the services of physicians and other medical professionals, drugs, appliances and rehabilitation. Indirect costs are defined as production losses due to an illness. They represent the monetary value of the production losses due to absenteeism of the patient and his/her caregiver.

### Patient selection

Patients 18 years of age and older following a diagnosis of hemorrhagic or ischemic stroke were included in the analysis. Demographic characteristics (age, sex, type of stroke) and stroke-related complications (eg. spasticity, aphasia, epilepsy and depression) were collected. Data on cost items were collected using the bottom-up method. For direct cost estimation, the duration of stay (number of days) in the neurological acute

care unit and the fees for all kinds of investigations, drug administrations, procedures, physician visits, consultations and inpatient rehabilitation services until the time of discharge were retrieved from the computerized hospital databases. Data and information on investigations, medicines administered, appliances, physician visits and outpatient rehabilitation services after discharge were obtained from the patients and their relatives. The unit prices of healthcare resources were obtained from the payment list of 2014 Healthcare Implementation Notification (HIN)<sup>[9]</sup> and vademecum (a book for ready reference).<sup>[10]</sup> For indirect costs, annual financial loss was calculated by multiplying the monthly income of the patient by 12 which corresponded to economic losses due to absenteeism. Since most caregivers were unemployed relatives of the patients, potential indirect costs incurred by their loss of productivity were not included in the cost analysis. Approval for the conduct of the study was obtained from the local ethics committee of Istanbul Medeniyet University Goztepe Education and Research Hospital. Informed consent was obtained from patients or their relatives before initiation of the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

### Statistical analysis

NCSS (Number Cruncher Statistical System), 2007 & PASS (Power Analysis and Sample Size) and 2008 Statistical Software (Utah, USA) were used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage and minimum-maximum) were used for analysis of study data. For between-group comparisons, Student's t-test was used to compare normally distributed quantitative variables and Mann-Whitney U test for non-normally distributed quantitative variables. Spearman's correlation analysis were used to assess relationships between study parameters. A *p* value of <0.05 was considered statistically significant.

## RESULTS

*Eighty-four stroke survivors were evaluated in the study: 53 males (63.1%) and 31 females (36.9%). The mean age of patients was 61.4±13.5 years with an age range of 28-89 years. The type of cerebrovascular accident (CVA) was ischemic in 88.1% (n=74) of the patients and hemorrhagic in 11.9% (n=10). The characteristics of stroke patients are shown in Table 1. The length of hospital stay of study patients ranged between 0 and 75 days with a mean duration of 15.4±11.2 days. It was found that 61.9% (n=52) of*

**Table 1.** Characteristics of patients

	n	%	Mean±SD	Min-Max
Age (year)			61.4±13.5	28-89
Number of stroke			1.4±0.8	1-5
Number of comorbidity			2.2±1.3	0-6
Number of complications			1.8±0.8	1-4
Number of BoNT injections			2.3±2.0	1-7
Length of hospitalization stay (day)			15.4±11.2	0-75
Sex				
Male	53	63.1		
Female	31	36.9		
Type of stroke				
Ischemic	74	88.1		
Hemorrhagic	10	11.9		
Spasticity	52	61.9		
Aphasia	37	44.0		
Depression	16	19.0		
Epilepsy	9	10.7		
Botulinum neurotoxin	10	11.9		
Rehabilitation	43	51.2		

SD: Standard deviation; Min: Minimum; Max: Maximum.

stroke survivors had spasticity, 44% (n=37) had aphasia, 19% (n=16) had depression and 10.7% (n=9) had epilepsy. Botulinum toxins were administered by injection to 10 patients (11.9%). 51.2% of the patients (n=43) were enrolled in a rehabilitation program. Thrombolytic therapy was given to only two patients.

Estimated direct cost per person was 10.594,90±6.554,20 (median 8.668,50) Turkish Liras (TL). Costs incurred through hospitalization in neurological care units accounted for the majority of direct costs (acute cost), followed by physical therapy and rehabilitation services. Distribution of costs is presented in Table 2.

Indirect cost of lost productivity from stroke was estimated at 9.357,10±10.195,60 (median 10.800) TL per person. Estimated total annual cost of stroke per person was 19.952±13.131 (median 17.253,50) TL on average (Table 2).

Based on our findings, there was a significant negative correlation between age and total cost (r=0.640, p=0.001). Total cost was not associated with sex, type of CVA or presence of aphasia or depression (all p>0.05). Of the study patients, total costs were statistically significantly greater for spastic patients, those who had botulinum toxin injection, epileptic patients and those who received physical therapy and rehabilitation services (Table 3).

## DISCUSSION

This study is the first to report total estimated annual cost of stroke per patient in Turkey. Several

studies demonstrate that stroke poses a significant burden on society in all developed countries.<sup>[2-4,11,12]</sup> Despite the use of different methodologies, selected cost-of-illness studies have shown that about 3% of health care costs were spent on stroke patients.<sup>[4]</sup> However, costs per capita spent on stroke are more diverse. This can be explained by the relative increase in expenditures on health care costs over time in several developed countries. An alternative explanation might be the difference in data collecting and calculating methods between several COI studies.<sup>[4]</sup> Also, the costs of stroke may vary depending on the characteristics of patients (type and severity of stroke)<sup>[13,14]</sup> or the organization of the healthcare system (delivering prolonged acute care versus inpatient rehabilitation services).<sup>[4]</sup>

Cost-of-illness studies, if performed using the top-down model, are based largely on secondary data. Consequently, the estimation of the stroke costs

**Table 2.** Distribution of the costs of stroke

	Min-Max (TL)	Median (TL)
Direct cost	525-35326	8668.50
Acute care	0-28521	4752
Rehabilitation	0-15600	625
Medicine	0-2102	689
Braces	0-800	0
Botulinum neurotoxin	0-2800	0
Visits	60-2370	865
Indirect cost	0-48000	10800
<b>Total cost</b>	<b>525-66560</b>	<b>17253.50</b>

Min: Minimum; Max: Maximum; TL: Turkish Lira.

**Table 3.** Assessment of the relationship between total cost and variables

	Total cost (Turkish lira)		<i>p</i>
	Mean±SD	Median	
Sex			0.202
Male	21463,5±14115,8	21122	
Female	17367,9±10989,5	14840	
Type of stroke			0.334
Ischemic	19536,1±13163,97	16834,50	
Hemorrhagic	23029,8±13143,7	24043,50	
Spasticity			0.028*
No	15672±10717,9	14682,50	
Yes	22585,8±13865,3	21585	
Aphasia			0.853
No	20261,5±13521,4	17920	
Yes	19558,8±12793,5	16691	
Depression			0.186
No	18701,1±11749,3	16834,50	
Yes	25268,3±17329,7	235137	
Epilepsy			0.037*
No	18958±12969,7	16715	
Yes	28235,2±12109,4	25572	
BoNT			0.001**
No	17624,3±11477,8	15983	
Yes	37176,9±12145,6	34811	
Rehabilitation			0.001**
No	12912,7±9240,7	12398	
Yes	26663,9±12843,5	24814	

SD: Standard deviation; \*  $p < 0.05$ ; \*\*  $p < 0.01$ ; Mann-Whitney U test.

depends on the quality and accuracy of the data used. This might induce some bias which is checked by sensitivity analyses. A review of studies conducted between 1966 and 2003 reported that sensitivity analyses were performed in less than one-third of the studies. Studies using data collected with bottom-up approach provide a more realistic picture of the costs.<sup>[15]</sup> As in our study, a subpopulation analysis may be conducted using this approach and its results may be extrapolated to the general population.<sup>[4]</sup>

In the first year after a stroke, a considerable portion (76% on average) of stroke costs are devoted to inpatient treatment. However, a shift occurs in the following years with increased outpatient treatment and long-term care costs.<sup>[4]</sup> In some countries, stroke patients stay in inpatient treatment facilities for only a short period.<sup>[16]</sup> In most European countries, particularly in Netherlands and Scotland, a smaller part of the total cost is spent on outpatient treatment (3% and 2% respectively) as opposed to North American countries (United States and Canada). Countries that spend a relatively large part on long-term care, spent a relatively small portion on inpatient care. This might be explained by variations in the organization of care in these countries. For instance, in some

countries, rehabilitation and nursing home care is part of the inpatient hospital organization, whereas in other countries these are separate facilities.<sup>[4]</sup>

Average annual costs of stroke range from \$7,342 to \$146,149 in many countries.<sup>[17]</sup> In a study conducted in Sweden with 140 stroke survivors who were followed for one year, estimated average cost per patient was \$32,976. Hospitalization costs accounted for the majority of the total cost. In the present study, average total cost was 19,951.99 TL (8,674.77 USD). Costs of acute inpatient care represented the largest part of the direct costs for our patients. Interventions increasing the total cost such as thrombolysis and endovascular surgeries are not often performed in acute care facilities. In our study, direct costs were slightly greater than indirect costs. Currently, the retirement age is 65 in Turkey; estimated indirect costs were low since most of our study population were over the age of 65 years. If in our study population were younger, employed persons, indirect costs and accordingly total costs would have been much higher. The duration of hospitalization was identified as a factor that significantly increased the total cost.

Cost of informal care (cost of caregiver and caregiver's loss of productivity), a component of indirect costs, constitutes a major part of the total cost of care.<sup>[13]</sup> Caregiver burden was not calculated in the present study. Considering the chronic nature of stroke, it would obviously increase the cost of long-term care. In a cost analysis conducted by Saka et al.<sup>[3]</sup> it was found that 50% of total costs were spent on patient care, 27% accounting for direct costs and 24% for indirect costs incurred by the patient's loss of productivity. In a Korean study,<sup>[18]</sup> indirect costs were identified as the largest component of the overall cost and an Irish study<sup>[19]</sup> found that the largest part of the total cost was spent during the chronic phase of the illness due to high indirect cost and cost of nursing home care. The total omission of informal care costs in the majority of the COI studies is noteworthy.<sup>[4]</sup> In several studies, only out-of-pocket caregiver's costs and not informal care time.<sup>[16]</sup> In our study, neither the informal care time nor the expenses of caregivers were analyzed as part of cost analysis.

A negative correlation was found between the total cost of stroke and age of the patient. Since elderly stroke survivors are sometimes neglected by their families and often suffer from cognitive impairment and do not receive rehabilitation services, advanced age can be considered as a factor that reduces the cost of stroke. On the other hand, younger stroke patients generally participate in rehabilitation programs and receive more support during long-term treatment. Our results show

that aphasia and depression do not have an impact on the cost of stroke. In Turkey, most of the stroke patients do not receive aphasia treatment because of the small number of speech physiotherapists. Studies have shown that psychiatric comorbidity caused by stroke is generally not taken into account.<sup>[20]</sup>

The cost of stroke was significantly higher among patients with spasticity. Direct costs for 12-month stroke survivors were four times higher than direct costs for patients with stroke without spasticity as reported by Lundström et al.<sup>[15]</sup>

One limitation of our study was the exclusive enrollment of patients who were still alive one year after stroke. The cost for patients who died after a stroke was not included in the analysis. Another limitation of our study is that it was a small scale study which did not involve patients from other parts of Turkey. Also, caregiving cost incurred by productivity loss and informal care time were not taken into account because caregivers were mostly patients' relatives.

The cost of stroke will increase even further in the future with the overall aging of the world's population. In an Irish study conducted in 2007, future costs of stroke in Ireland were estimated to increase by 50% between 2007 and 2021.<sup>[19]</sup> Cerebrovascular diseases alone account for 5.9% of the total disease burden in Turkey according to DALY estimations, indicating that stroke is a priority public health concern.<sup>[5]</sup>

Further studies in a larger number of patients are needed to estimate the cost of stroke in Turkey using national statistics taking into account regional differences in costs and data obtained should be used to guide healthcare expenditures. This will help reduce mortality and disability associated with stroke through planning a more effective allocation of resources and developing both chronic and acute care strategies for stroke management.

#### Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

#### Funding

The authors received no financial support for the research and/or authorship of this article.

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