

Economic Burden Associated with Neurocysticercosis at a Tertiary Care Neurological Center in Nepal

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ABSTRACT

Introduction: Neurocysticercosis (NCC) is the most common parasitic disease of the central nervous system and is a major cause of epilepsy and neurological morbidity in humans in endemic areas of the world. This study was conducted to estimate economic burden of the patients due to Neurocysticercosis arriving at Tertiary Neurological center of Kathmandu, Nepal.

Methods: A cross sectional prospective study was conducted for 2 years among the patients with NCC at Tertiary Neurological Center in Kathmandu. Patients treatment plan and followup date were recorded and patient were categorized into four different groups depending on the frequency of followup and completion of treatment (Group 1 to Group 4). Direct and indirect cost centers were categorized and calculated accordingly. The cost was estimated in US dollar as of 2020.

Results: Out of 52 patients who were followed up completely for treatment, majority of patient were from age group 21-30 years. The total cost incurred for group 1, group 2, group 3 and group 4 were \$468, \$714, \$1054 and \$1986 respectively. The average cost per day for a patient with NCC was calculated to be \$1.5.

Conclusion: This study suggests that Neurocysticercosis results in considerable monetary losses to patient in developing country like Nepal. The average loss of each individual accounted for around one half of per day capita income of Nepal. Various programs and policies shall be implemented to reduce the burden of NCC so as to reduce the economic burden associated to it.

Keywords: Cost analysis; Economic Burden; Neurocysticercosis.

INTRODUCTION

Neurocysticercosis (NCC) is a common parasitic infection of the human brain which is caused by the larval stage of *Taenia solium*, that enters the CNS (central nervous system) by ingestion of its eggs due to the use of contaminated hand, water or food.¹ NCC it is the most common cause of acquired, preventable adult-onset epilepsy and neurological disability worldwide.²⁻³ This parasitic infection mainly affects disadvantaged people in endemic regions, which include Latin America, sub-Saharan Africa, and Asia causing the hindrance in socioeconomic growth as well. The natural history of NCC infection remains poorly understood, and the proportion of cases with lesions in their brains that will manifest at some point during the course of the infection remains unknown.⁴ In 2013, the World Health Assembly passed the WHA66.¹²

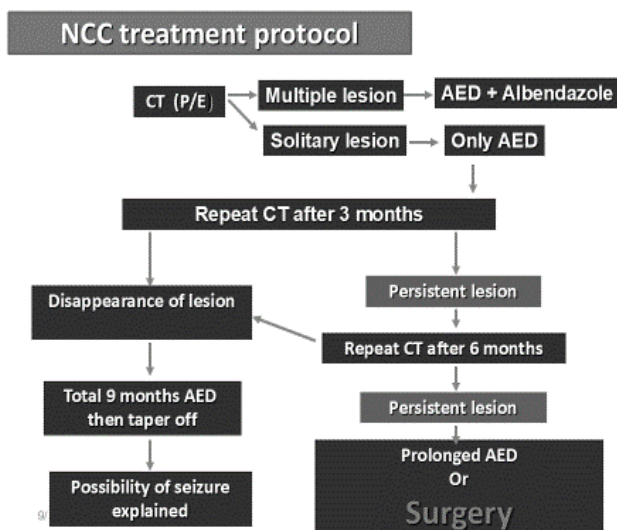
resolution with the aim of eliminating cysticercosis as a public health problem.⁵ Recent results of a study coordinated by the Foodborne Disease Burden Epidemiology Reference Group ranked *T. solium* as the most important foodborne parasite in the world causing a great number NCC-associated epilepsy cases and deaths, resulting in 2.8 million disability-adjusted life years (DALYs).⁶ Neurocysticercosis is a major public health problem leading to burden both physically, socially as well as economically.⁷ This burden seems very high in low-and-middle income countries with high rate of treatment gap resulting in higher number of morbidity and mortality. In a low income country like Nepal, where still out of the pocket expenditure exists, economic factor is also one of the major cause of treatment gap.⁸ Radiological

techniques including Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI) combined with serological techniques are the common techniques to investigate NCC.⁷ Where as in Nepal, with limited tertiary care facilities, limited expertise and diagnostic facility, poor socioeconomic condition, late diagnosis are made for the patient with NCC. The direct cost factors related to NCC includes Cost factor related treatment including, consultation, admission, investigation, and medication. Beside these, transportation, lodging, fooding and other miscellaneous indirect cost are the common factor that makes the family and patient suffer economically.

This study aims to analyze the cost associated with the treatment of Neurocysticercosis in the patients who arrived at Annapurna Neurological Institute & Allied Sciences with its diagnosis. As there are no studies done in Nepal to analyze the cost associated with NCC, the result of this study will definitely help for the Health care Institute as well as Public health organizations to plan and make polices related to treatment of NCC in Nepal.

METHODS

This study was a prospective study conducted at Annapurna Neurological Institute and Allied Sciences among the patients with Neurocysticercosis from Jan 2018- September 2020. Neurocysticercosis was defined based on the presence of compatible cerebral lesions on a computed tomography (CT) scan . All of the 62 patients with NCC were treated according the protocol for NCC (Figure 1)



Patients arriving for the treatment were divided into 4 different categories according to Treatment protocol which included (i) Group I – Patient with NCC who were followed up till 9 months (ii) Group II – Patient with NCC

who were followed up for 15 months (iii) Group III – Patient with NCC who were followed up for 2 years and (iv) group IV – Patient with NCC who were followed up for more than 2 years .These patients were consulted with neurophysician/ neurosurgeons and investigated with radiological Investigation (CT plain /CT Enhanced) , blood investigations including Complete Blood count (CBC) , Liver Function Test (LFT), Renal Function Test (RFT), Electroencephalogram (EEG) . All the diagnosed cases were treatment with Antiepileptic drugs and allowed to follow-up and assessed after few months according to NCC treatment protocol. Anti-epileptic as well as other medications prescribed were sodium valproate, Carbamazepine, Phenytoin, Leveteracetam, Clobazam, and Phenobarbitone as a mono therapy as well as multiple therapy combination within them.

A Performa was developed to record the costs associated the treatment of Neurocysticercosis. Direct cost including consultation, radiology, laboratory, admission and medication were taken from the hospital records. Similarly, Indirect costs including transportation, fooding, lodging and other miscellaneous cost were obtained from patient and family members. Ethical approval was taken from Institutional Review committee prior to the study . Informed consent was obtained from the patients as well as their family members .Data were analyzed using SPSS version 17.

RESULTS

Among 62 patients with Neurocysticercosis, 52 patients could be followed up properly whereas remaining 10 patients (6.2%) were missed during follow-up. Out of 52 patients, 29 patients were male whereas remaining were female. Majority of patients (76.93%) arrived to our center for treatment were out of Kathmandu valley (Table 1) and the mode of transportation to the hospital was bus followed by airplane , private vehicle and taxi.

Patient who arrived for treatment were undergone various investigations including CBC, LFT,RFT,CT scan, EEG and doctor’s consultation in the price of hospital. (Table 2). Among total of 52 patients, 20 patients (38.4%) were categorized in Group 1, 12 patients(23.07%) were categorized in group 2 , 10 patients (19.2%) were categorized in group 3 and 10 patients(19.2%) were categorized in group 4 depending on the course of treatment. The average direct cost including investigation and doctors consultation was \$195 , \$310, \$424, \$533 for group 1,2,3 & 4 respectively. Similarly the cost of antiepileptic drugs were \$135.54, \$225.90, \$361.44 & \$650.00 for each type of group respectively (Table 3) .

Table 1: Socio-demographic profile of the patients with NCC

S.N	Categories	Frequency(n)	Percentage (%)
1.	Age		
	10-20	12	23.07
	21-30	24	46.15
	31-40	8	15.38
	41-50	6	11.53
	50 above	2	3.84
2.	Gender		
	Male	29	55.76
	Female	23	44.23
3.	Family History		
	Present	10	19.23
	Absent	42	80.76
4.	Residency		
	Province 1	7	13.46
	Province 2	12	23.07
	Province 3	5	9.67
	Province 4	9	17.30
	Province 5	10	19.23
	Province 6	5	9.67
	Province 7	4	7.69
5.	Occupation		
	Student	21	40.38
	Housewife	6	11.53
	Teacher	8	15.38
	Farmer	14	26.92
	others	3	5.76
6.	Mode of Transportation		
	Bus	21	40.38
	Private Vehicle	12	23.07
	Taxi	6	11.53
	Airplane	14	26.92

Regarding Indirect cost, majority of expenses were made on transportation, lodging and fooding by the patient and

Table 2: Costs of Investigations during

S.N	Category	Rate (in dollar)/ test
1.	Complete Blood Count	4.77
2.	Liver Function test	5.90
3.	Renal Function Test	5.00
4.	CT scan	45.45
5.	EEG	11.81
6.	Consultation Charge	4.54

Table 3: Direct cost distribution of patient according to course of treatment

Group & Frequency	Characteristics	Course of treatment	Total cost/ patient (in dollar)
Group 1 , n=20	1st Visit & follow up after 3 months and 9 months of diagnosis (with investigations)	9months	195
Group 2 , n=12	1st Visit & follow up after 3 months and 9 months & 15 months of diagnosis (with investigations)	15 months	310
Group 3 , n=10	1st Visit & follow up after 3 months, 9 months,15 months & 24 months of diagnosis (with investigations)	24 months	424
Group 4 , n=10	1st visit & regular follow up in every 6 months & persistent lesion with no seizure control for more than 2 years of the diagnosis	2-5 years	533
Medica- tion cost	Anti-epileptic Drugs	Group Wise	\$0.5/day
		Group 1 –	135.54
		Group 2	225.90
		Group 3	361.44
		Group 4	650.00

the family members during treatment period which was \$150,\$200,\$300 & maximum of \$540 for group 1,2,3 & 4 respectively(Table 4). Beside these cost, additional cost of \$110 were paid by patient if they needed admission in hospital for detail treatment.

Table 5: Indirect cost distribution of patient according to course of treatment

S.N	Category	Cost/visit (in dollar)	Group visit	Total cost (in dollar)
1	Travel & fooding Cost with accom-pany person	37	Group 1 3 visit Group 2 4 visit Group 3 6 visit	150 200 300
2	Accommo- dation	23	Group 4 6+ visit	400-540

Figure 1 shows the overall average cost including direct and indirect cost of the patients who were treated for NCC according to the group. The overall cost for patient in Group 1 was \$468, Group 2 was \$714, and Group 3 was \$1054 and \$1986 for patient in group 4. Majority of cost center was for Indirect cost i.e. 43% followed by medication cost (\$30) and investigations cost (\$27%) (Figure 2). Average cost per day for group 1 to group 4 was \$1.73, \$1.60, \$1.50 & \$1.10 respectively. The overall expenses per day was calculated to be \$1.5.

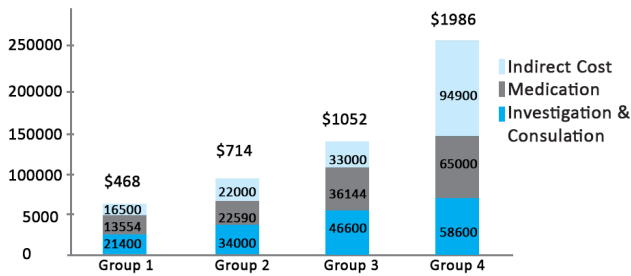


Figure 1: Group-wise overall cost of patients with NCC

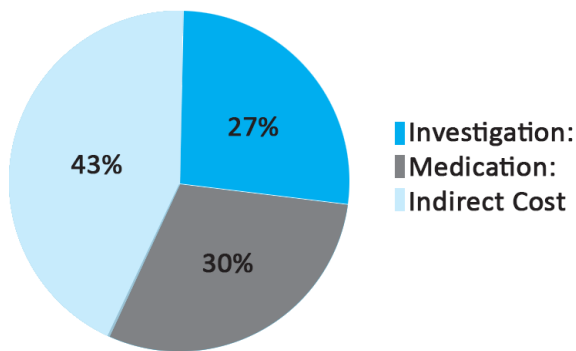


Figure 2: Breakdown of cost center for patient with NCC

DISCUSSION

Neurocysticercosis is an endemic disease and a health burden in Nepal. Neurocysticercosis is an endemic disease and a health burden in Nepal. Neurocysticercosis is one of the major public health burdens in Nepal. This study was a first attempt to present a comprehensive picture of economic burden to the patient due to neurocysticercosis in tertiary neurological center in Nepal. The finding of this study demonstrated that neurocysticercosis poses considerable health and economic burden in developing country like Nepal. In our study the ratio of female to male was 1:1.2 where the number of male was higher than female. Similar result with male dominance were found in the prevalence studies of NCC that was conducted in Nepal before.^{9,10} In our study, Majority of the participants were from Province 2 i.e Terai region of Nepal followed by

Province 5 i.e Western part of Nepal. Very few (n=4) patients were from Province 3 including Kathmandu, Capital city of Nepal. In contrasts, various studies conducted before found that the majority of the patients in the studies were from Kathmandu.^{10, 11} The route of transportation was long route bus for the 40% of patient. This may be due to poor economic condition of the patient as they have to travel a long route to arrive capital city of Kathmandu by private vehicle or by air. Patients enrolled in this study were divided into four different groups depending on the course of their treatment which showed that the patient with 9 months of treatment spent \$468 (Group I), patient with 15 months of treatment spent \$714 (Group II), patient with 15 months of treatment spent \$1052 (Group III) and patient with more than 24 months of treatment spent upto \$1986 (Group IV). The cost center involved was direct and indirect cost. Direct cost included medication, investigations, doctor consultation and treatment. Similar indirect cost included transportation, accommodating and fooding. Average cost per day for group 1 to group 4 was \$1.73, \$1.60, \$1.50 & \$1.10 respectively. The overall expenses per day was calculated to be \$1.5. This expenses is almost similar to the study of economic burden of neurocysticercosis conducted in Mexico^{12,13} and India¹⁴ in two different duration. However the cost of medical treatment was quiet less than the cost in South Africa.¹⁵ Further, in the cases where patient require surgery for NCC may have to spend almost \$ 1400 as per the treatment protocol. This surgery cost is however cheaper than the surgery cost in Mexico.¹²

This expenses derived from this study to treat NCC is around one half of the GDP per capita of Nepal per day as of 2019. This shows that there is huge economic expenses for the people especially from developing countries like Nepal. So NCC must be taken as a serious public health issue in health policy, planning and programs, as an agenda of public health. Kathmandu Declaration on NCC.¹⁶ organized in 2018 focused on the agends to eradicate cysticercosis realizing an urgency to take action for its prevention and management. Implementation of such kind of commitments would be beneficial to reduce the morbidity due to NCC as well as reducing the economic burden of NCC.

This study has some limitations. The study was conducted in only one Tertiary care neurological Hospital in capital city of Nepal so this study only represents a fraction of the total regional population with NCC. Though opportunity cost of family member accompanying with patient was also considered in this study as indirect cost but the indirect burden to the patient due to wages loss during illness were not calculated. Similarly, very few patient underwent surgery during this period and the patient undergone surgery for NCC were not included in the study.

CONCLUSION

Neurocysticercosis is an increasing public health concern in the Nepal. Treatment gap of NCC is especially due to some common factors including, access to health care facilities, limited expertise and diagnostic capacity, sociocultural attitudes and treatment-seeking behavior. Out of Pocket expenditure with poor socioeconomic condition is the common cause of economic burden of NCC. Individual patients with NCC treated at tertiary care Center in Capital of Nepal incurred significant economic loss due to NCC-associated clinical manifestations. The average loss of each individual accounted for around half of per day capita income of Nepal. Different levels of programs and policies to be incorporated by the concerned stakeholders to eradicate NCC so as to reduce and morbidity and economic burden of NCC.

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