

**Amit Thapa, MBBS, MS, MCh**

Associate Professor  
Department of Neurological Surgery,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Bidur KC, MBBS, MS, MCh**

Lecturer  
Department of Neurological Surgery,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Bikram Shakya, MBBS, MS, MCh**

Medical Officer  
Department of Neurological Surgery,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Dipesh Kumar Yadav, MBBS**

Professor  
Department of Neurological Surgery,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Karjome Lama, MBBS**

Professor  
Department of Neuro-Medicine,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Rabindra Shrestha, MBBS, MD, DCN**

Professor  
Department of Neuro-Medicine,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu

**Address for correspondence:**

Dr Amit Thapa,  
Associate Professor,  
Department of Neurological Surgery,  
Kathmandu Medical College Teaching Hospital,  
Sinamangal, Kathmandu  
Email: dramitthapa@yahoo.com  
Phone No. 9851177995

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## Changing epidemiology of stroke in Nepalese population

We are witnessing changing patterns in stroke in our practice. Documenting changes in epidemiological profile are important for public health policy. We hereby present analysis of patients with stroke to stress upon the dynamics and update the improvement in their care.

We retrospectively studied all patients with first time stroke presenting in Kathmandu Medical College Teaching Hospital during June 2012 till November 2015. Diagnosis was made on clinico-radiological basis with prospective follow up for at least 1 year from the event. Risk factors as well outcome in terms of Glasgow outcome score were studied. Statistical analysis was performed on SPSS.

A total of 1017 patients of 16260 patients admitted to the hospital during the study period had first time stroke, a hospital based annual incidence of stroke of 64 per thousand admissions was hence calculated. Mean age was 55 years with 60.5% males. 503 patients (49.5%) had infarction with 20 patients having hemorrhagic conversion while 3 had TIA. 50.2% had hemorrhagic stroke. 56.7% females had ischemic stroke whereas 54.9% of males had hemorrhagic stroke ( $p=0.002$ ). Common risk factors like HTN (54.7%), Smoking (41.5%), Alcohol (39.2%), dyslipidemia (34.1%) and DM (4.8%) were seen with stroke however, active smoker were more at risk of hemorrhagic stroke ( $p=0.000$ ) while diabetic patients for ischemic stroke ( $p=0.000$ ). Due to availability of neurosurgical services, 14.6% patient could undergo procedures like decompressive craniectomy, hematoma evacuation, CSF diversion procedures and carotid endarterectomy for stroke. 66.9% patients required surgical intervention within 48 hours of admission. We had 30 days mortality of 0.5% mortality in this series (majority in hemorrhagic stroke), however over 3 years duration of study mortality rose to 8.3% (majority in ischemic stroke). Almost 88.5% patients achieved mRS<

2 over a period of 3 years. Persistent vegetative state was seen in 7.6% cases after 1 year.

We observe a very high incidence of hemorrhagic stroke in general with higher than reported proportion of females being involved with ischemic stroke in our series. Most of the vegetative state conditions occurred in ischemic stroke patients however early mortality was common in hemorrhagic stroke. This change in pattern of stroke as well as need of surgical intervention mandates early involvement of neurosurgical services. Poor long term prognosis in ischemic stroke may be reversed by timely thrombolytic services and prevented by mitigating risk factors.

**Keywords:** Epidemiology, Hemorrhagic stroke, Hospital based study, Ischemic stroke, Nepal

Being one of the Least Developed Country (LDC) according to United Nations<sup>16</sup>, Nepal is mired with challenges of not only feeding its poor people but also face burden of physically incapacitated patients as a result of stroke. According to a report published in 2012, stroke is a major cause of death and one of the top five diseases in Nepal on the basis of Disability Adjusted Life years (DALY).<sup>25</sup> In Asian countries it kills 3 million people every year.<sup>6</sup> Etiologically stroke is more heterogeneous than ischemic heart disease (IHD), hence pattern of occurrence differs with ethnicity. There has been lot of hospital as well community based studies looking into differences in risk factors across different population but the changing pattern of stroke is less studied.<sup>31</sup>

With the changes in lifestyle and increase in life expectancy, recently we have seen changes in epidemiological profile of the patient being affected by stroke which needs to be documented.<sup>5</sup> It is important to study changing epidemiological profile to make public health policies as well as audit the improvement in health care delivery.<sup>27,36</sup> Kathmandu Medical College Teaching Hospital (KMCTH) being a tertiary care health care hospital has both neurological and neurosurgical services. We conducted a hospital based study to know the change in epidemiological profile of stroke, treatment being provided and outcome of intervention.

## Materials and Methods

A retrospective study was conducted at KMCTH to include all patients presenting with first time cerebrovascular accidents (CVA) between June 2012 till November 2015 in both departments of Neurology and Neurosurgery. All patients were admitted through emergency department and after primary resuscitation underwent Plain CT Scan Head. Diagnosis was made on clinic-radiological basis. Routine examination of blood, hematocrit, biochemistry, coagulation profile, lipid profile and electrolytes was performed. MRI head was advised for patients with ischemic stroke or those patients who were suspected to have arteriovenous malformations (AVM), cavernomas, vasculitis or cortical venous thrombosis. CT angiography was performed for patients with aneurysm or AVM or fistulas. ECG, echocardiography and carotid Doppler was performed on patients with ischemic stroke or on cardiologist advice. Patients were prospectively followed for atleast 1 year from the event. Data was collected in excel sheet for patient profile, risk factors for CVA, radiological findings, Glasgow Coma Score (GCS) at presentation, Neurological deficits at presentation, intervention performed, complications during hospital stay and outcome in terms of modified Rankin Scale (mRS).

Primary outcome measures were death and morbidity in terms of mRS. mRS of >3 was categorized as poor outcome.<sup>3</sup> Secondary outcome measures were improvement in neurological deficits. Historical cohorts from published series were used to compare the epidemiological profile, intervention and outcome. Descriptive statistics were used to assess patients' socio-demographic and clinical characteristics. Statistical analysis was performed on SPSS Statistics version 17.0.0 (SPSS Inc., Chicago, IL, USA). Unpaired t-test,  $\chi^2$  test, Fisher's exact test, and Mann-Whitney U tests were used to perform univariate comparisons.  $P < 0.05\%$  was used to identify statistical significance.

Since this was a retrospective study with prospectively collected data and without any study related additional investigations or interventions, ethical clearance was not required for the conduct of the study. No incriminating personal data were collected or shared.

## Results:

### Characteristics of the cohort

1017 patients with CVA were identified and prospectively followed. During this period, 16260 patients were admitted to the hospital. Based on this data, a hospital based disease specific annual incidence of stroke was found to be 64 per thousand hospital admission. Mean age of patients affected was 55+/-21.9 years (Range 1 to 99 years). 31.9% patients were under 45 years of age. 511 patients (50.3%) had hemorrhagic stroke as compared to 503 patients (49.5%) who has infarction and only 3 (0.3%) had transient ischemic attack (TIA). 20 patients with ischemic stroke had presented with hemorrhagic transformation.

### Risk Factors

Mean age of patients presenting with infarction was 64.6+ 16.3 years as compared to hemorrhage who presented in relatively younger age of 46.4+ 23.2 years ( $p=0.000$ ).

402 (39.5%) of patients were female. Of the females, 228 (56.7%) had infarction as compared to 173(43%) who developed hemorrhagic stroke, whereas of 615 males 275(44.7%) developed infarction as compared to 338 (54.9%) who had hemorrhage ( $p=0.002$ ).

114 patients (12.2%) of 937 whose glucose levels were known, 45 (4.8%) had uncontrolled hyperglycemia.

452 patients (48.7%) of 928 patients whose blood pressure recordings were available, had hypertension of which 247 (54.7%) had uncontrolled HTN. Surprisingly Hypertension (HTN) was seen more associated with ischemic stroke than hemorrhagic stroke. 144 (30.9%) of

466 patients without HTN had ischemic stroke as compared to 255 (56.4%) of 452 patients with HTN ( $p=0.000$ ).

Mean Systolic Blood Pressure (SBP) recording of patients with infarction was 133+ 26.2 mmHg as compared to 128.4+ 30.6 mmHg in patient with hemorrhagic stroke ( $p=0.015$ ). There was not much difference in Mean Diastolic Blood Pressure (DBP) recordings in patients with ischemic stroke of 82.9+ 15.3 mmHg when compared to 82+ 16.9 mmHg ( $p=0.424$ ) of patients with hemorrhagic stroke.

365 (39.2%) of 931 patients who could give history of alcohol intake, were consuming alcohol.

91(34.1%) of 267 patients who had lipid profile evaluated, had dyslipidemia.

Of 946 patients whose history of smoking was known, 337 (35.6%) were active smokers and 56 (5.9%) were reformed in the series. Active smokers were seen to be at risk for hemorrhagic stroke, as 211(64.1%) of 329 had hemorrhagic stroke when compared to 9(16.1%) out of 56 patients who had quit smoking ( $p=0.000$ ). 291(55.2%) of 538 patients who were non smokers had hemorrhagic stroke.

Diabetes Mellitus (DM) either controlled or uncontrolled, was seen to be more common in ischemic stroke (74 patients, 62.1%) rather than hemorrhagic stroke (39 patients, 32.8%). 466 (57.7%) of 807 patients without DM had hemorrhagic stroke ( $p=0.000$ ).

ECHO was performed in 290 patients of which 225 (77.6%) were abnormal. 188 (77.4%) patients of 243 with infarction, 36 (78.3%) of 46 with hemorrhagic stroke and 1 (100%) with TIA had abnormal ECHO findings ( $p=0.083$ ).

Carotid Doppler were available in 135 patients, of which 22 (16.3%) had stenosis and 93 (68.9%) had non significant plaques. 19 (15.6%) of 122 patients with infarction, 3(25%) of 12 patients with hemorrhagic stroke and 1 (100%) of TIA had carotid stenosis ( $p=0.125$ ).

### Interventions

869 patients (85.4%) were conservatively managed. Of 148 patients undergoing surgical interventions, 39 (26.3%) underwent decompressive craniotomy, 55 (37.2%) had definitive procedures like hematoma evacuation or clipping of aneurysm and 54 (36.5%) had various procedures like burr hole evacuation of subdural hematomas or external ventricular drainage or carotid endarterectomy. 12 (2.4%) out of 497 patients with infarction required surgical intervention, of which 6 (50%) had developed hemorrhagic transformation ( $p=0.000$ ). 50 patients (9.7%) of 511 patients with hemorrhagic stroke had to be evacuated or underwent clipping of aneurysm with additional 34 patients (6.7%) requiring decompressive craniectomy due

to deep seated hematoma with brain edema. 52 patients with subdural hematoma were managed with burr hole evacuation.

56 patients (38.6%) had undergone surgery within 24 hours, 41 (28.3%) within another 24 hours and only 14 patients (9.7%) had required surgical procedure after 1 week.

### Outcome

71 patients in the study left against medical advice, hence their outcome is not known. During treatment, 5 patients (0.5%) died. 3 of them had hemorrhagic stroke.

Mean hospital stay was higher in hemorrhagic stroke on 10+ 9.4 days when compared to 7.1+ 8.1 days in ischemic stroke ( $p=0.000$ ).

As these patients were followed, 84 patients (8.3%) died over a period of 3 years. 30-days mortality was 2.4% (25 patients). Of all the deaths recorded in this series, patients with ischemic stroke died in 250.9+ 293.8 days as compared to hemorrhagic stroke who died much earlier in 127.8+ 178.4 days.

Of the surviving 946 patients, 558 (58.9%) had mRS of  $< 2$  at the time of discharge which improved to 88.5% (115 of 130 patient) at the end of 3 years.

At the time of discharge, among the surviving 409 infarcted patients, 204 (49.9%) had mRS of  $< 2$  as compared to 338 (66.4%) of 509 surviving patients with hemorrhage ( $p=0.000$ ). This dichotomous result improved to 60.6% (20 of 33) in infarcted patients as compared to 97.9% (93 of 95) with hemorrhage at the end of 3 years ( $p=0.000$ ). Persistent vegetative state was seen in 72 patients (7.6%).

### Discussion:

Stroke incidence and pattern is changing rapidly but variably all over the world.<sup>31,32,36</sup> Stroke seems to occur even in younger than 45 years age in developing countries, where two third mortality in stroke occurs.<sup>4,9,14,17</sup> In our practice we have seen changes in the epidemiological profile as well as advancement of services for stroke, however no comparisons have been studied till date. Last 2 decades have witnessed tremendous improvement in socio-economic status of the people in urban areas. Due to lack of facilities and opportunities, rural emigration to urban areas has increased by leaps and bounds. In cities the exposure to high risk life style (sedentary life, heavy consumption of alcohol, high fatty foods, lack of exercise and stressful life) have somehow increased the burden of stroke.<sup>20</sup> To help allocate resources as well as audit the interventions being done, such studies are mandatory.<sup>6</sup>

Jaya Stroke Foundation had earlier estimated 50,000 people per year been afflicted with stroke in Nepal, 21

however if we extrapolate the disease specific hospital admission rate of 64 per thousand per year to the adult Nepalese population of 18.2 million (of 29.5 million populations as of 2018)<sup>28</sup>, stroke can be astonishing affecting 1.16 million per year (or an incidence of 11.<sup>6</sup> per 100,000 person-years). Even though this figure may appear factitiously high in comparison to previous published estimates, and the correction may lower this figure to half but still then compared to the estimate two decades back incidence of stroke in Nepal has increased by 10 times.<sup>21</sup> This incidence is however lower to what is reported of India (119-145 per 100,000 person-years), China (116-219 per 100,000 person-years) and Pakistan (250 per 100,000 person-years) in 2017.<sup>30</sup> Risk of stroke has been studied to double for each successive decade after age of 55 years.<sup>7</sup> With the increasing life expectancy which is predicted to be 72.4 years in next 20 years from the existing 63.8 years, burden of stroke seems to rise.<sup>5</sup> To quantify confidently we need population based studies on stroke in Nepal.

Stroke leaves most of the victims maimed and invalid. For poor countries like ours, if resources are not allocated to either prevent or at least decrease the impact of stroke, long term outcome is going to be worst. Ouyang et al found poorer patient to have comparably poor post stroke functional outcome (OR 2.85, 95%CI 1.93—4.23).<sup>20</sup> Recent literature from China suggest shifting of stroke burden from urban to rural areas.<sup>29,32,37</sup>

Compared to previous literature, currently patients are being affected by stroke at a younger age. Shaik et al found mean age of affected between 59 to 62 years in different series published from Nepal as compared to ours of 55 years.<sup>18,19,22,25,27</sup> This difference in age may be due to higher proportion of hemorrhagic stroke in our series which usually affects at younger age than infarction. The previous literature had higher proportion of ischemic stroke. However, we had almost 31.9% patients younger than 45 years of age with stroke in our series which is far more than 9 to 15.3% reported from hospitals in Kathmandu.<sup>27,36</sup> High prevalence of rheumatic heart disease and chronic infection like CNS tuberculosis have been cited as possible reasons.<sup>27</sup>

Our study found increase in proportion of hemorrhagic stroke, with almost 50% presenting with bleed which is very high as compared to previous series (31.9 to 42.4%) published in Nepal except for Rajouria et al (50.7%) in 2012 and Achary et al (55%) in 2014.<sup>1,9,18,22,23,25,27</sup> Even in western literature till 2 decades back, infarction used to be 4 times commoner than hemorrhagic stroke.<sup>33</sup> This increase could be due to widespread use of anti-platelets and anticoagulants being prescribed, due to increase in public awareness of cardiac illness and tendency of

Study/ Hospital vs community	Duration	Cases	Females	% ischemic stroke	Risk factors
Oli et al <sup>19</sup> Hospital	1996-2000	683	48.5%	63%	Smoking (28.5%), HTN (42%), Alcohol (18.4%) DM (10.8%)
Devkota et al <sup>9</sup> Hospital	2000-2005	72	47.1%	68.1%	Smoking (58.3%), alcohol (41.4%), HTN (47.2%), AF (12.5%) DM (11.1%)
Pathak et al <sup>22</sup> Hospital	2003-2005	72	-	68%	Smoking (61%), HTN (60%), AF (8%)
Naik et al <sup>18</sup> Hospital	2004-2005	150	30.6%	58%	Smoking (40.7%), HTN (42%) Excessive meat consumption (69.1%)
Rajouria et al <sup>23</sup> Hospital	2008	75	25.3%	49.4%	-
Shrestha et al <sup>27</sup>	2010-2011	210 (neurology admission)	40.9%	57.6%	Smoking (60.5%), alcohol (41.4%), HTN (38.6%), DM (10%), Dyslipidemia(9.1%), VHD (3.3%)
Acharya et al <sup>1</sup> Hospital	2011-2012	100	34%	45%	-
Our series	2012-2015	1017	39.5%	49.5%	Smoking (41.5%), alcohol (39.2%), HTN (48.7%), DM (12.2%), Dyslipidemia(34.1%),

Table 1: Change in epidemiology as seen in published series

doctors to prescribe prophylactic anti-platelets even in low risk patients. Besides, the risk factors of Hypertension and smoking also seem to be higher in our series which increases the risk of bleed more than infarction. Globally 15-40% incidence of stroke due to hemorrhage in Asia is much higher than reported 15% in most developed countries.<sup>5,30</sup>

Hemorrhagic transformation in infarction was seen in 4% patient, of which 30% required surgical intervention. Hence blood pressure management and cautious use of anti-platelets and anti-coagulants is mandatory.

In our series a very low incidence of transient ischemic attack (TIA) was seen. This may be due to poor public knowledge of stroke and poor socio-economic status. Both ignorance of the disease and failure to get medical evaluation after so called minor illness could hide the true prevalence of the disease. Evaluation and mitigation of risk factors associated with TIA is necessary to avoid untreated TIA to convert into ischemic stroke which occurs in one third patient.<sup>9</sup>

We found almost similar gender proportion of patients having stroke as 2 decades back (See table 1). Literature had cited women to suffer from stroke at a younger age.<sup>5</sup> This could be because stroke except for venous infarction affects post menopausal women, who due to changing nature of their occupation as well as changing lifestyle are also equally prone for stroke. However, we found women more at risk of ischemic stroke and men more for hemorrhagic stroke.

Regarding the risk factors for stroke, we did not find any significant difference as compared to previous series published from Nepal except for dyslipidemia which has increased 3 times (See table 1). This could be due to changes in dietary habits of Nepalese which included deep fried meat and used of desi dalda or ghee in food. Still major but modifiable risk factors for stroke are smoking, alcohol, hypertension and diabetes mellitus. We did find active smoker more at risk of hemorrhagic stroke and diabetic patients more for ischemic stroke. Vibha et al in their review of literature have found similarities

- Incidence of stroke had increased by 10 times over last two decade
- People are being affected by stroke at a younger age
- Hemorrhagic stroke has become more common than ischemic stroke
- Women are increasingly at risk of stroke with higher number suffering from ischemic stroke. Males are more at risk of hemorrhagic stroke.
- Hospital based incidence of TIA is still less, may be due to ignorance of disease and subsequent risk of progression of disease
- Hypertension, Diabetes mellitus and smoking are still significant risk factors. Dyslipidaemia has increased by 3 times.
- Ready availability of medical and surgical services has decreased the overall mortality. As majority (two-third) of surgical interventions required is within 48 hours of ictus, surgical team should be involved in medical care very early.
- Mortality could be decreased by early surgical intervention
- Morbidity can be prevented by mitigating risk factors and early thrombolytic and endovascular interventions

Table 2: What has changed in stroke in Nepal?

in risk factors for stroke in South Asia when compared to developed countries except for causes like rheumatic heart disease and post partum cerebral venous thrombosis which are more common in this part of the world. In the same study, the authors have found risk factors among all south Asian countries similar.<sup>31</sup>

In our series, 15% patients required surgical intervention (2.4% of infarction and 26.6 % of hemorrhagic stroke). We found almost two third of the surgical intervention had to done within 48 hours of admission to the hospital, hence neurosurgical team should be involved early in the case of stroke. Besides almost 10% patient required surgical intervention after 1 week, hence all patients with stroke should be observed for at least 1 week for any neurological deterioration. Even though health services in Nepal are cheaper than its neighboring countries, most of the population could not avail the services due to lack of super specialized facilities and trained manpower in rural areas. This is compounded by difficulties in travelling from far-flung places to hospital as well as general ignorance of public which consider such neurological disorders a wrath of God and turn to traditional healers.<sup>26</sup>

We found a very low 30-days mortality as compared to previous published literature. Oli et al found 16.8% in-hospital mortality among 683 patients with stroke (30.5% of hemorrhagic and 14.17% of ischemic stroke died).<sup>19</sup> Shrestha et al in another government hospital in Kathmandu found 5.7% mortality in hospitalized patients.<sup>27</sup> This may be due to availability of better emergency neurosurgical services. Availability of CT angiography in most of the centers have helped early angiographic diagnosis and

hence the management. However most of the patients in our country still could not make it to the hospital or are brought dead to the hospital. Many relatives on being explained of bad prognosis after being diagnosed of stroke do not get their patients admitted; this may be the reason of low early mortality in our series. Emergency Department (ED) based research could help us find the incidence of early death in stroke. However, on following the survived patients we find a high 1.4 times higher risk of mortality in patients with infarction than hemorrhagic stroke.

In absence of thrombolysis services at our center, ischemic stroke patients remained deprived of this proven therapy with substantial impact. Trials have shown for every 100 patients treated with tissue plasminogen activator (t-PA) within the first 3 hours, 32 had a better outcome as a result and 3 had a worse outcome. An absolute improvement of 12% in patients with minimal or no disability had been quoted.<sup>2,12,13</sup> Hence it is advisable to administer thrombolytic therapy in ischemic strokes at the earliest.

Similar to previous literature, out of 946 survivors, good outcome (mRS<2) was seen 1.3 times more in patients with hemorrhagic stroke as compared to infarction on short term follow up. Due to poor follow up, only 13.7% patients could be followed for 3 years. We have seen improvement in power as well as speech in some patients with only 7.6% remaining invalid. However due to poor follow up, statistically verifiable analysis could not be drawn. This needs community based survey of these patients who due to their socio-economic condition as well as handicap unfriendly transportation facilities

make routine follow up to hospital arduous. Globally around 20% stroke patients require institutional care after 3 months of stroke with around 15-30% remaining permanently invalid.<sup>17</sup>

The burden of disease related morbidity can only be decreased by prevention. Even the best and most developed health care system by their treatment cannot significantly impact the burden of stroke. Hence “prevention is better than cure” holds very valid for stroke.<sup>31</sup> Primordial preventions by promoting physical exercise, quitting smoking and tobacco, nutritional modifications and diabetes screening have shown to help.<sup>34</sup> Primary prevention like managing the modifiable risk factors of hypertension, exposure to cigarette smoke, diabetes, atrial fibrillation, dyslipidaemia, carotid artery stenosis, sickle cell disease, post menopausal hormone therapy, obesity and potentially modifiable risk factors like the metabolic syndrome, alcohol abuse, drug abuse, oral contraceptive use, sleep-disordered breathing, migraine headache, hyper-homocysteinemia, elevated lipoprotein(a), elevated lipoprotein-associated phospholipase, hypercoagulability, inflammation and infections.<sup>11</sup> Secondary prevention in stroke involves controlling the risk factors like controlling the blood pressure, glucose and lipid levels to optimum levels and starting anti-platelets in infarctions.<sup>10</sup> Anticoagulation should be started in every patient with atrial fibrillation. Carotid ultrasound should be performed on all patients who would be considered for carotid endarterectomy. Therapy with a statin should be considered for all patients with history of TIA or ischemic stroke.<sup>8</sup> Tertiary prevention involves effective evidence based management of stroke based on guidelines, which includes early hematoma evacuation and decompressive craniectomy for stroke.<sup>24</sup> Decompressive craniectomy for malignant middle cerebral artery territory infarction if done within 48 hours of stroke is associated with a reduction in death or dependency from 76.5% (conservative) to 60.2% (surgery) (absolute risk reduction [ARR], 16.3%; 95% confidence interval, -0.1 – 33.1%).<sup>15</sup>

In 1990 stroke caused 3% of world’s disability and then it was expected to double by 2020.<sup>35</sup> We have seen in the other literature as well as ours, this prediction is taking shape and hence it is vital to step on prevention measures and declare stroke a public health challenge.

#### Limitations of study

Being a hospital based registry, selection bias, survivor bias and referral bias could not be ruled out. Hospital based data only suggest outcome in events reaching hospital. Hence we need community based study including all incident cases of stroke to corroborate on findings of this study.

## Conclusion

We have seen massive increase in incidence of stroke over the last 2 decades in Nepal with younger people and more women being affected. Hemorrhagic stroke has now become more common than ischemic stroke. Despite public health awareness program, modifiable risk factors are still common in stroke, notable of which is 3-fold increase in incidence of Dyslipidemia in patients with stroke. Even though early mortality was higher in patients with hemorrhagic stroke, during follow up more people died with infarction. Improvement was significantly more in hemorrhagic stroke as compared to ischemic stroke. Availability of neurosurgical interventions has helped decreased mortality but morbidity can be decreased further by risk modifications and widespread availability of thrombolytic and endovascular interventions.

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#### References:

1. Acharya S, Chaturvedi SK. Significance of computed tomography in the diagnosis of cerebrovascular accidents. **Journal of Lumbini Medical College** 2:18-20, 2014
2. Albers GW, Clark WM, Madden KP, Hamilton SA. ATLANTIS trial: results for patients treated within 3 hours of stroke onset. Alteplase Thrombolysis for Acute Non-interventional Therapy in Ischemic Stroke. **Stroke** 33:493-5, 2002
3. Banks JL, Marotta CA. Outcomes Validity and Reliability of the Modified Rankin Scale: Implications for Stroke Clinical Trials: A Literature Review and Synthesis. **Stroke** 38:1091-1096, 2007
4. Bevan H, Sharma K, Bradley W. Stroke in young adults. **Stroke** 21: 382–6, 1990
5. Bhalla D, Marin B, Preux PM. Stroke profile in Afghanistan and Nepal. **Neurology Asia** 14: 87 – 94, 2009
6. Bharucha NE, Raven RH, Bharucha PE, Bharucha EP. Application of neuroepidemiological research in the organization of neurological services. Eds: Progress in neurology. **BI Churchill Livingstone**, 167-71, 1995
7. Brown MM, Stroke epidemiology and clinical features. **Med Int Neurol** 10: 4: 45-51, 2000
8. Das K, Ghosh M, Khanna B, et al. Discontinuation of secondary preventive treatment of stroke: an

- unexplored scenario in India. **Clin Neurol Neurosurg** **112**:766-9, 2010
9. Devkota KC, Thapamagar SB, Malla S. Retrospective analysis of stroke and its risk factors at Nepal Medical College Teaching Hospital. **Nepal Med Coll J** **8**:269 – 75 32, 2006
  10. Furie KL, Kasner SE, Adams RJ, et al. Guidelines for the Prevention of Stroke in Patients with Stroke or Transient Ischemic Attack. A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association. **Stroke** **42**:227-76, 2011
  11. Goldstein LB, Adams R, Alberts MJ, et al. Primary prevention of ischemic stroke: a guideline from the American Heart Association/American Stroke Association Stroke Council: cosponsored by the Atherosclerotic Peripheral Vascular Disease Interdisciplinary Working Group; Cardiovascular Nursing Council; Clinical Cardiology Council; Nutrition, Physical Activity, and Metabolism Council; and the Quality of Care and Outcomes Research Interdisciplinary Working Group: the American Academy of Neurology affirms the value of this guideline. **Stroke** **37**:1583-633, 2006
  12. Hacke W, Donnan G, Fieschi C, Kaste M, von Kummer R, Broderick JP, et al. Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. **Lancet** **363**:768-74, 2004
  13. Hacke W, Kaste M, Bluhmki E, Brozman M, Dávalos A, Guidetti D, et al. Thrombolysis with alteplase 3 to 4.5 hours after acute ischemic stroke. **N Engl J Med** **359**:1317-29, 2008
  14. Hoffmann M. Stroke in the young in South Africa – an analysis of 320 patients. **S. Afr Med J** **90**: 1226-37, 2002
  15. Hofmeijer J, Kappelle LJ, Algra A, Amelink GJ, van Gijn J, van der Worp HB. Surgical decompression for space-occupying cerebral infarction (the Hemicraniectomy After Middle Cerebral Artery infarction with Life-threatening Edema Trial [HAMLET]): a multicentre, open, randomised trial. **Lancet Neurol** **8**:326-33, 2009
  16. Least Developed Countries. United Nations Department of Economic and Social Affairs. Available from: URL <https://www.un.org/development/desa/dpad/least-developed-country-category/lDCs-at-a-glance.html> Retrieved 2018-03-10
  17. Murray CJL, Lopez AD. The Global Burden of Disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020. Boston: Harvard University Press, 1996
  18. Naik M, Rauniyar RK, Sharma UK, Dwivedi S, Karki DB, Samuel JR. Clinico-radiological profile of stroke in eastern Nepal: a computed tomographic study. **Kathmandu Univ Med J** **4**:161-6, 2006
  19. Oli KK, Agarwal JP. Critical review of stroke. **J Inst Med** **23**:63-6, 2001
  20. Ouyang F, Wang Y, Huang W, Yicong Chen Y, Yuhui Zhao Y, Dang G, Zhang C, Lin Y, Zeng J. Association between socioeconomic status and post-stroke functional outcome in deprived rural southern China: a population-based study. **BMC Neurology** **18**:12, 2018
  21. Pandit A, Arjyal A, Farrar J, Basnyat B. Nepal. **Pract Neurol** **6**:129–33, 2006
  22. Pathak V, Kanth R, Pant H. Stroke: a case series study in Nepal Medical College Teaching Hospital. **Nepal Med Coll J** **8**:180-1, 2006
  23. Rajouria AD, Rana KJ, Karki L, Gaire D, Pokheral. Stroke Scoring??? Does it have role. **PMJN** **12**: 13-19, 2012
  24. Rothwell PM, Coull AJ, Giles MF, et al. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). **Lancet** **363**:1925-33, 2004
  25. Shaik MM, Loo KW, Gan SH. Burden of stroke in Nepal. **Int J Stroke** **7**:517-2, 2012
  26. Shankar PR, Paudel R, Giri BR. Healing traditions in Nepal. **J Am Assoc Integr Med** -Online [Internet]. [Cited 2013 Nov 12]. Available from: URL:<http://www.aaimedicine.com/jaaim/sep06/Healing.pdf>
  27. Shrestha A, Shah DB, Koirala SR, Adhikari KR, Sapkota S, Regmi PR. Retrospective Analysis of Stroke and Its Risk Factors at Bir Hospital. **PMJN** **11**:28-30,2011
  28. Source: Worldometers ([www.Worldometers.info](http://www.Worldometers.info)) Elaboration of data by United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision. (<https://esa.un.org/unpd/wpp>)
  29. Tang X, Laskowitz DT, He L, Østbye T, Bettger JP, Cao Y, Li N, Li J, Zhang Z, Liu J, Yu L, Xu H, Hu Y, Goldstein LB. Neighborhood socioeconomic status and the prevalence of stroke and coronary heart disease in rural China: a population-based study. **Int J Stroke** **10**:388-95, 2015
  30. Venketasubramanian N, Yoon BW, Pandian J, Navarrod JC. Stroke Epidemiology in South, East, and South-East Asia: A Review. **Journal of Stroke** **19**:286-294,2017
  31. Vibha D, Prasad K. Cerebrovascular disease in South

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- Asia – Part II: Risk factors and prevention. **J R Soc Med Cardiovasc Dis** 1:21, 2012
32. Wang J, An Z, Li B, Yang LI, Tu J, Gu H, Zhan C, Liu B, Su TC, Ning X. Increasing stroke incidence and prevalence of risk factors in a low-income Chinese population. **Neurology** 84:374–81, 2015
  33. Warlow CP, Dennis MS, van Gijn J et al. What caused this transient of persisting ischemic event? In *Stroke: a practical guideline to management*. Oxford: **Blackwell Science** 223-300, 2001
  34. Weintraub WS, Daniels SR, Burke LE, et al. Value of primordial and primary prevention for cardiovascular disease: a policy statement from the American Heart Association. **Circulation** 124:967-90, 2011
  35. WHO. The world health report 2000: Health systems - improving performance. Geneva: WHO, 2000.
  36. World Health Organization: The world Health Report. Shaping the future. Geneva: **World Health Organization** 2003
  37. Zhang XH, Guan T, Mao J, Liu L. Disparity and its time trends in stroke mortality between urban and rural populations in China 1987 to 2001: changing patterns and their implications for public health policy. **Stroke** 38:3139–44, 2007