



ISSN: 0975-833X

## RESEARCH ARTICLE

### STROKE AT HIGH ALTITUDE: GARHWAL REGION, NORTH INDIA

\*Dr. Murali Mohan, K. T. K., Dr. Monica, P., Dr. Butola, K. S., Dr. Leena, P. and Dr. Avinash, K. S.

Associate Professor of Medicine Working in Ver Chander Singh Garwhal Medical College, Srinagar in Uttarkhand

#### ARTICLE INFO

##### Article History:

Received 15<sup>th</sup> September, 2015  
Received in revised form  
22<sup>nd</sup> October, 2015  
Accepted 27<sup>th</sup> November, 2015  
Published online 30<sup>th</sup> December, 2015

##### Key words:

Stroke,  
High altitude,  
Garwhal,  
North India,  
Hypertension,  
Diabetes.

#### ABSTRACT

**Background:** Sir Veer Chandra Singh Garhwal Government Institute of Medical Sciences and Research Centre is a tertiary referral Centre for Eastern Garhwal Region which caters to the medical needs of Chamoli, Rudraprayag and Pauri-Srinagar Districts of Uttarkhand, North India. H.N. Bahuguna Government Base Teaching Hospital is attached to the above institution is located near Srinagar town in the Alakananda Valley at 579 meters above the sea level. The patients who are referred here come from Kedarnath and Badrinath valleys lying at an altitude of 1500 to 3500 meters above the sea level.

**Aims and Objectives:** This is an observational study undertaken to study the clinical presentation, risk factors, neurological presentation, pattern of brain strokes, areas of brain affected as per CT scan findings in the adult population coming from the high altitudes of Eastern Garhwal region of Uttarkhand State in North India during the period from January to December 2013. Materials and Methods: All the adult admitted cases in the hospital were examined clinically for hypertension, Diabetes and systemic and neurological examination were conducted followed by laboratory investigations, which included routine urine and blood examination, ECG, X-Rays, CT-Brain plain and contrast and CSF analysis, when indicated.

**Observations:** Out of the 336 cases of stroke studied during the period from 1st January 2013 and to 31st December 2013 in our hospital, 61.3% were having hypertension, 20.5% were smokers, 10.11% were having diabetes mellitus, and 7.44% were having cardiac disease. Over all incidence of stroke was 28/100,000 population with male to female ratio 7:4. Clinically, unilateral weakness was seen in 58.6%, unilateral sensory impairment in 19.9%, conjugate deviation of eyes in 16.4%, impaired cognitive function 37.2%, impaired consciousness in 21.4%, aphasia in 13.4%, dysphasia in 19.6%, dysphagia in 11.6%, dysarthria in 27%, ataxia in 5.4%, headache 16.1%, vertigo in 8.6% and seizures 12.5%. Ischemic infarctions were 58.65%, hemorrhages were 25.89%, transient ischemic attacks were 12.5%, subarachnoid hemorrhage were 1.78% and cortical vein thrombosis 1.91% as revealed by CT scans reports. Recurrent strokes were 5.95%. Mortality in the study was 8.3%.

Copyright © 2015 Murali Mohan et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Citation:** Dr. Murali Mohan, K.T.K., Dr. Monica, P., Dr. Butola, K. S., Dr. Leena, P. and Dr. Avinash, K.S., 2015. "Stroke at high altitude: Garhwal region, north India", *International Journal of Current Research*, 7, (12), 24231-24235.

## INTRODUCTION

Developing countries like India are facing a double burden of communicable and non-communicable diseases. Stroke is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range from 84-262/100,000 in rural and 334-424/100,000 in urban areas as per recent review by Jeyaraj Durai Pandaian and Paulin Sudhan, 2007 Razdan Kaul *et al.*, 1989 who have studied stroke at high altitudes in Kuthar Valley, Ananthanag District of Jammu and Kashmir. In the 91 cases studied they reported an incidence of stroke 143/100,000 population. Age specific prevalence of 41/100,000 in the age group of 15 to 39 years and 630/100,000 in the age group above 40 years; out of which

58.24% were hypertensive. Strokes formed 13.7/1000 of hospital admissions from high altitude area, compared to 1.05/1000 in non high altitude area as per Jha *et al.*, 2003. This observational study was undertaken to study the burden of stroke due to impact of hypertension and diabetes on stroke events in the adult population coming from high altitudes of Eastern Garhwal region in the State of Uttarkhand, North India. All cases admitted and treated in the Department of Medicine from January 2013 to December 2013. The pediatric cases were excluded in the study. The consent of institutional ethical committee was taken.

## MATERIALS AND METHODS

All the adult cases admitted in the hospital in the Department of Medicine, a complete history was obtained from the

\*Corresponding author: Dr. Murali Mohan, K.T.K.

Associate professor of Medicine working in Ver Chander Singh Garwhal Medical College, Srinagar in Uttarkhand

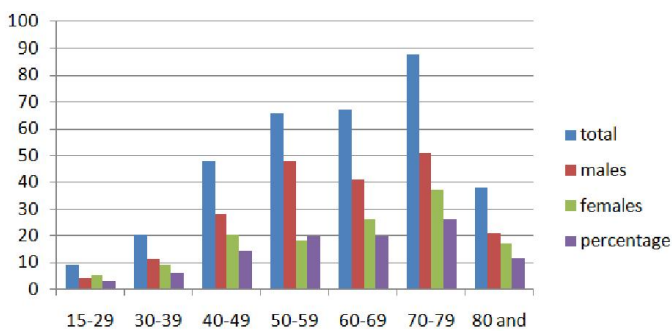
relatives or attendants of stroke patients and recorded. The patients were examined clinically; blood pressure was recorded by using Mercurial sphygmomanometer and systemic and neurological examination were conducted followed by laboratory investigations. Routine urine and blood examination for FBS, PPBS HBA<sub>1c</sub>, S. creatine, electrolytes, lipid profile were done. ECG, X-Rays, CT-Brain plain and contrast were taken. Fundoscopy was done to rule out papilledema and lumbar puncture was done taking due precautions and CSF analysis done when indicated. The patients were monitored in Medical Intensive care unit still the patient was stabilized.

**Observations**

Out of the 336 cases of stroke studied during the period from 1<sup>st</sup> January 2013 and to 31<sup>st</sup> December 2013 in our hospital 61.3% were having hypertension and graded as per JNC 7<sup>th</sup> Report as shown in table4. Chronic smokers were 20.5%, diabetes mellitus comprised 10.11% and 7.44% were having cardiac disease. Over all incidence of stroke was 28/100,000 population with male to female in the ratio of 7:4. The age-wise distribution of stroke of 336 patients for year January to December 2013 is as shown in table1 and chart 1. The incidence of stroke was 2.68% in the age group of 15-29 years, slowly rising to 5.9% in the 3<sup>rd</sup> decade. It spiked to 14.29% in the 4<sup>th</sup> decade, steadily increasing to 19.64% in the 5<sup>th</sup> decade and reached a plateau at 19.94% in 6<sup>th</sup> decade. Again peaking to 26.19% in the 7<sup>th</sup> decade, thereafter it decreased to 11.19% in the age group above 80 years.

**Table 1. Showing the Age and Sex Wise Distribution of Stroke Cases**

Age Group (years)	Males	Females	Total	Percentage
15 – 29	04	05	09	2.68
30 – 39	11	09	20	5.95
40 – 49	28	20	48	14.29
50 – 59	48	18	66	19.64
60 - 69	41	26	67	19.94
70 – 79	51	37	88	26.19
80 and above	21	17	38	11.31
<b>Total</b>	<b>204</b>	<b>132</b>	<b>336</b>	

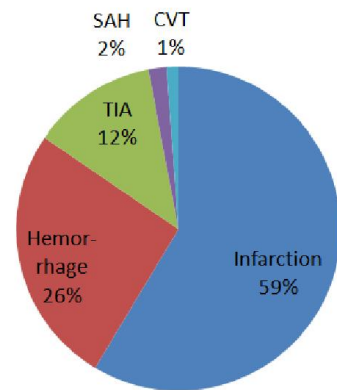


**Chart 1. Histogram showing Age-wise and Sex wise distribution of Stroke Cases**

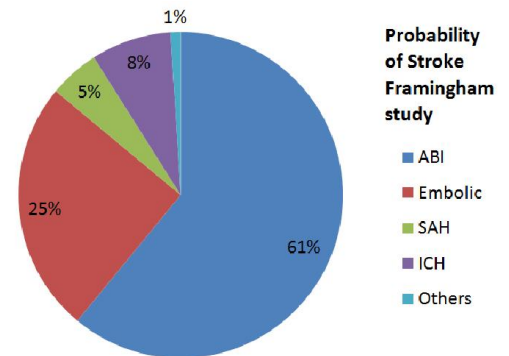
Males and females put together, ischemic infarctions were 58.65%, hemorrhages were 25.89%, transient ischemic attacks were 12.5%, subarachnoid hemorrhage were 1.78% and cortical vein thrombosis 1.91% as revealed by CT scans reports. They are shown in Table 2 and Chart 2 pie diagrams Among infarctions male to female ratio was 3.7:2.1, among hemorrhages male to female ratio was 2.1:1, transient ischemic

attacks the ratio between males to females was 1:2. Among incidence of subarchanoid hemorrhage, male were 4 cases and females were 2 cases. Cortical vein thrombosis was seen in 4 cases of females and males one case only. The details are shown in Table 2 and chart 2.

Type of Lesions	Percentage	sex	No.cases	Percentage
Infarction	58.62	male	125	37.20
		female	72	21.42
Hemorrhage	25.88	male	60	17.85
		Female	27	8.03
Transient ischemic attacks	12.19	Male	23	6.54
		Female	19	12.19
Subarchanoid hemorrhage	1.78	Male	4	1.18
		Female	2	0.59
Cortical vein thrombosis	1.18	Male	1	0.29
		female	3	0.89



**Stroke patterns**



SAH= Sub Arachanoid Hemorrhage, CVT= cortical vein thrombosis, TIA =Transient Ischemic Attack  
 ICH Intracranial Hemorrhage ABI- atheroembolic Brain Infarct

**Chart2. Pie diagrams showing Stroke patterns present and Framingham Study (Wolf et al., 1991)**

Out of 336 patients, 205 were hypertensive (61.3%). Among them 39 had isolated systolic hypertension (12.6%) and 131 cases were normotensive. Among the hypertensives males were 146(71.1%) and females were 59(28.9%). Among 131 normotensives, males were 67 and females were 64. Out of 336 patients, 25 patients (7.44%) had involvement of the heart. Among them 16 were females with 10 having atrial fibrillation and 2 having ischemic heart disease with heart block. Among the males 9 patients 7 were having Left ventricular hypertrophy with ischemic heart disease, 2 had rheumatic heart disease with left atrial enlargement. There were 69 chronic

smokers (20.5%), males were 64 and females 5 only. Out of 336 patients, 34 patients were having diabetes mellitus. Out of which 20 were males and 10 were females. Among the 20 males diabetics, 10 were also hypertensive; 6 of them had infarcts and 4 of them had hemorrhages. Among the remaining 10 male diabetics were normotensive; 4 had ischemic infarcts, 4 had lacunar infarcts and 2 had transient ischemic attacks. Out of the 14 females 6 had associated hypertension with 4 having ischemic infarcts and 2 having hemorrhage. The female diabetics without hypertension were 8 and among them 6 had transient ischemic infarcts and 2 had lacunar infarcts.

**Table 3. Showing various neurological manifestations**

No.	Neurological manifestations	No. of cases	Percen-tage
1.	Impaired Cognitive functions	125	37.2
2.	Impaired Conciousness	72	21.4
3.	Conjugate deviation of eyes	55	16.4
4.	Unilateral motor impairment	197	58.6
5.	Unilateral sensory loss	67	19.9
6.	Aphasia	45	13.4
7.	Ataxia	18	5.4
8.	Dysphasia	39	11.6
9.	Diplopia	23	6.8
10.	Dysphagia	39	11.6
11.	Dysarthria	27	8.1
12.	Dizziness	125	37.2
13.	Hemianopia	56	16.6
14.	Headache	154	45.83
15.	Seizures	43	12.8
16.	Vertigo	29	8.6

The patients had also developed a number of complications. They were fever in 31.5%, hyperpyrexia in 3.6%, aspiration pneumonia in 26.5%, Upper gastric bleeding in 15.6%, bed sores in 11%, Urinary tract infections in 9.6% and renal failure in 2.5%. Total deaths recorded in the hospital were 28(8.3%). Among them males were 22 and females were 6. Deaths due to infarcts were 14, those due to hemorrhage were 12 cases and subarachnoid hemorrhage were 2 cases.

**Table 4. Showing the grading of Hypertension as per Joint National Committee 7th Report**

Hypertension Categories	Systolic BP mm of Hg	Diastolic BP mm of Hg	Number of patients	Percentage
Normal	120	80	131	38.90
Pre-Hypertension	120-139	80-89	20	5.90
Stage I Hypertension	140-159	90-99	54	16.07
Stage II Hypertension	160 and above	100 and above	92	27.38
Isolated Systolic hypertension	140 and above	80 and above	39	12.60

Clinically, neurological examination revealed impaired cognitive function seen in 37.2%, impaired conciousness (semicoma/coma) in 21.4%, unilateral weakness was seen in 58.6% which included monoparesis/monoplegia/hemiparesis/hemiplegia. Unilateral sensory impairment was seem in 19.9%, aphasia in 13.4%, dysphasia in 19.6% , ataxia in 5.4% of cases. Cranial nerve involvement were manifest as conjugate deviation of eyes in 16.4%, diplopia in 6.8% dysphagia in 11.6%, dysarthria in 8.1%,hemianopia16.6%, and Vertigo in 8.6%. Symptoms of dizziness were noted in 37.2%, headache in 45.83% and seizures in 12.5%, as shown in the Table 3.

## DISCUSSION

The world health organization estimates that here are 15 million cases of strokes each year. Of these 5 million will die

from the stroke and 5 million will live with long term disability (Mackay, 2004). In the present study of 339 cases 205 (61.3%) were hypertensive. They were graded as per Joint National Committee 7<sup>th</sup> report in to 4 categories as shown in table 4. The number of patients with stage II hypertension were 27.38% which correlates with hemorrhagic infarcts of 25.89%. Out of 205 cases only 56 patients were taking hypertensive medication. Among them only 20 patients were taking regularly. Out of the 20 patients taking regularly, 15 patients were diabetics who were taking oral hypoglycemic agents also. Most of the hypertensives who were not taking medication were detected to have hypertension for the first time with stroke as a primary presentation. This could be due to the lack of awareness among the public about hypertension and also due to lack of doctors in the primary health care centres and poor accessiblity to health services in the hilly areas of Eastern Garhwal districts.

Men have a higher incidence of stroke at young ages (Pathophysiology, ?). The gender difference narrows with advanced age above 70 years (Pathophysiology, ?). Similar findings were noted in the study (chart1). In a systematic review of 15 population-based stroke incidence studies, (Sridharan *et al.*, 2009) the rate of total stroke for those aged less than 45 years ranged from 0.1-0.3 per 1000 person years, while for those aged 75-84 years, the range was 12-20 per 1000 person years in most studies. The present study it was 0.024 per 1000 person years for age group below 40 years and 0.25 per 1000 person years for age group 40-85 years. The risk of stroke increases with increasing systolic BP above 115 mm of Hg (Pathophysiology, ?). The percentage of hemorrhagic strokes were high 25.89% correlates with 27.38% having Hypertension Stage II of JNC report (table 4). Incidence of Isolated Systolic hypertension in the present study was 12.6%, correlates well with number of strokes in elderly above 80 years was 11.31%.

Comparing the other studies performed at other centres in high altitudes, Razdan *et al.* 1989 hypertension was 58.24% but in our study it was 61.3%, a little higher. In the Trivandrum registry (Sridharan *et al.*, 2009), nearly 85% had hypertension, half had diabetes mellitus, 26% had dyslipidemia and 26.8% of men smoked tobacco. Our study 61.3% had hypertension, 7.44% had diabetes and 20.5% were smokers. Smokers have roughly twice the ischemic stroke risk of non smokers after controlling for other risk factors (Goldstein *et al.*, 2001). Diabetics have a stroke at an younger age than the non diabetics, possibly due to accelerated atherosclerosis and 15-33% of the patients with ischemic strokes have diabetics (Sacco *et al.*, 2010). In the present study diabetics with hypertension were 4.46% and among them those having infarctions were more than those having hemorrhages. Atrial

fibrillation is associated with five fold increase in stroke risk in Wolf *et al.* study. The present study 10 patients were having atrial fibrillation and all were females and had ischemic infarcts possibly due to cerebral embolism. Effective BP control can reduce stroke risk by upto one third (Wolf *et al.*, 1991). Most of the cases 150 out of 201 were not on any hypertensive medication and among the 56 who were taking medication, 36 were noncompliant or taking irregularly. In stroke survivors of ages 40-69 years, 15% of men and 17% women are expected to have a recurrent stroke within 5 years (Goldstein *et al.*, 2001). Our study there were 19 patients from all age groups with recurrent strokes, 63% were male and 27% were female. Probability of stroke a risk profile from Framingham studies Wolf *et al.*, 2010 reported strokes as athero- embolic in 61%, embolic on 25%, subarachnoid hemorrhage in 5%, Intracranial hemorrhage in 8% and others as 1%.

In the present study, Ischemic infarctions were 58.65%, intra cranial hemorrhages were 25.89%, transient ischemic attacks were 12.5%, subarachnoid hemorrhage were 1.78% and cortical vein thrombosis (CVT) 1.91% as revealed by CT scans reports. Comparison is shown in chart 2. Indian experience of stroke at high altitude by Jha *et al.*, 2002 reports that long term stay a high altitude (above 4000 meters above sea level) for more than 10 months is associated with high risk of stroke. Ischemic strokes were common. Massive infarcts were common. Polycythemia was pointed out as risk factor. A Study from Pakistan at high altitudes by Niaz, 2013 report that above altitude at 4000 meters above sea level risk of stroke is increased 10 times greater than at Rawalpindi 660 metres above sea level. Our patients were coming from altitudes from 600 meters to 3500 meters. In our experience, ischemic infarcts were 58.65% compared to hemorrhagic infarcts 25.89%. Fujimeki, *et al.*, 1986 from Japan reports a case of cortical vein thrombosis due to high altitude polycythemia. We had 4 cases of CVT, 3 in females and one in male. The case fatality rate was 24.5% for urban and 37.1% for rural population (overall 27.2%) in Trivandrum stroke Registry (Sridharan *et al.*, 2009). It varied from 42% in calcutta study (Das *et al.*, 2007) to 29% in Mumbai study (Dalal *et al.*, 2008). Mortality in the present study was low, (8.3%) most of them coming from rural hilly areas. The low mortality rate could be due to referral, discharged against medical advise by the patient relatives and lack of follow up.

### Limitation of Study

Our institution is a government medical college recently established in Garhwal region in the newly constituted Uttarkhand State 8 years ago. There is lack of infrastructure and inadequate faculty members, radiologists, neurologists and neurosurgeons, lack of investigative facilities like MRI Scanning, echocardiography, transcranial Doppler and Neuro-care and rehabilitation facility. So the patients were referred to higher centres. Many poor patients could not afford to go to higher centres or deteriorated in the hospital were taken away by relatives to home against medical advise. They could not be followed up. Most of the time shortage of kits for routine biochemical investigation, lipid profile assessment could not be carried out in this study, so hyperlipidemic related issues could not be addressed in the study. The polycythemia as a risk

factor pointed out by Jha *et al.*, 2002 and this aspect was not looked in the present study for above reasons.

### Conclusion

India like other developing countries is in the midst of a stroke epidemic. There is a huge burden of stroke with significant regional variations. Stroke units, thrombolysis, and rehabilitation are predominantly available in urban areas, particularly in private sector hospitals (Jha *et al.*, 2002). In this study, among 205 hypertensives only 56 knew about their hypertensive state the rest were not aware of their hypertensive state till the incidence of stroke. This could be due to the lack of awareness among the public about hypertension and its associated risk. Due to lack of doctors in the primary health care centres and poor accessibility to health services in the hilly areas of Eastern Garhwal districts many of them have not been screened for hypertension or diabetes. Times of India (Fujimeki, 1986; Das, 2009; Bernard *et al.*, ?; Dalal *et al.*, 2008; Das *et al.*, 2007) reports, from 402 doctors recruited by Uttarkhand Public Service commission and only 175 joined for duty, so Director of Health Services is recruiting doctors from Tamil Nadu and Odhisa. The incidence of Hypertension in rural population is as common as in urban areas due to poverty and to migration of the people from hills to low lying towns for livelihood. Management of hypertension, the most important risk factor in the community is far from satisfactory. The Government of India (Das, 2009) has started the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases & Stroke (NPCDCS). The government is focusing on early diagnosis, management, infrastructure, public awareness and capacity building at different levels of health care for all the non-communicable diseases including stroke. There is a need for young doctors to take up the responsibility to work in the remote areas of Uttarkhand, either in government or private sector and to over come this burden of stroke related mortality and disability.

### REFERENCES

- Bernard, R. Bendok, Andrew, M. Naideeh Matthew Twalka, H. Hunt Batjer, Hemorrhagic and Ischemic stroke, Medical imaging Surgical and intervntional approaches.
- Dalal, P. M., Malik, S., Bhattacharjee, M., Trivedi, N. D., Vairale, J., Bhat, P. *et al.* 2008. Population-based stroke survey in Mumbai, India: Incidence and 28-day case fatality. *Neuroepidemiology*, 31:254–261
- Das, S. K., Banerjee, T. K., Biswas, A., Roy, T., Raut, D. K., Mukherjee, C. S. *et al.* 2007. A prospective community-based study of stroke in Kolkata, India. *Stroke*. 38:906–910. [PubMed]
- Das, S. K. 2009. WHO Steps stroke surveillance system: Feasibility in India. *Indian J Med Res.*, 130:359–360. [PubMed]
- Feigin, V. L., Lawes, C. M., Bennett, D. A., Anderson, C. S. 2003. Stroke epidemiology: A review of population-based studies of incidence, prevalence, and case-fatality in the late 20<sup>th</sup> century. *Lancet Neurol.*, 2:43–53
- Fujimeki, T. 1986. Masutami M asai.A.KohnoT.Koika M. Cerebral venous thrombosis due to hggh altitude polycythemia case report *J. Neurosurgery*, Jan 64:1 48:50.

- Goldstein, L. B., Adams, R. Becket *et al.* 2001. Primary Prevention of ischemic stroke. A statement for health care professions for the Stroke Council of American Heart Association Stroke 32:280-299.
- Jha, S.K., Anand, A.C., Sharma, V., Kumar, N., Adva, C. M. 2002. Stroke at high altitude Indian experience. High altitude Medicine biology 2002 Spring 3(1):21-7.
- Mackay, J. Mensah, G. 2004. The atlas of Heart disease and Stroke. Geneva World Health organization.
- Niaz, A., Nayyer, S. 2003. Stroke at high altitude Journal college of physican and Surgeon Pakistan August 13(8) 446-8.
- Pandian, J.D., Srikanth, V., Rao, S L., Thrift, A.G., Reed, S.J. 2007. Poverty and Stroke in India a time to Act, Stroke 38:3063-3069.
- Pathophysiology: Diagnosis and Management, 4<sup>th</sup> Edition New York Churchill Living Stone, pages 23-24. 9
- Razdan, S., Kaul, R.L., Motta, A., Kaul, S. 1989. Prevalence and pattern of major neurological disorder in rural Kashmir. Stroke Dec., 20(12):1691-3 PMID 2595731.
- Sacco, R. L. M., Adam, R., Albers, G. *et al.* 2006. American Heart Association American Stroke Association Council on Stroke. Stroke 37:577-617.
- Sridharan, S. E., Unnikrishnan, J. P., Sukumaran, S., Sylaja, P. N., Nayak, S. D., Sarma, P. S., *et al.* 2009. Incidence, types, risk factors, and outcome of stroke in a developing country: The Trivandrum Stroke Registry. Stroke, 40:1212–1218.
- Times of India November 25<sup>th</sup>, times city page 3, Uttarkhand to recruit docs from Tamil Nadu and Odisha
- Times of India, Dehradun edition, Date Saturday October 31, 2015 page3.
- Times of India, Dehradun edition, 14<sup>th</sup> October 2015. To Check migration, government to encourage self employment. Page2 column 2.
- Wolf, P. A., D'Agostino, R. B., Belanger, A.J., Kannel, W.B. 1991. Probability of stroke: Stroke a risk profile from the Framingham Study. Stroke, 22:312-318.

\*\*\*\*\*