

Neuroepidemiology of Epilepsy in Northwest India

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KEY WORDS

Epilepsy
Idiopathic
Symptomatic
Neuroepidemiology
Seizure types

ABSTRACT

Background: Epilepsy has a complex etiology characterised by recurring seizures. **Purpose:** To study clinical profile of epilepsy patients with reference to type of epilepsy in northwest India. No previous Indian study has reported relative incidence of various types of seizures with reference to type of epilepsy. **Methods:** Data of 400 epilepsy patients (200 idiopathic and 200 symptomatic) was collected for their clinical characteristics. The classification of epilepsy into idiopathic and symptomatic types was done on the basis of findings of EEG, CT scan and MRI tests. **Results:** The age of onset of seizures was less than 15 years in only one third of the total patients. The number of non-vegetarians was higher in SE (68.5%) than IE (58%). The male to female ratio was significantly higher (1.33:1 in IE and 1.47:1 in SE). No difference was seen for place of residence (urban vs rural) patients with epilepsy (PWE). The majority of patients (58.5% of symptomatic and 52.8% idiopathic) though reported no triggering factors, yet many of them, when questioned, had held supernatural powers to be the cause of the disease. Sleep deprivation was reported as a major triggering factor by 28.5% of idiopathic epilepsy (IE) and 25% of symptomatic epilepsy (SE) patients. The incidence of mental retardation (1.25%) and behavioral disorders (7%) was found to be relatively low. Loss of memory was reported in 46% of IE and 43.5% of SE and poor scholastic performance in 23% of IE and 16.5% of SE. A positive history was recorded in 11% first-degree relatives and 4% second-degree relatives. Generalized seizures were more common in IE patients (67.5%), while partial seizures with and without secondary generalization (50.5%), and generalized seizures (49.5%) were equally common in SE. **Conclusions:** The study demonstrates differences in the type of seizures between idiopathic and symptomatic epilepsies and not other demographic, clinical and psycho-social traits. The males were found to have higher risk of epilepsy than females. The epidemiological characteristics of epileptics show variations across populations and also within population.

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doi : 10.5214/ans.0972.7531.1017404

Introduction

Epilepsy is a condition of chronic, recurring seizures and its most disabling aspect is unpredictability of when and where the next seizure will occur. Its etiology is complex and heterogeneous. Its prevalence varies in relation to ethnicity, geography, age and sex.¹⁻³ Seizure frequency, type and duration are other important characteristics of epilepsy in a population. These peculiarities are known to affect other neurological, behavioral and scholastic characteristics.

It is believed that the relative frequencies of various clinically important characteristics observed in epilepsy patients living in different geographical settings would vary because of differences in the ethnicity environment and cultural patterns. The understanding of clinical profile of epilepsy patients from different human populations is important to broaden the available knowledge and to provide baseline data for cross-cultural comparisons. This would also be important for adopting strategies in effective and better health planning. It is important to record that no previous study had analyzed clinical profile of the epilepsy patients with reference to the type of epilepsy. With these major objectives in view, the present study was undertaken.

Methods

Data was collected prospectively from a sample of 400 epileptic patients (200 idiopathic and 200 symptomatic) attending the Neurology clinic of Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, India. The patients were referred to the clinic by general practitioners and hospitals of adjoining states of Punjab, Haryana, Himachal Pradesh and Jammu & Kashmir besides the other departments of PGIMER, Chandigarh. Both old and new patients attending the clinic were included. All the patients were clinically examined and under-

went one interictal Electroencephalogram (EEG) and Computed Tomography (CT) scan after clinical evaluations and were diagnosed as idiopathic epilepsy (IE) or symptomatic epilepsy (SE) on the basis of these reports. The symptomatic epileptic patients with normal CT scan underwent Magnetic Resonance Imaging (MRI) scan for final diagnosis. Behavior disorders included running away from school, stealing money, sleep disturbances, temper tantrums, fighting and assaultive tendencies. The chronic cases were included as abnormal. Mental retardation was diagnosed clinically on the basis of having delay in development of speech or language as compared with other sibs in the family, poor interaction with others, associated delay in motor development, inadequate bowel and bladder control, abnormal facial features, salivary drooling and subnormal intellect. Informed consent was obtained as per institute ethical committee guidelines.

Statistical analysis

The data so generated was subjected to statistical tests like mean, *t* - test and Chi-square to draw inferences. The protocol was previously evaluated and approved by the ethical committee of PGIMER, Chandigarh, India.

Results

Clinical profile

The results are summarized in Table-1. The age of onset of seizures was less than 15 years in only one third of the total patients. No difference was observed between idiopathic and symptomatic types for this characteristic. Place of residence had no bearing on the epilepsy, the number of patients from urban or rural place being equal. The dietary record shows that the number of non-vegetarians (68.5%) including pork eaters (21%) was higher in SE than IE (58% and 13.5% respectively).

Table 1: Clinical features of Epilepsy patients

Sr. No	Parameter	Idiopathic		Symptomatic		χ^2	Combined		
		N	%	N	%		N	%	
1.	Sex composition of patients								
	a) Male	114	57.0	119	59.5	0.26	233	58.25	
	b) Female	86	43.0	81	40.5	NS	67	41.75	
2.	Place of residence								
	a) Urban	101	50.5	98	49.0	0.09	199	49.75	
	b) Rural	99	49.5	102	51.0	NS	201	50.25	
3.	Dietary habits								
	a) Vegetarian	84	42.0	63	31.5	5.16	147	36.75	
	b) Non-vegetarian	116	58.0	137	68.5		253	63.25	
	c) Pork eaters	27	13.5	42	21.0	NS	69	17.25	
d) Chronic alcohol consumers	8	4.0	9	4.5		17	4.25		
4.	Positive family history of disease								
	a) First degree relatives	19	9.5	25	12.5	0.02	44	11.0	
	b) Second degree relatives	7	3.5	9	4.5		16	4.0	
c) Others	1	0.5	1	0.5	2		0.5		
5.	Age at onset of seizures (in years)								
	a) <1	10	5.0	7	3.5	0.24	17	4.25	
	b) 1-14	59	29.5	59	29.5	NS	118	29.5	
	c) 15-34	108	54.0	110	55.0		218	54.5	
	d) >34	23	11.5	24	12.0		47	11.75	
6.	Duration of disease								
	a) <1 year	34	17.0	43	21.5	0.33	77	19.25	
	b) 1-5 years	102	51.0	92	46.0		194	48.5	
c) ≥ 6 years	64	32.0	65	32.5	129		32.25		
7.	Number of fits in last one year								
	a) 1-10	68	34.0	69	34.5	0.33	137	34.25	
	b) 11-30	28	14.0	27	13.5	NS	55	13.75	
	c) >30	8	4.0	6	3.0		14	3.5	
	d) No seizure	96	48.0	98	49.0		194	48.5	
8.	Perceived triggers for epileptic seizures								
	a) Breath holding	-	-	-	-	1.63	-	-	
	b) Stress situation	9	4.5	7	3.5		16	4.0	
	c) Menstrual cycle	7	3.5	5	2.5		12	3.0	
	d) Exertion (Physical / Mental)	7	3.5	7	3.5		14	3.5	
	e) Sleep deprivation	57	28.5	50	25.0		107	26.75	
	f) Emotional stress / starvation	4	2.0	3	1.5		NS	7	1.75
	g) Watching T.V. / Movies	7	3.5	7	3.5			14	3.5
	h) Any other	4	2.0	4	2.0			8	2.0
i) Unknown	105	52.5	117	58.5			222	55.5	

Sr. No	Parameter	Idiopathic		Symptomatic		χ^2	Combined	
		N	%	N	%		N	%
9.	Neurological / Morphological / Behavioral abnormalities							
	a) Facial dysmorphism	-	-	2	1.0		2	0.5
	b) Subcutaneous nodules	5	2.5	10	5.0	3.32	15	3.75
	c) Behaviour disorders	14	7.0	14	7.0	NS	28	7.0
	d) Mental retardation	3	1.5	2	1.0		5	1.25
	e) Abnormal fundi	6	3.0	6	3.0	0.20	12	3.0
	f) History of head trauma	54	27.0	66	33.0	NS	120	30.0
	g) Neurological deficiencies							
	i) Cranial nerve deficit	2	1.0	1	0.5		3	0.75
	ii) Motor deficit	-	-	-	-		-	-
	iii) Visual disturbances	1	0.5	-	-		1	0.25
	iv) Involuntary movements	2	1.0	-	-		2	0.5
v) Other minor behavioral changes or deviations	79	39.5	80	40.0		159	39.75	
10.	Impact of seizures on patients' scholastic, social and vocational abilities							
	a) Poor performance	46	23.0	33	16.5	2.08	79	19.75
	b) Loss of memory	87	43.5	92	46.0	NS	179	44.75
	c) No change	67	33.5	75	37.5		142	35.5
11.	Electroencephalography (EEG) pattern							
	a) Normal	133	66.5	137	68.5	0.18	270	67.5
	b) Abnormal	67	33.5	63	31.5	NS	130	32.5
12.	Computed Tomography (CT) scan patterns							
	a) Normal	200	100	16	8.0	336.56**	216	54.0
	b) Abnormal	-	-	183	91.5		183	45.75
c) Not advised	-	-	1	0.5	1		0.25	
13.	Magnetic Resonance Imaging (MRI) Patterns							
	a) Normal	-	-	-	-	NA	-	-
	b) Abnormal	-	-	17	8.5		17	4.25
c) Not advised	-	-	183	91.5	183		45.75	

**p < 0.01, NS – Not-significant; NA –Not applicable

A positive family history of seizures was obtained in 13% IE and 17% SE patients. In majority of cases, they were either first - degree (9.5% and 12.5%) or second - degree (3.5% and 4.5%) relatives of IE and SE respectively. In 88% cases, the age of onset of seizures was before 34 years and in one-third cases (34.5% of IE and 33% of SE), it was before 15 years of age. Thus two-third of cases had age of onset of seizures after 15 years of age. 51% of idiopathic and 46% of symptomatic epileptics had seizures for one to five years and about one-third cases had seizure duration of more than six years. About one-third (34%) cases had 1 to 10 seizures and about 14% cases had 11 to 30 seizures during last one year of active epilepsy. About 48.5% cases had no seizure in the past one year or since the inception of medical treatment.

The majority of epileptics were unable to perceive any triggering factor, but when probed further by gaining their confidence, many of them attributed seizures to supernatural forces. Sleep deprivation was reported as a major triggering factor by 28.5% of IE patients and 25% of SE patients. Some female patients linked epilepsy with their menstrual cycles. Past history of head injury was noted in 27% IE and 33% SE patients. Abnormal fundus was recorded in 3% cases. Behavioral disorders and subcutaneous nodules were observed in 7% in both IE and SE and 2.5% in IE and 5% in SE respectively. Minor behavioral changes were recorded in 40% SE cases. The data on impact of seizures on patient's scholastic, social and vocational abilities revealed significant impact of disease progression. Poor performance was reported in 23% of IE and 16.5% of SE.

memory was noted in 45.5% IE and 46% SE. Only one-third of cases (33.5% IE and 37.5% SE) reported no effect of the disease on these abilities.

Neurological investigations revealed abnormal electroencephalography (EEG) in 66.5% of IE and 68.5% of SE. Computed Tomography (CT) scan was normal in all IE, while abnormal in 91.5% SE and differences between the two types were highly significant. Magnetic Resonance Imaging (MRI) was advised only to confirm symptomatic epilepsy in those who had normal CT scan report.

Type of seizures

The results of the seizure types are given in Table 2. Generalized type of seizures was more frequent in IE (67.5%) than SE (49.5%), tonic-clonic type of seizures being most common. The partial seizures with and without secondary generalization were more frequent in SE (21.5% and 29% respectively) than in IE (14.5% and 18%). The differences between the two types of epilepsies for these two groups were highly significant ($p < 0.001$).

Discussion

The profile of epilepsy varies across various cultures and the review shows that in western countries about two-third of the epileptic patients have partial seizures.^{4,5} Similar trend has been shown in some developing countries like Nigeria.⁶ Pre-dominance of partial seizures (52.1%) over generalized seizures (47.11%) though of lesser magnitude has been reported from Peru.² On the contrary, reverse trend has been reported in Indian studies, where generalized seizures constitute more than 70% of all seizures.⁷⁻⁹ However, Bharucha *et al*¹⁰ have reported

higher incidence of partial seizures (54.5%) than generalized seizures (45.4%) in Parsi community from Mumbai in India. In the present study, we report that generalized seizures are more frequent (67.5%) among IE, the results being comparable with the previous Indian studies. But in the SE patients, both generalized (49.5%) and partial seizures (50.5%) are almost equally frequent. There is no comparable data on other populations with reference to differences between IE and SE for the type of seizures as most of the studies do not segregate epileptics into idiopathic and symptomatic in order to study seizure types. However, one might expect a higher rate of partial seizures in symptomatic epilepsy. The lower frequency of partial seizures in developing countries has been attributed to ascertainment problems than to any specific geographical trend. Shorvon and Farmer¹¹ are of the opinion that partial seizures may be underreported in studies that use inadequate screening questionnaires. They have illustrated their view with the help of an example of a study from China¹² where 81% epileptic patients showed generalized convulsive seizures.

Seizure frequency is another important characteristic of epilepsy in a population. In developed countries, it has been estimated that among those with active generalized tonic-clonic seizures undergoing treatment, about 15% have seizures less than once a year, 60% have seizures frequency ranging between one per month and one per year and 25% have seizures occurring at a frequency of more than one per month.¹³ Similarly, over 50% of patients with partial seizures have seizures frequency of more than once per month. In an Indian study¹⁴ it has been reported that 49% patients have seizures occurring less than once per year, about 25% having between once per year and once every three months and 26% at a frequency of more than once in

Table 2: Type of seizures in epilepsy patients

Sr. No	Classification	Idiopathic		Symptomatic		Combined	
		N	%	N	%	N	%
1.	Generalized	135	67.5	99	49.5	234	58.5
	a) Tonic clonic	108	54.0	88	44.0	196	49.0
	b) Clonic	-	-	1	0.5	1	0.25
	c) Tonic	7	3.5	4	2.0	11	2.75
	d) Myoclonic	13	6.5	4	2.0	17	4.25
	e) Akinetic	1	0.5	1	0.5	2	0.5
	f) Atonic	2	1.0	1	0.5	3	0.75
2.	Partial	29	14.5	43	21.5	72	18.0
	a) Simple	12	6.0	35	17.5	47	11.75
	b) Simple secondarily complex	17	8.5	7	3.5	24	6.0
	c) Complex	-	-	1	0.5	1	0.25
3.	Partial secondarily generalized	36	18.0	58	29.0	94	23.5
	a) Simple	28	14.0	45	22.5	73	18.25
	b) Simple secondarily complex	-	-	1	0.5	1	0.25
	c) Complex	8	4.0	12	6.0	20	5.0

$$\chi^2 = 13.4, *** \quad df = 2; \quad p < 0.001$$

every three months. In the above sample, 15% patients were untreated. In the present study, the overall trend shows that about 48% active epilepsy patients had no seizures during the last one year or since the treatment, if the duration in the latter was less than one year. All the patients were being treated with antiepileptic drugs (AEDs). About 18% had seizures occurring at a frequency of more than one per month.

There is rising trend of epilepsy with increasing age, the peak being the third and fourth decade of life.¹⁵ But there is no consensus on this issue as different trends have been witnessed across various countries.¹⁶ The age of onset of epilepsy has been reported in the first two decades of life in 75-80% patients^{17,18} and in 68.8% before 15 year of age in another study.^{7,12} Troster¹⁹ has found that 68% cases had age of onset before 20 years. In the present study, in majority of cases, the age at onset of epilepsy was later than 15 years of age as only 34% patients had the age onset prior to 15 years. In Ethiopia,²⁰ Nigeria,^{16,21} and Sri Lanka,²² the highest prevalence was in the second decade of life; in Guam²³ in the third decade; and in Ecuador²⁴ in the fifth decade. The onset of epilepsy is in the first two decades of life in 80% of the patients in Mathai's study.¹⁷ In rural Kashmir, 90% of the surveyed patients reported onset of epilepsy before the age of 30 years,⁷ whereas, Bharucha *et al*¹⁰ in their study of the Parsi community of Bombay, noted that the median age of onset was 22 years. Age-specific prevalence rates were highest in the second decade in men and in the third and fourth decades of women. The possibility of under ascertainment of seizure disorders leading to lower prevalence rates in the elderly cannot be ruled out. There is no evidence to suggest that mortality due to epilepsy could account for the lower prevalence rate in the elderly.²⁵ The age-specific prevalence was found to be higher with increasing age.^{26,27}

Most studies of epilepsy in industrialized countries report that males are more frequently affected than females, although the difference is seldom statistically significant. Results from developing countries are similar, although, some studies in Nigeria,^{16,21} and Latin America,^{24,28-29} have found higher prevalences for females. Our study shows male preponderance in epilepsy cases (58.25%). Similar findings have been reported by many others^{7,10,30-34} though studies by Sohi *et al*³⁵ and Senanayke *et al*¹⁵ did not show any difference in the two sexes.

The familial aggregation of seizure disorders has been recorded. This clustering of disease among family members may be because of shared genetic and / or exposure to shared environmental factors. In the present study, 11% of the probands had first-degree relatives and 4% had second-degree relatives with epilepsy. A positive family history of epilepsy has been found to vary from 5.2% to 13.7% in the first-degree relatives in different studies.^{7,8,36-38}

The literature reveals that rural populations are at higher risk than urban populations to have epileptic seizures.³⁹⁻⁴¹ Various studies on the epidemiology of epilepsy in India have been published from 1964 until date. Nine studies were done with urban or semi urban populations, 14 with rural ones, and three with both rural and urban ones.⁴² These studies support the findings of the present study.

In this study, 8% of epilepsy patients have seizures per week, 22.5% have seizures per month, and almost same number have the frequency of seizures per year. Mani¹⁴ reported that 308 out of 627 patients (49.12%) had seizures occurring less than once

per year, 156 (24.88%) had once per year and once every three months, and 163 (25.99%) at a frequency of more than once every three months.

Epilepsy can be accompanied by changes in cognition, personality, and other elements of behaviour. There is no true epileptic personality complex, the only unifying theme to the behaviour in epilepsy is diversity.⁴³ Some patients may be irritable and aggressive, whereas, others may be timid and apathetic. Psychosis, depression, paranoia, and personality disorders may represent a negative role of epilepsy related behavioural changes. Common behavioural features in epilepsy include changes in emotional state with deepening or increase in emotionality.⁴³ The association of specific behavioural changes with epileptic patients has been questioned for hundreds of years.⁴⁴⁻⁴⁶ In this study, 4% of the patients show behavioural changes. Contrary to this, Koul *et al*⁷ found behavioural changes in 15.2% cases.

In the present study, mental retardation among the patients was found in 1% cases. In other studies, mental retardation among those with epilepsy was found in 4.38% by Das and Sanyal,⁸ in 18.18% by Bharucha *et al*,¹⁰ and in 22.9% by Koul *et al*.⁷ Many patients with epilepsy experience memory difficulties.⁴⁷⁻⁵³ The prevalence rate is the lowest in the present study (46%).

The association of epilepsy with changes in cognition, personality and behavior has been discussed for centuries.^{43-44,54} In the present study, behavioral disorders/acute changes have been noticed in 7% cases, and mental retardation in 1.25% cases. These incidences are much lower than reported in other Indian studies. Koul *et al*⁷ found behavior disorders in 15.2% and mental retardation in 22.92% epileptics in a study from rural Kashmir. The incidence of mental retardation as reported in some others Indian studies varies from 4.38% to 18%.^{8,10} Nevertheless, in the present study, behavioral changes which interalia included nervousness, anxiety, depression, increased anger, etc. have been recorded in about 40% cases. Dorrill *et al*⁵⁵ have reported emotional problems in 36-72% cases and vocational problems in 15-53% cases of adult epileptics across four countries namely Canada, Finland, Germany and U.S.A. Keith *et al*⁵⁶ found that the incidence of mental retardation with seizures beginning before six months was 65% and 12% in cases where seizures began between 7 to 15 years. So, the variations in the incidence of mental retardation and behavioral disorders may vary among populations due to difference in the age of onset of seizures. The findings of significant level of impact of seizures on scholastic and vocational abilities of patients in the present study is consistent with previous studies on epileptics in variety of settings across various cultures.^{47-53,57}

It has been estimated that about 5-15% of all cases of epilepsy result from head injury.⁵⁸ Most of the post-traumatic seizures appear within two years after head injury. In the present study, the history of head injury was recorded in 27% cases of IE and 33% cases of SE.

Epilepsy has been reported to be higher in males than females.^{2,7,10,12,21} A few studies have reported higher incidence in females.¹⁶ In the present study, male-female ratio was 1.33:1 in IE and 1.47:1 in SE. The sex differences are statistically significant. The higher male ratio in symptomatic epilepsy may be attributed to greater outdoor activities and other higher risk factors related to the gender differences which expose males to higher risk of epilepsy. This sex ratio is higher than that has

been reported from Lima (Peru) by Quinones and Lira² which is 1.16:1.

The literature review reveals that rural people are at higher risks than urban people for epilepsy,³⁹⁻⁴¹ a trend not observed in the present study. No attempt was made to select patients for their residence status. Some other Indian studies also do not reveal any such trend,³⁶ indicating divergent trends in different populations.

In conclusion, the study demonstrates significant differences in the type of seizures and number of non-vegetarians between IE and SE, but not for other clinical and psychosocial traits. Additional studies of epileptic populations across various cultures and geographical areas allow broad generalizations and the differences in the magnitude are due to the factors unique to each population.

Competing interests – None, Source of Funding – None

Received Date : 12 August 2010; Revised Date: 23 September 2010

Accepted Date : 07 October 2010

References

- Rose SW, Penry JK, Markush RE, et al. Prevalence of epilepsy in children. *Epilepsia* 1973; 14: 133–152.
- Quinones NM and Lira MD. Epidemiological profile of epilepsy in a hospital population Lima, Peru. *Rev Neurol* 2004; 38: 712–715.
- Sharma K. Genetic epidemiology of epilepsy: a twin study. *Neurology India* 2005; 53: 93–98.
- Juul - Jensen P. Epidemiology of intractable epilepsy. In: Schmidt D, Morselli PL, eds.: intractable epilepsy. LERS monograph series vol. 5. New York: Raven Press, 1986; 5–12.
- Hauser WA. Epidemiology of epilepsy. *World Neurology* 2000; 15(1): 6–8.
- Danesi MA, Odusote KA, Roberts OO, et al. Social problems of adolescent and adult epileptics in a developing country, as seen in Lagos, Nigeria. *Epilepsia* 1981; 22: 689–695.
- Koul R, Razdan S, Motta A, et al. Prevalence and pattern of epilepsy (Lath/Mirgi/Laran) in rural Kashmir, India. *Epilepsia* 1988; 29: 116–122.
- Ganeshs. Juvenilemyoclonic.epilepsy:efhcl at the cross roads? *Annals of Neurosciences* 2010; 17: 57–59.
- Kokatt AJ and Verma AK. Prevalence of seizures and paralysis in a rural community. *J Indian Med Assoc* 1998; 96: 43–45.
- Bharucha NE, Bharucha EP, Bharucha AE, et al. Prevalence of epilepsy in the Parsi community of Bombay. *Epilepsia* 1988; 29: 111–115.
- Shorvon SD and Farmer PJ. Epilepsy in developing countries: a review of epidemiological, socio-cultural and treatment aspects. *Epilepsia* 1988; 29 (Suppl.1): S 36–S 54.
- Li SC, Schoenberg BS, Wang CC, et al. Epidemiology of epilepsy in urban areas of the People's Republic of China. *Epilepsia* 1985; 26: 391–394.
- Shorvon SD. Medical Services. In: Richens AL, Laidlaw J, Oxley J, eds: A text book of epilepsy. Edinburgh: Churchill Livingstone 1988; 611–630.
- Mani KS. Collaborative epidemiological study on epilepsy in India. Final report of the Bangalore center. Department of Neurology, National Institute of Mental Health and Neurosciences, Bangalore, 1987.
- Senanayake N. Classifications of epileptic seizures: a hospital based study of 1250 patients in a developing country. *Epilepsia* 1993; 34: 812–818.
- Osuntokun BO, Adeuja AOG, Nottidge VA, et al. Prevalence of the epilepsies in Nigerian Africans: a community based study. *Epilepsia* 1987; 28: 272–279.
- Mathai KV. Epilepsy - some epidemiological, experimental and surgical aspects. *Neurology India* 1986; 34: 299–314.
- Thornton N and Robertson M. Epilepsy: an overview. *Axone* 2002; 23: 24–30.
- Troster H. Disclose or conceal? Strategies of information management in persons with epilepsy. *Epilepsia* 1997; 38: 1227–1237.
- Tekle-Haimanot R, Forsgren L, Abede M, et al. Clinical and electroencephalographic characteristics of epilepsy in rural Ethiopia: a community based study. *Epilepsy Res* 1990; 7: 230–239.
- Osuntokun BO, Schoenberg BS, Nottidge, et al. Research protocol for measuring the prevalence of neurologic disorders in developing countries - results of a pilot study in Nigeria. *Neuroepidemiology* 1982; 1: 143–153.
- Senanayake N. Epilepsy control in a developing country – the challenge of tomorrow. *Ceylon Medical Journal* 1987; 32: 181–189.
- Stanhope JM, Brody JA, Brink E, et al. Convulsions among the Chamorro people of Guam, Mariana Islands, I. Seizure disorders. *American Journal of Epidemiology* 1972; 95: 292–298.
- Cruz ME, Schoenberg BS, Ruales J, et al. Pilot study to detect neurologic disease in Ecuador among a population with a high prevalence of endemic goiter. *Neuroepidemiology* 1985; 4: 108–116.
- Mani KS. Epidemiology of epilepsy in Karnataka, India. *Neurosci Today* 1997; 1: 167–174.
- Hauser WA and Kurland LT. The epidemiology of epilepsy in Rochester, Minnesota. 1935 through 1967. *Epilepsia* 1975; 16: 1–66.
- Wagner AL. A clinical and epidemiological study of adult patients with epilepsy. *Acta Neurol Scand* 1983; 67(94): 63–72.
- Gomez JG, Arciniegas E, Torres J, et al. Prevalence of epilepsy in Bogota, Colombia. *Neurology (Minneapolis)* 1978; 28: 90–94.
- Cruz ME. Epidemiology of epilepsy. In: Poeck K, et al (eds). *Neurology*. Springer-Verlag, Berlin, 1986; 229–239.
- Moily S, Kishore Kumar KV, Uday Kumar GS, et al. Epilepsy in patient characteristics. *NIMHANS Journal* 1990; 8(2): 127–132.
- Li SC, Schoenberg BS, Wang CC, et al. Epidemiology of epilepsy in urban areas of the People's Republic of China. *Epilepsia* 1985; 26: 391–394.
- Crombie DL, Cross KW, Frey J, et al. A survey of epilepsy in general practice. *Brit Med J* 1960; 2: 416–422.
- Wajsborn J, Haral N, Alfandary I, et al. A study of epidemiology of chronic epilepsy in northern Israel. *Epilepsia* 1967; 8: 105–116.
- Zielinski JJ. Epidemiology. In: Laidlaw J, Richens A (eds). *A text book of epilepsy*. Churchill Livingstone, Edinburgh, 1982; 16–33.
- Sohi D, Walia IJ, Singh IJ, et al. Prevalence and treatment of epilepsy in a Chandigarh slum. *Bulletin PGI*, 1993; 27: 175–178.
- Sridharan K, Radhakrishnan K, Ashok PP, et al. Epidemiological and clinical study of epilepsy in Benghazi, Libya. *Epilepsia* 1986; 27: 60–65.
- Jain S, Padma MV, Puri A, et al. Occurrence of epilepsies in family members of Indian probands with different epileptic syndromes. *Epilepsia* 1997; 38(2): 237–244.
- Satish Chandra P, Gururaj G, Gourie-Devi M, et al. Epidemiology of epilepsy in Bangalore urban and rural population. Abstract of the 4th Annual Conference of Indian Academy of Neurology, Bangalore, Organizing Committee, 1996; 27.
- Grannieri E, Rosati G, Tola R, et al. A descriptive study of epilepsy in the district of Copparo, Italy 1964–1978. *Epilepsia* 1983; 24: 502–514.
- Rafael F, Dubreuilc, Prado JA, et al. Social and Cultural representation of Epilepsy in elderly aged 65 and more, during a community survey in two French Departments (Hautevienne Vienne and Creuse). *Annals of Neurosciences* 2010; 17: 60–62.
- Jallon P. ILAE workshop report: epilepsy in developing countries. *Epilepsia* 1997; 38: 1143–1151.
- Sridharan R and Murthy BN. Prevalence and pattern of epilepsy in India. *Epilepsia* 1999; 40(5): 631–636.
- Devinsky O and Vazquez B. Behavioural changes associated with epilepsy. *Neurol Clin* 1993; 11: 127–149.
- Freud S, Dostoievsky, Parricide, et al. In: Strackey J (ed). *Collected Papers*. Hogarth Press and the Institute of Psychoanalysis, London, 1950.
- Geschwind N, Shader RI, Bear DW, et al. Behavioural changes in temporal lobe epilepsy: assessment and treatment. *J Clin Psychiat* 1980; 41: 89.
- Reynolds EH. Mental effects of antiepileptic medication. *Epilepsia* 1983; 24: S85–S95.
- Brittain H. Epilepsy and intellectual functions. In: Kulig B, Meinardi H, Stores G (eds). *Epilepsy and behaviour*. Swets and Zeitlinger, Lisse 1980; 2–13.
- Loiseau P, Strube E, Broustet D, et al. Learning impairment in epileptic patients. *Epilepsia* 1983; 24: 183–192.

49. Aldenkamp A, Alpherts W, Dekker M, *et al.* Neuropsychological aspects of learning disabilities in epilepsy. *Epilepsia* 1990; 31 (Suppl 4): 9–20.
50. Corcoran R and Thompson P. Epilepsy and poor memory: who complains and what do they mean? *Brit J Clin Psychol* 1993; 32: 199–208.
51. Vermeulen J, Aldenkamp A, Alpherts W, *et al.* Memory complaints in epilepsy: correlations with cognitive performance and neuroticism. *Epilepsy Res* 1993; 15: 157–170.
52. Giovagnoli AR, Mascheroni S, Avanzini G, *et al.* Self-reporting of everyday memory in patients with epilepsy: relation to neuropsychological, clinical, pathological and treatment factors. *Epilepsy Res* 1997; 28: 119–128.
53. Prevey ML, Delaney RC, Cramer JA, *et al.* Complex partial and secondarily generalized seizure patients : cognitive functioning prior to treatment with antiepileptic medication : VA Epilepsy Cooperative Study 264 Group. *Epilepsy Res* 1998; 30: 1–9.
54. Johnson EK, Jones JE, Seidenberg M, *et al.* The relative impact of anxiety, depression and clinical seizure features on health - related quality of life in epilepsy. *Epilepsia* 2004; 45: 544–550.
55. Dodrill CB, Beier, Kasparick M, *et al.* Psychosocial problems in adults with epilepsy: comparison of findings from four countries. *Epilepsia* 1984; 25: 176–183.
56. Keith HM, Ewert JC, Green MW, *et al.* Mental status of children with convulsive disorders. *Ped Neurol* 1955; 5: 419–425.
57. Bergin PS, Thompson PJ, Baxendale DA, *et al.* Remote memory in epilepsy. *Epilepsia* 2000; 41: 231–239.
58. Gibbs GA and Gibbs EL. *Atlas of EEG-2*. Addison Wesley, Reading, Manachussetts 1952.