The Prevalence, Incidence and Etiology of Epilepsy

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Abstract

Epilepsy is a neuronal disorder that is observed globally but still it is not explored very well in most parts of the world. This disease is linked to different provocative causes and affects almost all generation, ethnicity and age population. Therefore, the aim of this article is to systemically review the literature about the prevalence, incidence and etiology of epilepsy to find possible approaches to control epilepsy. The worldwide prevalence of epilepsy is variable and varied among countries. High prevalence is found in adolescent and early age group population. In North America, Central and South America high prevalence is found in male except in New York, Bolivia, Honduras and Argentina where prevalence is high in female. In Asian countries such as China, India, Turkey and Saudi Arabia the prevalence is high in Male except in Pakistan here prevalence is high in female similarly to European countries where also prevalence is high in female. The prevalence of epilepsy in male and female is variable in African countries. Generalized seizure is high in America, Asia, Europe, and Africa than the other types of epilepsies. Very limited data is available about the incidence of epilepsy especially from low and lower middle income countries. The incidence rate of epilepsy is higher in the developing countries than the industrialized countries. Similarly, the incidence is also higher in male than female. Head injury, birth trauma, cerebrovascular disease, and intracranial infections (neurocysticercosis or meningoencephalitis) and genetic factors are the main causes of epilepsy.

Keywords: prevalence, incidence, epilepsy and causes of epilepsy


1. Significance Statement

Epilepsy is a neuronal disease which affects almost all groups of the society. It is still is not properly out of shadow and need more work at scientific background to know about the exact prevalence, incidence and etiology of epilepsy. The prevalence and incidence of epilepsy is varying among the countries with heterogeneous figures. The overall prevalence of epilepsy is 10 per 1000 persons.

2. Introduction

Epilepsy is a chronic neuronal disorder or group of disorders, which is characterized by the recurrent (two or more) epileptic seizures that usually recur unpredictably in the absence of provoking factors. An epileptic seizure is a clinical presentation which is linked to an abnormal and excessive discharge from a set of neurons in a specific locus of the brain. This clinical manifestation consists of sudden and transitory abnormal phenomena which may include alterations in consciousness, motor, sensory, autonomic or psychic behaviors [1]. Epilepsy is different from seizure which is characterized by an excessive, abnormal discharge of neurotransmitters from cortical neurons. Loss of consciousness, disturbance in sensory motor system, personal health and objectives are commonly concern with epilepsy. While, the seizure is usually of brief duration and may produce post seizure impairment. Similarly, convulsion is violent attack manifested by strong contraction of the involuntary muscles [2]. Literally “Epilepsy” is a Greek derived word “epilambanein”, meaning “to be seized” or “to be overwhelmed by surprise”. The word Epilepsy is used both in verbal and in written context from more than 4000 years and many misconceptions are found which are mainly linked to the culture of a particular era or part of the world. There are a lot of arcane theories found about the causes and manifestation of epilepsy in the world.

The forced cry, the loss of consciousness, the fall, the twitching and the foaming at the mouth, is linked to “possession by the spirit”. People with epilepsy are being looked upon as “being chosen” or as “being possessed” depending on the belief of that moment or place. Some people has believe that epilepsy is communicable disease and hesitate to help or touch that person who has fallen in a seizure, even when this happens in hazardous places, like in the water or near an open fire. The stigma associated with epilepsy also has a great effect on the education of children and young people and mostly lead to isolation from the society [3].

It has been stated that the history of epilepsy spans over 4000 years of ignorance, superstition and stigmatization [4]. Epilepsy affects approximately 70 million people of
all ages throughout the world. Epilepsy is responsible for 1% contribution to the global burden of diseases while this contribution is 80% in the developing countries [5]. To explore epilepsy as a Global Campaign against epilepsy was launched in 1997 “to improve acceptability, treatment, services and prevention of epilepsy effectively throughout the world [6,7]. We categorically review the literature on prevalence, incidence, and etiology of epilepsy by using PubMed, Google, Google scholar, and respective journals of epilepsy. The main purpose of this project to collect, compile and disseminate the relevant information about the prevalence, incidence and etiology of epilepsy.

3. Methodology

3.1. Protocol of the Searching

We searched the following tabulated databases, journals and sites by using the key word “prevalence of epilepsy”, “Incidence of epilepsy”, “etiology of epilepsy”, “epidemiology of epilepsy”, “prevalence by gender, age, race, ethnicity, and socioeconomic status” shown in Table 1. In order to specify our search by adopting a particular method such as by writing “title: or Auth: and then followed by the key words in Google and in Google scholar. Similarly, in order to specify the search in PubMed database by writing the key words followed by [ti] or [Auth] respectively.

3.2. Articles Review Criteria and Analysis

A total of 1000 articles were reviewed from 1980 to 2014. Articles were assessed on the basis of authors name and relevant topic. The results were evaluated on the basis of prevalence, incidence, demography, classification, etiology of epilepsy. A total of 135 articles were included for this study because these articles contain relevant information. The excluded articles are either contain no relevant information or may contain only abstract. The overall literature search process is pictured in the following Figure 1.

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3.3. Statistics

The data is presented in the form of bar graphs, Percent prevalence or prevalence per 1000 and incidence per 100,000.

4. Results

4.1. Prevalence

Prevalence is the proportion of people with a disease in the population in a period of time. The purpose of prevalence study of a disease is very vital because it enables us to find the number of people suffering from that particular disease and helps us to make a plan to prevent or treat this disease in time and also to reduce the burden of this disease on the society. Prevalence is expressed per 1000 people in the population.

4.2. Incidence

Incidence is the number of new cases in a population at a given time. Incidence is the number of new cases per year divided by the average susceptible population under
study during a specified time period and is expressed as new cases per 100,000 persons per year. Incidence studies provide a better understanding of the etiology and natural history of epilepsy. Due to exertion and expenses the incidence studies are conducted less often than prevalence studies.

4.3. Prevalence and Incidence of Epilepsy in Pakistan

According to Mac et al. the prevalence of epilepsy in Pakistan is 10 per 1000 which is become cleared from several other studies as well [8,9,10,11]. According to Aziz et al. the ratio in term of percent the epilepsy in urban area is 64.7% and in rural is 35.5% while 60% ratio is observed in married population of Pakistan. Generalized seizure is the most common type of seizure which is observed in 77% patients of Pakistan. The primary generalized seizure is 59%, secondary generalized seizures is 18%, partial seizures is 9%, myoclonic, tonic-clonic seizures is 5.8% [12]. There are two peak age groups which are commonly affected by epilepsy, one group is children and other group is adults younger than 30 years of age. In case of gender the prevalence in male is 9.2 while in female is 10.9 of Pakistan. The results are depicted in Figure 2, Figure 3 and Figure 4 [8,13]. There are no comprehensive studies available in regard of incidence of epilepsy in Pakistan.

![Figure 2. Distribution of Epilepsy on the Basis of Location in Pakistan in Term of Percent](image1)

![Figure 3. Distribution of Types of Epilepsies in Term of Percent in Pakistan](image2)
4.4. Prevalence and Incidence of Epilepsy in India

A meta-analysis study reveals that the prevalence of epilepsy is 5 per 1000 in India which is quite low as compared to the prevalence of epilepsy in Pakistan and some other countries, however, the prevalence is slightly high in Indian rural areas compared to Pakistani rural areas [13-20].

4.5. Prevalence and Incidence of Epilepsy in China

The overall prevalence in China is 3.6 per 1000 [21] according to epidemiological studies on the prevalence of epilepsy available at PubMed, Embase, Chinese Biological Medical Literature (CBM), Chinese National Knowledge Infrastructure (CNKI), and Chinese Wanfang and Chongqing VIP databases. The ratio is 3.83% and 3.45% in male and female respectively which is comparatively low as compared to the prevalence ratio between men and women of Pakistan and Indian epileptic patients. The ratio of epilepsy is 2.34% and 3.17% in urban and rural areas of China. There is no significant difference observed in the prevalence of epilepsy on the basis of location between China and Indian epileptic patients while, the said situation is different from Pakistani epileptic population [13,20,22].

Studies report a high prevalence in male as compared to female, in rural areas in contrast to urban areas and in peak age group is ranged from 10-20 years. The prevalence...
studies conducted shows a high proportion of patients have a generalized seizure as compared to other types of epilepsies in China. The epilepsy incidence rates reported from China is low which is ranging from 28.8 per 100 000 per year to 35.0 per 100 000 per year [23].

4.6. Prevalence and Incidence of Epilepsy in Bangladesh

Although there are no national statistics available about the prevalence of epilepsy, but it is estimated that there are at least 1.5–2.0 million people suffering from epilepsy in Bangladesh, i.e. about 10-12 per 1000 people and mostly common in age group of 16-31 years. The prevalence of epilepsy is slightly high in Bangladesh as compared to other countries [24,25]. The results of a prospective study which was conducted in Bangabandhu Sheikh Mujib Medical University from January 2008 to June 2010 are summarized in Figure 6 and Figure 7. There are comparable results in regard to types of epilepsies, age groups and gender mean that prevalence of generalized tonic clonic is high, age group is ranging from 10-30 years and males are more affected than females [26]. However, there are no articles available about the incidence of epilepsy in Bangladesh.

![Figure 6. Epilepsy on the Basis of Age in Bangladesh in Percent](image6)

![Figure 7. Types of Epilepsy in Bangladesh in Percent](image7)

4.7. Prevalence and Incidence of Epilepsy in Iran

The prevalence of epilepsy in Iran is 7.87/1000 individuals which is lower than the prevalence of epilepsy in Pakistan but on contrary to India the prevalence is high.
There is no marked difference in the ratio of epilepsy on the basis of gender in Iran however; this picture is different from the study report from Pakistan and India. The generalized epilepsy had a higher frequency than the other types of epilepsies [27]. The data are summarized about the types of epilepsy from cohort study in Figure 8.

![Figure 8. Depicts the Percent Distribution of Types of Epilepsy in Iranian Population](image)

Other important aspects of the studies are that the common cause of epilepsy is perinatal problems such as asphyxia, sepsis and neonatal hypoglycemia. A positive association of epilepsy with family history is observed. The prevalence of epilepsy in regard of age and sex in southern Iran is not too much different from rest of the world [28]. There is no study available to figure out the incidence of epilepsy in Iran.

4.9. Prevalence and Incidence in Egypt

A community based study was conducted by Eman M in Egypt. According to this study the crude lifetime prevalence rate (CPR) of epilepsy is 12.67/1000 while, the prevalence rate is 9.3/1000 and the incidence rate is 1.5/1000. Generalized seizures is more common (CPR 6.75/1000) than partial seizures (CPR 2.5/1000) in this study. The prevalence of partial seizures leading to secondary generalize seizure is 0.84/1000 while simple partial and complex partial seizures had CPR of 1.4/1000 and 0.34/1000 respectively. Epilepsy is slightly high in male than female with no prominent difference (CPR of 14.4 and 10.9 per 1000). The CPR is higher in rural, illiterate group than urban and literate populations (17.7/1000, 9.56/1000 and 12.02/1000, 9.94/1000, respectively). The highest prevalence rate is recorded in the early and late childhood group (69.78/100,000 and 43.78/100,000) [29]. The determination of incidence rate is still to be studied in Egypt.

4.10. Prevalence and Incidence in Middle East Region of Arab Countries

The prevalence is 6.5/1,000 in Saudi Arabia and high in male population as compare to female which is confirmed by three different studies. The prevalence is probably 2 times higher in children, in young adults compared to other groups and with a lower rate in middle-age people [30]. The incidence study about the epilepsy is not available up to now.

4.11. Prevalence and Incidence in America

The age adjusted prevalence is 5.0 in North America, 7.1 in Mississippi of North America [31,32,33]. In Central and South America the age adjusted prevalence is ranging from 3.7 per 1000 in Argentina [34] to 22.2 per 1000 in Ecuador [35]. There is lowest age adjusted prevalence in South America which is 3.7 [34]. The prevalence is high in lower-income families, older, and male children [36]. The point prevalence of epilepsy in Canada is 5.2/1000 according to data from two national health surveys [37,38]. The age adjusted incidence rate is ranged from 16 to 51 per 100,000 people in North America [39].
prevalence rate of epilepsy increased from the western to the eastern regions of Russian Federation in those times which are 2.2 in Moscow to 4.2 per 1000 in Irkutsk. Late-onset epilepsy is more common in the European region than in the Asian region of Russia [50]. Age adjusted incidence of epilepsy in European studies ranged from 26 per 100,000 person years in Norway (110) to 47 per 100,000 person years in England [51].

4.13. Prevalence and Incidence in African Countries

Data collection is one of a big health problem to address a disease in African countries [52]. The prevalence was evaluated through a questionnaire by University of Limoges, in tropical countries [53]. The prevalence is varying in range of 2.2 to 58 per 1000 in the African region is ranging from 2.2 to 58 per 1000 with an average prevalence of 15.83 [52,54]. Low prevalence rate is observed in Sudan which is 0.9 per 1,000[30]. The prevalence of active epilepsy is at peak in two age groups which are 20 to 29 (11.5 per 1000) and 40 to 49 (8.2 per 1000). The lowest prevalence is 3.1 per 1000 is observed in age group of 60 or more than 60 and the above two ways pattern is also present in both men and women population. There are only two studies conducted about the incidence of epilepsy in Africa. In Tanzania the crude incidence is 73 per 100,000 and age-adjusted incidence is 51 per 100,000 [55]. In Ethiopia the crude incidence of epilepsy is 64 per 100,000 while age-adjusted incidence of epilepsy is 43 per 100,000 [39].


There is no such study available to know about the prevalence of epilepsy but a cross sectional survey in Tasmania and a study conducted 30 years ago suggests that it is prevalent in between 6 and 7.5 per 1000 people. Maree et al suggest that over 8,800 Australians develop the epilepsy every year [56,57].

4.15. Overall Prevalence of Epilepsy

The worldwide prevalence of epilepsy is inconsistent and diversified among countries but, it is estimated that the overall prevalence is 10/1,000 people [58]. The prevalence of epilepsy of some countries is summarized in Figure 9.

![Prevalence of Epilepsy in Different Countries of the World](image)

In Europe, age-adjusted prevalence is low, 2.7 per 1000 to 3.3 per 1000, respectively [59,60] while there is a prevalence of 7.0/1000 in European region of Turkey [61]. The majority of studies in regard to epilepsy are conducted in Asia which is a significant health problem in Asia. The age-adjusted prevalence of epilepsy is 10.2 per 1000 in Asian Turkey [62] which is higher than in European Turkey [13]. The difference may be due to some biological variability between the Asia and the West population, and the smaller physique among Asians [63]. Mac et al systematically review the literature on epidemiology, etiology, and management of epilepsy in 23 Asian countries while prevalence data are available for only 11 countries [11].

In 1997, Jallon reviewed studies from Asia, mostly done in the 1980s, and showed a prevalence varying from 1·5 per 1000 in Japan to 9·99 per 1000 in Pakistan [12,64].

Data on prevalence of epilepsy are available from Azerbaijan, Estonia, Lithuania and the Russian Federation, but the differences in methodology and study populations make the comparisons quite difficult. The prevalence rate in the Nakhchivan area, Azerbaijan is 5.9 per 1000 population (S. Magalov, personal communication, 2004). The crude and age-adjusted prevalence rate of active epilepsy in an adult population in Estonia is 5.3 per 1000 [65].

4.16. Age Specific Prevalence

Generally it is found from most of the studies that there is increased prevalence in adolescent and early childhood age [65,66,67,68]. The prevalence is constant in adult age but increases after the age of 50 in developed countries [67,69]. The prevalence of epilepsy remains stable in third and fourth decades but then drops after the fifth decade of life in developing countries [65,66,67,68]. The epilepsy in adolescent and childhood are commonly idiopathic (primary) in nature while, in the rest of the groups are commonly secondary epilepsy.

4.17. Prevalence by Gender
The prevalence is higher in male than female in North, Central and South America except in New York, Bolivia, Honduras and Argentina where the female ratio is high. The Placencia et al., 1992 study shows a high prevalence in male but after Basch et al., 1997 study then this ratio become change and the prevalence become high in female [35,66,70,71,72,73]. In Europe the prevalence is high in female in Italy but according to Rocca et al in 2001 the male ratio become high while in Turkey the prevalence is high in male [34,59,60]. In Asian countries such as China, India, Turkey and Saudi Arabia the prevalence is high in Male while according to Aziz et al the prevalence is high in female in Pakistan [13,15,20,51,61,74,75]. The prevalence of epilepsy in male and female in the countries of sub-continent of Africa is variable. In Nigeria and in Uganda the prevalence is high in female [76,77,78,79]. On contrary the prevalence in male is high as compared to female in Ethiopia, Tunisia, Kenya and Zambia [39,69,80,81]. According to Rwiza et al in 1995 in Tanzania the prevalence is high in female while according to Dent et al in 2005 the prevalence become high in male as compared to female [55,82]. However, absolute difference in gender-specific prevalence is minimal. The most extreme example of a male excess is reported in a study conducted in India, in which prevalence of males (5.1 per 1000) is significantly higher than females (2.2 per 100) [83]. The biological differences, climatic differences is a partly reason for the higher prevalence. Psychosocial, cultural, economic, political and organizational factors are also important in manipulating epilepsy causation, management and outcome in the region [63]. In some population, the symptoms and diagnosis of epilepsy in women is concealed from public because the exposure of epilepsy may become a hurdle in their marriage. To explore the exact cause of difference in epilepsy between genders an extensive further scientific study is needed.

4.18. Prevalence by Race and Ethnicity

Few studies are available about the prevalence of epilepsy on the basis of race and ethnicity. Haerer et al assessed the prevalence of epilepsy on the basis of race and ethnicity and found age adjusted prevalence is high in African-Americans (8.2 per 1000) as compared to Caucasians (5.4 per 1000) [31]. Wright et al examined racial differences between South Asians and non-South Asians, and found prevalence of active epilepsy to be lower in South Asians in comparison to Non South Asians [84]. The difference may be due to some endemic problems such as neurocysticercosis or malaria, the status of medical infrastructure, Preventive Health related programs or availability of local health care system[85].

4.19. Prevalence of the Basis of Seizure Types

Seizure types are dependent on accurate of history, availability and sophistication of diagnostic tests used, and age at which the patient. However, prevalence of generalized seizure is high in America, Asia, Europe, and Africa as compared to other types of seizures [58].

4.20. Incidence of Epilepsy

Incidence studies provide a better understanding of the etiology and natural history of epilepsy. There is a limited data available about the incidence of epilepsy [3]. A meta-analysis of incidence studies reports that developing countries have a higher incidence rate of epilepsy as compared to developed countries which are figured in median as 68.7/100,00 and 43.4/100,000 [86]. Age-adjusted incidence of epilepsy is ranging from 16 per 100,000 people per years to 51 per 100,000 person-years in North America [87,88]. There is a diversified figure about the incidence of epilepsy in Europe. Age adjusted incidence of epilepsy is 26 per 100,000 person years in Norway while 47 per 100,000 person years in England of Europe [89]. One age adjusted incidence study is available from Asia which is conducted in India and age adjusted incidence is 35 per 100,000 people in year [90]. In Tanzania, crude incidence is 73 per 100,000 and age-adjusted incidence is 51 per 100,000 of Africa [55]. In Ethiopia, crude incidence of epilepsy is 64 per 100,000 while age-adjusted incidence of epilepsy is 43 per 100,000 [39]. Statistic about the incidence of epilepsy in China and India are similar to those in the America and Europe but lower than those from Africa and Latin America [11]. The whole picture about the incidence of epilepsy in developing countries is different from those in developed countries. However, overall age- adjusted incidence of epilepsy is 24 to 53 per 100,000 [11]. The difference in incidence may be attributed to economic status of the countries because this is an expensive study to carry out. The second main cause of difference is cousin marriages which are common in certain societies and particular in India and Muslim population. The treatment gap is also the main cause of difference in incidence in epilepsy. The treatment gap is defined as the proportion of people with active epilepsy who is not appropriately treated at a given point of time.

4.21. Age Specific Incidence

The incidence of epilepsy is high in first year of life, early childhood and after adolescent in developed countries [19,48,91,92] while, in developing countries the incidence is higher in only childhood group [39,55,66,88,93,94]. We presume that genetic (Family history), environmental factors (Aspasia, infections during and after birth), and health system (ignorance and no proper care system) mainly affect the incidence of epilepsy because early children and adolescent age group is more prone to these factors.

4.22. Incidence by Gender

Many studies report a higher incidence in males than female in both developed and developing countries [58]. The difference in incidence may be due some sex hormones which has some association with epilepsy. It is proved scientifically that two female sex hormones (estrogen and progestogens) affect the threshold of seizure to some extent which is lead to differences in gender [3,66].

4.23. Incidence by Race and Ethnicity

No statistically significant differences in incidence are found among non-Hispanic whites, African-Americans, Hispanics, and Asians [86].
4.24. Incidence by Seizure Type

Eight incidence studies are available to give information on seizure types. The incident studies performed in developing countries, particularly in Africa, reported a greater proportion of individuals to have epilepsy characterized by generalized onset seizures than epilepsy characterized by partial seizures [3,85].

4.25. Etiology of Epilepsy

From the available literature, causes seem to be dominated are head injury, birth trauma, asphyxia, cerebrovascular disease, and intracranial infections (neurocysticercosis or meningocencephalitis) [64]. Genetic factors have a strong association with idiosyncratic epilepsy [94].

4.26. Head Injury

Head injury is the main cause of epilepsy and account for 5% epilepsy and 20% of symptomatic epilepsy [95].

4.27. CNS Infections

The Commission on Tropical Disease of the International League Against Epilepsy listed several diseases as causes of epilepsy, including malaria, tuberculosis, schistosomiasis, acquired immunodeficiency syndrome, and cystercerosis [74,96]. An association between neurocysticercosis and epilepsy is found in various studies in Africa and Latin America the results on the relation between neurocysticercosis and epilepsy in Asia is varied significantly [97]. Neurocysticercosis is probably an important cause of seizures and epilepsy in regions with a high prevalence of *Taeniasolium* infection in human beings [98,99,100].

4.28. Genetic Factors

Some studies show that there is no association of genetic factors with epilepsy [101-106]. However, family history and largely genetic factors is linked to epilepsy in many studies [107,108]. The most common human genetic epilepsies display a complex pattern of inheritance and the associations with genes are largely unknown. Pathogenic alterations or mutation in genes and structural abnormalities in chromosomes (deletions, insertions) are responsible for a variety of epilepsies [95].

5. Conclusion

It is clear from the study that overall prevalence of epilepsy in the world is about 10 per 1000 people. There are differences in prevalence by gender which is slightly high in male than female although, the differences is non-significant and generalized type of epilepsy is the common one among the other types of epilepsies. However, the number of affected patients in the world is still large and much remains poorly documented. There is still a limited data available about the prevalence of epilepsy to find exact figure. There is lack of consistency in incidence studies although, statistically non-significantly higher incidence is observed for males as compared to females. Classification of seizure types is largely dependent on the proper history, advanced technology and neurologist but, still misclassification might be expected. We need further study to know accurately about the prevalence and incidence of epilepsy and the study must be include people from different ages, races, socioeconomic background to explore the role factors clearly a such age, gender, race and socioeconomic status on epilepsy. It is important to conduct prevalence study in those region from which still no data available about the prevalence of epilepsy. To know about the etiology of epilepsy it is important to carry out more detailed studies about the incidence of epilepsy. The proper consideration of culture of society, health care policies and access to health care system is important to interpret the findings from all studies.

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References


