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Review Article

Pharmacology for better Drug screening

A Review on an Epilepsy Epidemiology Focuses on its Measures, Data Sources, and Global Burden of Disease from 2010-2019 Before the Onset of the COVID-19 Pandemic

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Abstract: This review includes all the additional evidence and cutting-edge knowledge regarding the epidemiology of epilepsy that the previous article skipped. There are fewer articles related to the epidemiology of the disease and some on the burden of disease. To bring about educational change in line with the vision for the existing health system, we at the institutional level gather in this article a full description of the epidemiology of epilepsy, aggregating all standard measure concepts and different sources with some evidence of observational studies according to the World Health Organization. To make comparisons on the topic, we limited our investigation to the last ten years, from 2010 to 2019, which fell before the COVID-19 pandemic. We aimed to update a review and analyse the burden of the disease at the global level. We studied and concluded that, globally, in 2019, distinctive epilepsy incidents increased in all ages by [1.5 million (1.1–2.0)] in males and [1.3 million (0.9–1.7)] in females; prevalent cases increased by [13.0 million (9.9–16.2)] in male and [12.0 million (9.1–15.1)] in female as compared to 2010, respectively; death 114010.9 (95% UI, 100177.7 to 129928.1); high SDI (socio-demographic index) regions showed the lowest death as compared to low SDI regions in all age and sex. We updated estimates for up to 2023 and explored new data, methodological improvements, and up-to-date available information to help allocate resources.

Keywords: Epilepsy, Epidemiology, Data sources, Measures, Global, Prevalence

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1. INTRODUCTION

Sometimes to experience epilepsy,
All people may use the words "seizure disorder",
Not all people with seizures have epilepsy.

Epilepsy is one of the world's longest-recognized conditions, dating back to the 4000 BCE Akkadian tablet found in Mesopotamia. It describes a person with "their neck twisting left, hands and feet stiff, eyes wide open, and from the mouth, froth is flowing without them having any consciousness"[1] In 2005, Epilepsy was defined as a brain disorder also characterized by an enduring predisposition to produce epileptic seizures. Epilepsy is a disease of the central nervous system that may be characterized by repeated seizures that occur after an acute CNS insult (structural, systemic, toxic, or metabolic) over long periods, permanently or spontaneously. These events are acute *symptomatic* or *provoked seizures,* considered acute revelations.[2] Recently, in 2023, WHO reported that 100 million people worldwide were affected by neurological disorders, and epilepsy was the most common chronic non-communicable disease of the brain that affects around 50 million people of all ages, races, social classes, and geographical locations worldwide. [3] Between 4 and 10 individuals out of every 1000 were believed to have active epilepsy, meaning they either were still experiencing seizures or required medication. Approximately five million individuals receive a diagnosis of epilepsy each year worldwide. An estimated 49 out of every 100,000 individuals are diagnosed with epilepsy in high-income nations each year. In countries with lower and moderate incomes, the statistic reached 139 per 100,000. This was probably due to the increased risk of endemic conditions like neuro-cysticercosis and malaria, greater numbers of traffic incidents and birth-related injuries, variations in medical facilities, and accessible care options and preventive health programs. Nearly eighty percent of people with epilepsy reside in low- and middle-income nations. [3] In 2017, a new classification of the International League against Epilepsy (ILAE) was revised from previous drafting data that incorporates etiology along each stage and step of diagnosis and carries proper treatment for the affected person. [4,5]

Terminology and ILAE new classification of Epilepsy
Firstly, ***focal-onset seizures*** (FOS), also called simple partial seizures, begin in an aside or in a group of cells on one side of the brain. When a person is awake and aware during a seizure, or instead of being partial, to be more accurate when talking about where seizures begin, these people are confused, or their awareness was affected in some way during a focal seizure that is known to be a focal impaired awareness seizure or complex partial seizure.
Secondly, ***generalized seizures*** (GS) had different terms, such as tonic-clonic, grand mal, absence, or atonic seizure. When seizures occur in one half (hemispheres) of the brain, they are known as partial seizures, and whenever they occur in both halves of the brain simultaneously, they are known as GS.
***Tonic-clonic seizures*:** Tonic means phase 1 seizures come on one side of the brain with stiffening of muscles, where air may push past vocal cords with a cry or groan. A person may be unconscious and fall to the floor; they may start to bite their tongue or the inside of their cheek. Clonic phase 2 seizures after the tonic phase 1 start, which spread to affect both sides with rhythmical jerking. This class of seizures was named status epileptics who needed emergency treatment in a hospital.
Thirdly, ***unknown-onset seizures*** were understood by the term when the beginning of a seizure was unfamiliar. This type of seizure was not witnessed or seen by anyone; for example, when seizures happen at night or in a person who lives alone, it is called an unknown-onset seizure. At the third level, it was said about epilepsy syndrome, where a specific diagnosis can be made. This new classification of epilepsies was designed to classify them clinically and to acknowledge the wide variation worldwide, depending on the availability of resources for the clinician making the diagnosis.
Status epilepticus (SE) was an epileptic seizure that lasted longer than 5 minutes or was repeated at sufficiently brief intervals—more than 1 seizure within 5 minutes—without returning to a normal level of consciousness between episodes. SE may have long-term consequences, including medical emergencies that may lead to neural injury or death.
Sudden unexpected death (SUDEP) in epilepsy in someone who was otherwise healthy. Researchers reported that 1 in 1,000 people with epilepsy may die from SUDEP in a year. In individuals with epilepsy, it implies a sudden, unexpected death that occurs either during or after a seizure, with or without documented SE, and in particular, the autopsy also fails; it does not reveal nor identify a toxicologic or histologic cause of death [14]. The reports about the mechanisms of death in SUDEP are unknown. There are several reports and evidence supporting the hypothesis that SUDEP is triggered by a seizure with both cardiac and pulmonary derangements [16].

1.1 The Commission on Epidemiology of the ILAE has reported the following measures to focus on the burden of epilepsy[7,8]

First is public health surveillance of data for primary prevention, early detection, and treatment, emphasizing public health and healthcare and determining additional service and education requirements related to medical issues. These were the highlighting points of epidemiologic studies and surveillance. To fulfill these goals, epidemiologic and surveillance data must be comparable throughout time and across locations. Second, depending on the availability and content of different data sources with different necessary items for case ascertainment and verification, describe other characteristics of each case defined in later sections of this document. Such common sources are direct population surveys and existing coded data (the WHO codes death certificates for mortality registries). Another U.S. Department of Health and Human Services 2003

code is used to code other medical records describing hospital admissions, emergency department visits, clinic visits, or physician visits. The GBD 2016 collaborators reported a systematic analysis of the Global Burden of Disease Study from 1990–2016, which was investigated by the neurological collaborators.[9] Collaborators discussed that the 46 million people with epilepsy are a relevant fraction of the worldwide disease burden. They found out that about 80% of epileptic people reside in low- or middle-income countries (LMICs). As a comparison, rates of epilepsy prevalence and incidence are higher than in high-income countries (HICs). The differences were seen due to differing causes, a higher incidence of injuries, and a lack of access to health care. [9]

1.2 The mortality of people with epilepsy imposes a significant burden on the public health of high-income countries.

Here, studies were focused on reviews of epidemiologic studies of important causes of death among people with epilepsy due to injuries, status epilepticus, and sudden unexpected death in epilepsy (SUDEP), which may be preventable with access to high-quality specialty health care. The Centers for Disease Control and Prevention (CDC) was the major platform of the Department of Health and Human. From the literature, they comprehensively explained that traumatic brain injury (TBI) happens when someone gets a bump, blow, or jolt to the head or a penetrating injury to the head (such as a gunshot). [11] Nearly twenty years ago, TBI was an issue in the deaths of nearly a million Americans. [11,12] The largest numbers and rates of admissions and mortality from TBI have been recorded among people 75 years of age and older. Reportedly, approximately 28% of TBI-related deaths, as well as 32% of hospitalizations, were related to this age group. From 2000 through 2021, about 450,000 U.S. service members received a TBI diagnosis. According to a new CDC surveillance report, from 2000 to 2017, American Indians and Alaska Natives continuously had the highest age-adjusted rates of TBI-related deaths; in the intervening years, motor vehicle crashes accounted for the greatest rate of such TBI-related deaths. [12] To prevent as well as accurately identify victims of intimate partner abuse and people who may be at risk of suicide, the CDC developed based on study methods. Together with various other entities, the CDC performed research and created efforts to assist veterans and service members with traumatic brain injury (TBI). As the reviewer implies, SUDEP was documented in a wide variety of people, from young toddlers to older people. [13] The age range between 20 and 45 exhibits the highest prevalence of SUDEP. [14] Research studies conducted in the USA and Europe have found that groups facing socioeconomic hurdles to care, such as unemployment, limited access to medications and other treatments, and a greater distance from suitable healthcare providers, had a higher incidence of SUDEP. Many forms of epilepsy, such as focal and generalized epilepsy, were linked to SUDEP; however, according to new population-based research, patients who had merely absence or myoclonic seizures were not at elevated risk. [15] Here, we find a thorough analysis of the death and life span rates for individuals with SE and epilepsy in 2023. [16] There were fewer existing studies of epilepsy-associated mortality, indicating a need for additional epidemiologic studies and the development of methods and systems for long-term surveillance of mortality in people with epilepsy. [16] The International League against Epilepsy, 2023, reported the burden of mortality in epilepsy with a specific focus on potentially preventable causes of death. [4] WHO also reported that the risk of premature death in people with epilepsy was up to three times higher than for normal people. Three-quarters of people with epilepsy living in low-income countries do not get treatment according to their needs. It is estimated that 70% of people living with epilepsy are seizure-free if they are properly diagnosed and treated. [3] The assessments of comorbidity burden were reviewed through patient self-reports, and the number of reliable and valid questionnaires in adult populations was shown. The population-based studies on comorbidity showed that the co-occurrence of two or more separate medical conditions in the same person is of greatest interest when it appears at above-chance levels. In 2020, studied comorbidities in a pathophysiological way: first were *causal comorbidities* that resembled the conditions that were the cause of epilepsy, such as stroke, brain infections, brain tumors, or other neurological problems that lead to structural damage. [17] The treatment and management of such patients were very challenging concerning interactions between any of the anti-seizure medications (ASMs). Second, *reciprocal comorbidities* were a 'bidirectional relationship' condition in which not only does epilepsy increase the incidence of developing these disorders, but also these disorders might increase the risk of developing epilepsy. This occurrence was described as schizophrenia, attention deficit hyperactivity disorder (ADHD), and autism. Third were *mutual comorbidities,* which mean a simplified and straightforward way to identify an etiological factor shared by epilepsy with another condition or both. Fourth were the resultant comorbidities that arise during seizures or epilepsy treatments, such as osteopenia, sexual dysfunction, or obesity. [17] The burden of comorbidities was used to measure the impact of mortality. Comorbidities may impact patients' quality of life and their treatment decisions. The comorbidities of epilepsy care are changing rapidly in different scenarios. Continuous research in this area is needed for a better understanding of epilepsies, their treatment, and their management.

2. DIFFERENT SOURCES FOR EPIDEMIOLOGICAL STUDIES

The Neurology Atlas**,** which lists the nation's resources for neurological illnesses, is a prime instance. [18] A worldwide investigation called the Neurology Atlas Project was conducted in 2014 and 2015. This document provides data from 132 nations, one Associate Member, and one territory spanning all WHO regions and continents, accounting for 94% of the global population. It highlights the methodological procedures used to create the second edition of the Neurology Atlas: questionnaire development, questionnaire dissemination stage, and data clarification and analysis. [18] For some data variables (such as workforce numbers), rates per 100,000 people were estimated using official country data from the WHO Global Health Observatory**,** released in 2015. [19] Its goal was to introduce neurology to all nations on the entire globe, with a focus on public health consciousness, research, treatment, prevention, and advocacy. Another is the Global Burden of Disease (GBD) studies**,** which were coordinated by the Institute for Health Metrics and Evaluation (IHME) and synthesize a large number of input sources to estimate the causes of death, injuries, and risk factors in multiple countries and territories from 1,250 censuses and 747 population registry location-years. [20] This data input source provides migration estimates by location, sex, age, and single calendar year. It explores input sources and retrieves relevant metadata. Systemic analysis of the epidemiology of disease by

the IHME data tool reports an annual update collected by a growing collaboration of scientists globally. [20, 21]

3. SYSTEMIC ANALYSIS OF GBD: EPILEPSY

We found and analysed GBD 2010-2019 (Fig. 1 a): prevalence, incidence, YLLs (Fig. 2), YLDs, DALYs, and deaths (Fig.3); for neurological disorders: epilepsy (idiopathic categories) in all ages, at an age-standardized rate (per 100,000 people) and sex (male and female) at global level, regionally, high socio-demographic index (SDI), high middle SDI, middle SDI, low middle SDI, and low SDI; and for GBD countries from the GBD Compare Tool and GBD Results Tool which researcher designed for the GBD studies. [20]

YLDs stands for years lived with disability.
YLLs stands for Years of life loss
And DALYs stands for Disability-adjusted life years20
DALYs= YLD+ YLLs 20

4. PREVALENCE ESTIMATES

Globally, in 2010, there were 11.4 million cases of idiopathic epilepsy in males with 0.0034% and 10.4 million cases in females of *all ages* with 0.0030%. As a comparison, in 2019, prevalence increased, with 13.0 million males at 0.0035% and 12.0 million females of *all ages* at 0.0032%, respectively (Table S1 and Fig. 2). [20,21,25]

4.1 Incidence Estimates

Globally, Incidence case in 2010, in all ages, there were 1.3 million cases of idiopathic epilepsy in males and 1.1 million cases in females, with 0.0001% in both sexes. As a comparison, in 2019, the incidence was 1.5 million in males and 1.3 million in females in both sexes. We analyzed from 2010 and 2019; there were no significant incidents changed in both sexes at all ages, respectively also at age-standardized rates per 100,000 people (Table S1 and Fig. 2). [20, 28,30]

4.2 Mortality/Death Estimates

We found the deaths of 5 SDI countries (socio-demographic index, a composite indicator of development status that resembles health outcomes) and estimated the GBD from 2010 to 2019. [28-30] A geographic area on the SDI basis was identified into SDI quintiles with 5 regions, i.e., into high, high-middle, middle, low-middle, and low SDI. Between 2010 and 2019, the deaths from IE decreased in all four SDI regions, except the low SDI regions (0.182%) in all ages both sexes (Table S2, Fig. 3). [20] As we find out that there were seven different variations of death in both sexes and all ages of epilepsy globally, with the highest number observed in (a) South Asia: 39,454.23 deaths (31,825.68–47,483.99). (b) Sub-Saharan Africa: 21,489 deaths (17,737.73–27,543.4) (c) Southeast Asia, East Asia, and Oceania: 16,717.36 deaths (14,539.93–19,533.12) (d) High income: 1,347.07 deaths (11,766.51–15.254.73) (e) Latin America and the Caribbean 9,140 deaths (6,212.77–10,314.06) and a lesser number of deaths observed in (f) North Africa and the Middle East (6,570.44–7,628.63) (g) Central Europe, Europe, and Central Asia 6,292.8 deaths (5,675.95–6,868.89) (Fig. 1 b, 4; Table S2).[20]

Table S1: Global prevalence, incidence, and YLLs in all ages and age-standardized rates per 100,000 people in neurological disorder: Idiopathic Epilepsy 2010–2019

	All Ages								Age-standardized rate (per 100,000 people)			
	Male				Female				Male	Female	Male	Female
	2010		2019		2010		2019		2010		2019	
Measures	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percentage		Percentage	
Prevalence	11484795 (8950391-14376094)	0.0034% (0.0026-0.0043)	13030337 (9938599-16262221)	0.0035% (0.0026-0.0044)	10436838 (8088189-12956269)	0.0030% (0.0023-0.0038)	12080773 (9154134-15147310)	0.0032% (0.0024-0.0040)	0.0040% (0.0026-0.0040)	0.0027% (0.0023-0.0038)	0.0035% (0.0027-0.0045)	0.0032% (0.0024-0.0040)
Incidence	1397260 (1022794-1836589)	0.0001% (0.0001-0.0001)	1574244 (1141271-2073583)	0.0001% (0.0001-0.0001)	1170944 (854769-1533950)	0.0001% (0.0001-0.0001)	1323978 (960744-1746804)	0.0001% (0.0001-0.0001)	0.0001% (0.0001-0.0001)	0.0001% (0.0000-0.0001)	0.0001% (0.0001-0.0001)	0.0001% (0.0000-0.0001)
YLLs	3276945 (2922668-3544384)	0.0031% (0.0028-0.0033)	3146476 (2789947-3713081)	0.0033% (0.0030-0.0038)	2278170 (1858037-2484392)	0.0029 % (0.0024-0.0031)	2190345 (1799228-2521114)	0.0031% (0.0026-0.0035)	Rate		Rate	
									92.5655 (82.2448-100.1172)	65.8810 (53.6162-72.1013)	81.2305 (72.0263-95.9784)	57.6562 (47.5801-66.8400)

	All Ages								Age-standardized rate (per 100,000 people)			
	Male				Female				Male	Female	Male	Female
	2010		2019		2010		2019		2010		2019	
Measures	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percentage		Percentage	
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The table illustrates no significant changes in the rate of P, I, and YLLs of IE in both sexes at all ages and at age-standardized, respectively (2010-2019). Numbers in brackets show a 95% uncertainty interval.

Table S2: Global death, DALYs, and YLDs in all ages in neurological disorder: Idiopathic Epilepsy (2010-2019)

	(Death)		DALYs (Disability-Adjusted Life Years)		YLDs (Years Lived with Disability)	
	2019 Counts	% change at all ages (2010-2019)	2019 Counts	% change at all ages (2010-2019)	2019 Counts	% change at all ages (2010-2019)
Global	114010.9 (100177.7 to 129928.1)	-0.024% (-0.071 to 0.081)	13077624 (9986730 to 16734086)	0.065% (-0.012 to 0.150)	7740804 (4810323 to 11216664)	-0.042% (-0.137 to 0.062)
High SDI	13359.04 (11129.59 to 14268.35	-0.057% (-0.089 to -0.025)	1281949 (883071.2 to 1887128)	-0.102% (-0.241 to 0.057)	871925.9 (474469.1 to 1472266)	-0.121% (-0.315 to 0.129)
High-middle SDI	14841.36 (13530.72 to 16261.95)	-0.061% (-0.103 to -0.007)	1760651 (1267275 to 2360202)	-0.032% (-0.145 to 0.093)	1161072 (668364.7 to 1749422)	-0.084% (-0.250 to 0.110)
Middle SDI	26017.67 (23216.61 to 30439.46)	-0.113% (-0.163 to -0.019)	3477914 (2556903 to 4508754)	-0.015% (-0.115 to 0.091)	2261802 (1394665 to 3284389)	-0.081% (-0.213 to 0.065)
Low-middle SDI	36695.11 (29876.26 to 43645.78)	-0.004% (-0.069 to 0.130)	3744715 (2910586 to 4799430)	0.116% (-0.020 to 0.274)	1955025 (1184802 to 2879425)	-0.008% (-0.206 to 0.257)
Low SDI	23028.56 (19455.09 to 27636.28)	0.182% (0.085 to 0.377)	2804186 (2102968 to 3691130)	0.297% (0.122 to 0.520)	1486130 (839120.7 to 2351063)	0.032% (-0.189 to 0.355)
Asia	63656.75 (54362.6 to 72961.06)	-0.095% (-0.154 to 0.016)	6858210 (5286899 to 8711364)	-0.005% (-0.099 to 0.103)	3857214 (2364255 to 5548424)	-0.073% (-0.211 to 0.076)
South Asia	39454.23 (31825.68 to 47483.99)	-0.044% (-0.113 to 0.091)	3697879 (2884525 to 4712177)	0.073% (-0.066 to 0.237)	1827004 (1118774 to 2751089)	-0.017% (-0.245 to 0.263)
Central Asia	2624.455 (2253.075 to 3000.264)	0.006% (-0.052 to 0.070)	274641.2 (207185.7 to 365143)	0.017% (-0.229 to 0.327)	130150.5 (66199.61 to 216714.6)	-0.089% (-0.505 to 0.609)

East Asia	12374.38 (10616.95 to 14640.83)	-0.203% (-0.271 to -0.107)	1429169 (1026275 to 1920747)	-0.170% (-0.300 to -0.018)	869680.2 (485807.9 to 344360)	-0.214% (-0.403 to 0.032)
Southeast Asia	4145.272 (3466.874 to 4834.013)	-0.098% (-0.166 to -0.009)	805838.4 (557961.3 to 1119211)	0.074% (-0.143 to 0.339)	616609.8 (373711.1 to 927287.7)	-0.008 % (-0.265 to 0.338)
Africa	23442.54 (19389.2 to 30238.69)	0.198% (0.079 to 0.414)	3198918 (2385380 to 4257114)	0.294 % (0.126 to 0.492)	1867486 (1114065 to 2831130)	-0.003% (-0.178 to 0.208)
North Africa and the Middle East	6570.439 (5357.437 to 7628.629)	-0.118% (-0.185 to -0.014)	955271.2 (682841.7 to 1293169)	-0.031% (-0.224 to 0.191)	603113.5 (342286.3 to 938664.1)	-0.113% (-0.373 to 0.239)
Europe	14415.67 (12275.2 to 15476.79)	0.007% (-0.034 to 0.045)	1279296 (896739.4 to 1822415)	0.014% (-0.148 to 0.221)	829509.2 (452389.6 to 1365254)	-0.017% (-0.253 to 0.316)
Eastern Europe	1687.131 (1499.707 to 1938.547)	0.038% (-0.021 to 0.098)	221327.1 (149747 to 313226)	0.103% (-0.094 to 0.345)	148770.2 (78941.39 to 241996.7)	0.005% (-0.248 to 0.340)
Central Europe	1981.215 (1712.036 to 2250.031)	-0.072 % (-0.117 to -0.024)	208506.5 (145230.2 to 288107.8)	-0.010% (-0.208 to 0.209)	136094.5 (73532.23 to 217178.9)	-0.018% (-0.316 to 0.340)
Western Europe	9233.603 (7141.932 to 9953.305)	-0.014% (-0.062 to 0.025)	662434.7 (453393.4 to 1018721)	-0.029% (-0.269 to 0.310)	428590.4 (216976.3 to 779997.4)	-0.027% (-0.388 to 0.554)
America	12363.67 (11381.35 to 13601.3)	-0.004 (-0.045 to 0.038)	1725696 (1236274 to 2312313)	0.022% (-0.095 to 0.152)	1176498 (703559.1 to 1768691)	-0.062% (-0.215 to 0.121)
North America	2625.456 (2404.904 to 2725.485)	-0.014 (-0.060 to 0.014)	361271.9 (235954.4 to 530889.8)	-0.198% (-0.338 to -0.033)	266757.4 (141151.8 to 436385.4)	-0.242% (-0.416 to -0.025)
Southern Latin America	693.8107 (640.4892 to736.3426)	-0.013% (-0.055 to 0.032	88019.21 (52266.82 to 139997.3)	-0.002% (-0.431 to 0.676)	58712.48 (23404.87 to 111204.8)	-0.033% (-0.611 to 1.202)
Andean Latin America	820.6148 (658.638 to 1055.367)	-0.102% (-0.177 to 0.012)	137191.2 (81656.99 to 211207.6)	0.044% (-0.384 to 0.760)	96825.72 (42972.19 to 169601.5)	-0.052% (-0.563 to 1.139)
Tropical Latin America	3021.752 (2821.344 to 3183.632)	-0.012% (-0.050 to 0.026)	417338.4 (296897.9 to 567517.7)	0.135% (-0.090 to 0.438)	282184.7 (160406.9 to 433282.7)	0.112% (-0.206 to 0.590)
Central Latin America	4295.553 (3655.62 to 5038.23)	-0.090% (-0.127 to-0.052)	625264.1 (447997.9 to 849213.5)	-0.014% (-0.205 to 0.220)	421159.6 (251817.7 to 647618.1)	-0.047% (-0.305 to 0.311)
South Asia - WB	40656.75 (32745.82 to 48442.32)	-0.043% (-0.111 to 0.092)	3836552 (2994213 to 4897927)	0.0724% (-0.0661 to 0.2385)	1895462 (1153959 to 2865072)	-0.018% (-0.236 to 0.255)
Middle East & North Africa - WB	3883.33 (3170.304 to 4911.116)	-0.119% (-0.184 to-0.019)	637183.4 (442557.8 to 876897.9)	-0.046% (-0.257 to 0.207)	435665.1 (245186.5 to 660239.7)	-0.089% (-0.505 to 0.609)
Europe & Central Asia - WB	16664.88 (14249.21 to 17873.27)	0.007% (-0.031 to 0.043)	1505831 (1085977 to 2082542)	0.017% (-0.129 to 0.192)	931060.1 (516201.9 to 1524195)	-0.020% (-0.243 to 0.266)
East Asia & Pacific - WB	18195.38 (15878.86 to 20856.98)	-0.171% (-0.229 to -0.084)	2401065 (1723659 to 3183347)	-0.093% (-0.207 to 0.024)	1598533 (941527.6 to 2354726)	-0.129% (-0.288 to 0.039)
Sub-Saharan Africa - WB	22090.47 (18305.73 to 28158.58)	0.236 % (0.110 to 0.467)	2953045 (2195745 to 3887515)	0.333% (0.150 to 0.549)	1691648 (1000587 to 2593263)	0.016% (-0.166 to 0.254)
Eastern Sub-Saharan Africa	6866.127 (5811.213 to 8496.599)	0.262% (0.144 to 0.459)	979316.7 (700638.8 to 1360240)	0.391% (0.123 to 0.723)	593843.4 (325212.9 to 955975)	0.045% (-0.248 to 0.504)
Western Sub-Saharan Africa	10606.26 (8070.594 to 15158.61)	0.231% (0.060 to 0.509)	1333419 (992216.5 to 1788345)	0.273% (0.093 to 0.504)	713837 (415402.5 to 1097726)	-0.026% (-0.216 to 0.232)

Southern Sub-Saharan Africa	1736.862 (1500.11 to 1993.27)	0.203% (0.101 to 0.370)	198522.5 (146332.6 to 263033.7)	0.286% (0.038 to 0.589)	113433.5 (64309.77 to 176284.6)	-0.035% (-0.349 to 0.432)
Central Sub-Saharan Africa	2279.751 (1766.751 to 2883.426)	0.240% (0.073 to 0.566)	366966.6 (210891 to 577470.9)	0.498% (-0.129 to 1.540)	234216.2 (78575.45 to 445658.8)	0.104% (-0.567 to 1.792)
South-East Asia Region	38242.2 (31793.13 to 45119.21)	-0.068% (-0.143 to 0.053)	3721812 (2894671 to 4718264)	0.056% (-0.076 to 0.226)	1932824%(1148469 to 2830045)	-0.018% (-0.224 to 0.236)
European Region	16799.96 (14370.18 to 18020.1)	0.006% (-0.031 to 0.042)	1520217 (1094168 to 2100180)	0.017% (-0.129 to 0.195)	940776.6 (521684.7 to 1534782)	-0.020% (-0.244 to 0.262)
Western Pacific Region	15594.35 (13563.81 to 17955.4)	-0.187% (-0.242 to -0.100)	1909337 (1365698 to 2534086)	-0.133% (-0.253 to -0.006)	1224420 (702687.7 to 1851608)	-0.162% (-0.336 to 0.037)
Eastern Mediterranean Region	9310.552 (6771.04 to 11722.14)	0.027% (-0.067 to 0.179)	1282043 (946162 to 1718085)	0.087% (-0.129 to 0.343)	775954 (461524.6 to 1200181)	-0.080% (-0.342 to 0.273)
African Region	21459.69 (17728.68 to 27528.94)	0.234% (0.107 to 0.464)	2888397 (2134950 to 3823885)	0.330% (0.150 to 0.545)	1670759 (975832.1 to 2557110)	0.013% (-0.169 to 0.253)
Region of the Americas	12363.67 (11381.35 to 13601.3)	-0.004% (-0.045 to 0.038)	1725696 (1236274 to 2312313)	0.022% (-0.095 to 0.152)	1176498 (703559.1 to 1768691)	-0.062% (-0.215 to 0.121)
Australasia	364.9943 (333.821 to 388.8915)	-0.117% (-0.165 to -0.068)	34407.39 (19820.56 to 57617.8)	-0.080% (-0.495 to 0.700)	20972.6 (6420.578 to 44289.04)	-0.062% (-0.688 to 2.038)
Oceania	197.7036 (119.5514 to 274.1663)	-0.001% (-0.089 to 0.114)	24607.62 (14079.45 to 37108.02)	0.064% (-0.339 to 0.729)	12749.55 (4514.544 to 24890.87)	-0.003% (-0.638 to 1.551)
High-income North America	2626.692 (2405.995 to 2726.868)	-0.014% (-0.060 to 0.014)	361321.8 (236123 to 530959.4)	-0.198% (-0.338 to -0.033)	266756.7 (141220 to 436403.8)	-0.242% (-0.416 to -0.025)
High-income Asia Pacific	1427.974 (1155.002 to 1562.809)	-0.065% (-0.146 to -0.004)	148928.8 (95276.78 to 229907.5)	-0.044% (-0.273 to 0.248)	108228.4 (54314.89 to 188733.1)	-0.028% (-0.349 to 0.436)
Commonwealth High Income	1952.612 (1818.185 to 2046.955)	-0.120% (-0.141 to -0.094)	178327.1 (124944.7 to 251202.8)	-0.109% (-0.258 to 0.080)	109531.6 (56509.15 to 182383)	-0.103% (-0.345 to 0.216)
Commonwealth Middle Income	45453.43 (36919.14 to 56875.56)	-0.003% (-0.076 to 0.149)	4550174 (3518814 to 5826985)	0.107% (-0.010 to 0.251)	2327248 (1418969 to 3461932)	-0.021% (-0.191 to 0.185)
Commonwealth Low Income	5363.383 (4357.19 to 6708.864)	0.212% (0.091 to 0.414)	753910.4 (518172.6 to 1065164)	0.354% (0.005 to 0.847)	469624.4 (244188.6 to 770550.1)	0.042% (-0.361 to 0.774)
World Bank High Income	16550.61 (13759.35 to 17658.17)	-0.039% (-0.077 to -0.008)	1538572 (1059213 to 2235091)	-0.100% (-0.284 to 0.121)	1040703 (574328.6 to 1729445)	-0.0996% (-0.2838 to 0.1207)
World Bank Low Income	14182.77 (12037.31 to 17055.03)	0.276% (0.174 to 0.467)	1779936 (1288538 to 2380283)	0.386% (0.173 to 0.689)	964840.9 (524818.7 to 1539070)	0.058% (-0.206 to 0.490)
World Bank Upper Middle Income	27045.34 (24367.34 to 30101.96)	-0.113% (-0.155 to-0.043	3548980 (2603402 to 4672142)	-0.097% (-0.229 to 0.055)	2310995 (1394801 to 3430852)	-0.097% (-0.229 to 0.055)

The table illustrates between 2010 and 2019, idiopathic epilepsy counts, and percentages both showed varied data for deaths (D), DALYs, and YLDs across GBD countries. The table shows the values of 5 SDI countries (socio-demographic index, a composite indicator of development status that resembles health outcomes) and estimates the GBD 2019 location for 2010–2019. As mentioned above, a geographic area on the SDI basis was identified as an SDI quintile with 5 regions, i.e., high, high, middle, low, middle, and low SDI. Between 2010 and 2019, the deaths from IE decreased in all four SDI regions, except the low SDI regions (0.182%). The greatest declines in deaths were seen in the high-middle and middle SDI regions, showing a more significant reduction from 2010–2019, i.e., -0.061% and -0.113%. High SDI showed the lowest death rate of -0.057% compared to low SDI. The deaths reported due to IE decreased in Asia, South Asia, East Asia, and Southeast Asia except for Central Asia by 0.006% (95% UI -0.052

to 0.070). The greatest declines in deaths were seen in Southeast Asia and East Asia, showing a more significant reduction from 2010–2019, i.e., -0.098% (-0.166 to -0.009) and -0.203% (-0.271 to -0.107). South Asia is showing the lowest death rate of -0.044% (-0.113 to 0.091) as compared to Asia, which is -0.095% (-0.154 to 0.016) in all ages, so changes occur in D, DALYs, and YLDs in other countries, respectively, that are mentioned in the table.[20]

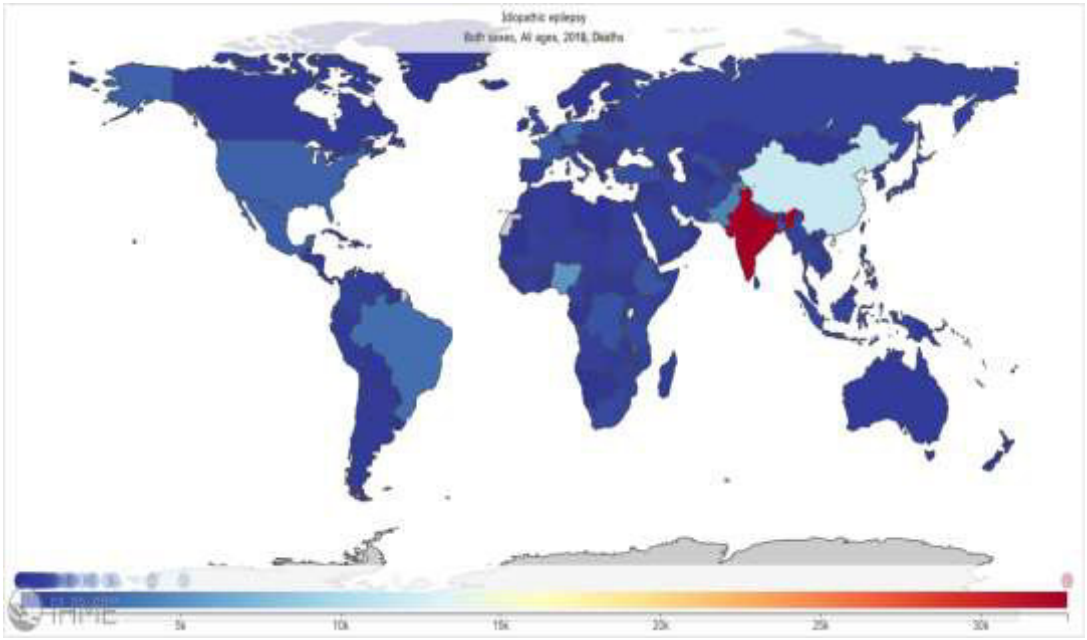

Fig. 1a Global death per 100000 of idiopathic epilepsy for both sexes in all ages, 2019 [20]

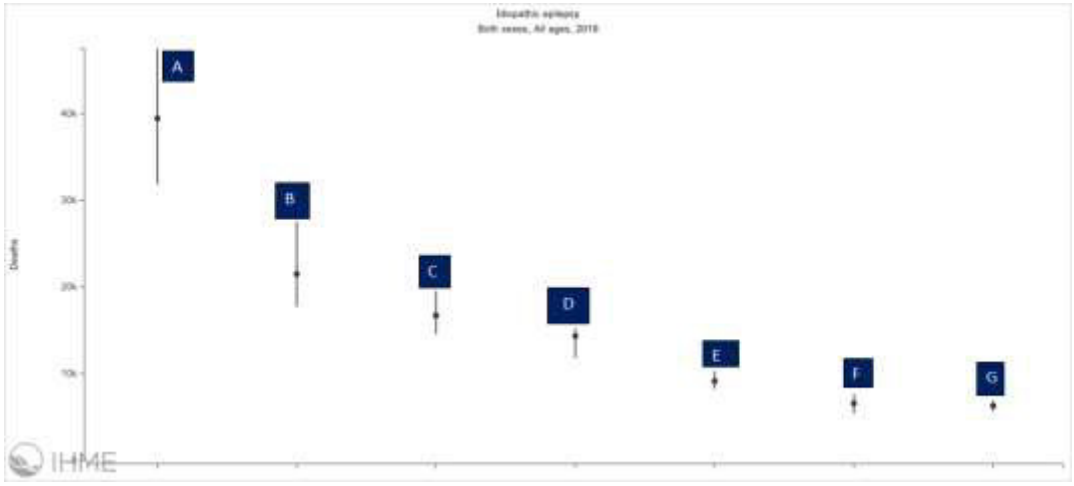

Fig. 1b Death per 100000 of idiopathic epilepsy for both sexes in all ages, 2019

Figure representing in X-axis: GBD Countries; whereas Y-axis: Death in millions according to years in all ages in both sexes. Where (A) South Asia: 39,454.23 (B) Sub-Saharan Africa: 21,489 (C) Southeast Asia, East Asia, and Oceania: 16,717.36 (D) High income: 1,347.07 (E) Latin America and the Caribbean 9,140 (F) North Africa and the Middle East (G) Central Europe, Europe, and Central Asia. This explains that (A) countries have the highest and (G) countries have the lowest number of deaths due to idiopathic epilepsy IE. [20]

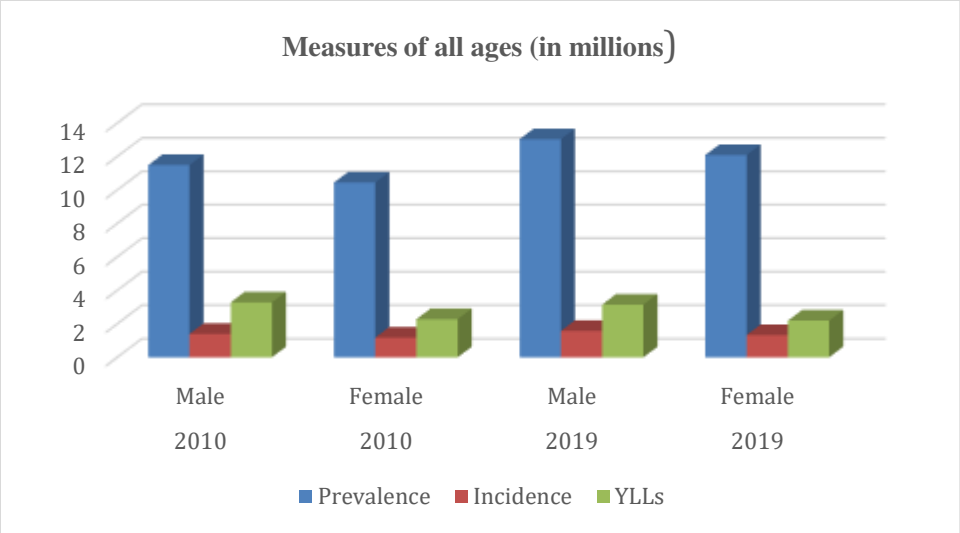

Fig. 2 Prevalence, incidence, and YLLs measures in millions of idiopathic epilepsy for males and females of all ages, 2010-2019

Figure representing in X-axis: Prevalence (P), incidence (I), and YLLs of males and females in 2010 and 2019; whereas Y-axis: P, I and YLLS in millions according to years in all ages in male and female.

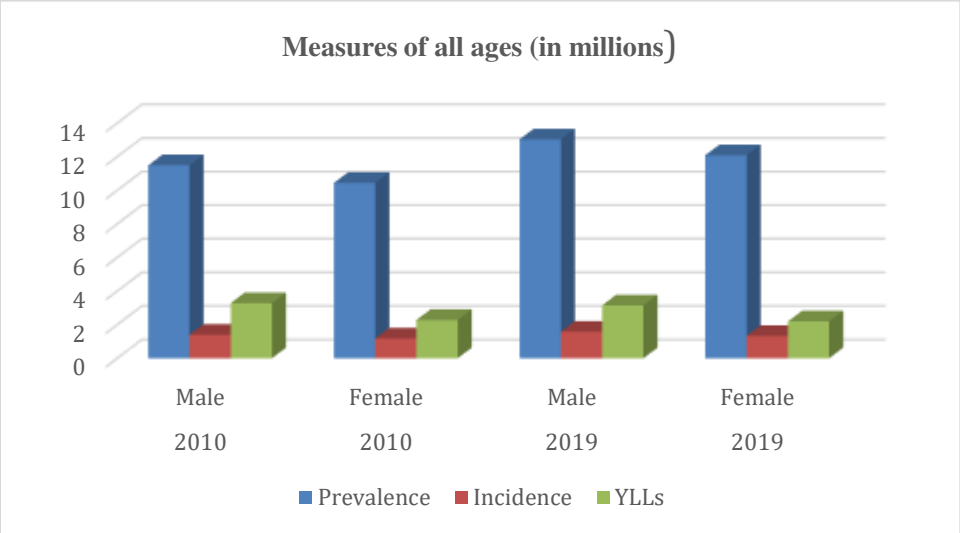

Fig. 3 Global percentage of deaths, DALYs, and YLDs in a million populations of idiopathic epilepsy, all ages and sexes, 2019

Figure representing in X-axis: Death (D), DALYs, and YLDs in both sexes, 2019; whereas Y-axis: D, DALYs, and YLDs in millions.

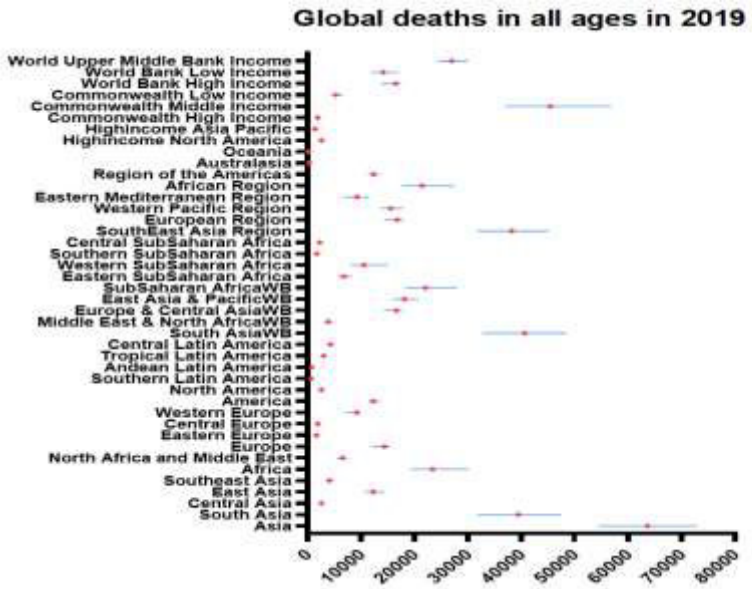

Fig 4: Global deaths per 100,000 populations of idiopathic epilepsy, all ages and sexes, 2019

Figure representing in X-axis: Death in both sexes, 2019; whereas Y-axis: GBD countries and regions.

5. DISCUSSION

According to the study, 50 million people have epilepsy worldwide, and nearly 80% of them live in low- and middle-income countries. In different regions of the world, epileptic people and their families were suffering from both stigma and discrimination[3]. In studies presenting the epidemiologic analysis of epilepsy in developed and low- and middle-income countries, different definitions and methods complicate study interpretation and comparison tasks. As our study found, epilepsy is characterized by recurrent seizures with brief episodes of involuntary movement that either involve a partial (part of the body) or a generalized (whole body) or are sometimes accompanied by loss of consciousness and control of bowel or bladder function. However, to conduct epidemiology studies, the ILAE *Epidemiology Commission* advises that epilepsy be defined either as two or more unprovoked seizures occurring at least 24 hours apart. [4] This revised definition of epilepsy brings the term into concordance with common use. In the present study, we reviewed classifications of epilepsy, such as focal onset, generalized seizures, and unknown seizures. According to the 2017 classification of epilepsies by the International League against Epilepsy (ILAE), epilepsy has been defined into three diagnostic levels, including seizure type, epilepsy type, and epilepsy syndrome. Epilepsy syndromes were recognized as distinct electro clinical entities well before the first ILAE classification of epilepsies and epilepsy syndromes in 1985.[5] The SUDEP term has been introduced, and 1 out of 1000 was affected by epilepsy. The reported mechanisms of death in SUDEP remain unknown. There are several reports and evidence supporting the hypothesis that a seizure with both cardiac and pulmonary derangements triggers SUDEP. [20] These studies specify the rationale for any significant changes in terminology or definition. We have currently done the meta-analysis and reported different measures that focus on the burden of epilepsy. There are many standard measures developed for conducting epidemiological research in epilepsy to study the occurrence and burden of epilepsy, such as public health surveillance, data sources focused on mortality in high-income countries, assessment of comorbidity burden, and adaptation of the concept from commissions (ILAE, WHO, etc.). The finding most likely signifies increased therapeutic accessibility, as it lowers the chance of death and decreases the severity of the disorder. This article used and studied a scientific epidemiology technique and various metrics to measure epilepsy frequency. Among them are prevalence, incidence, death, YLDs, YLLs, and DALYs by age and sex. In 2019, incidence cases of epilepsy in males were more than 1.5 million as compared to females at 1.3 million in all ages; prevalence showed a significantly increased value, 13.0 million in males with 0.0035% (0.0026–0.0044) and 12.0 million in females at all ages (Fig. 2, Table S1). [20] From a review of such cases, an age between 20 and 45 is associated with the highest prevalence of SUDEP. [14] WHO annually estimates the incidence and prevalence of people in developing countries per 100,000; they stated that the case incidence in developing countries can often be twice as high and highlighted the possibility of enduring brain injury with a higher risk phase. [3,21,22-25] According to a previous report on epidemiologic studies, the causes of death in epilepsy may be injuries, status epilepticus, and SUDEP. [26-28] Here, we find 114010.9 deaths globally in cases of idiopathic epilepsy, 13·1 million DALYs, 3.1 million YLLs, and 7.7 million YLDs at all ages in 2019 (Fig. 4). [20] The ability to identify variations between countries is limited since the 95% UI is used to quantify the precision of the estimates and reflect the total uncertainty of the estimates. [28-30] Presently studied SDI quintiles, which were divided into high, high middle, middle, low middle, and low SDI, which show developmental status with health outcomes from 2010–2019, with high SDI showing the lowest death rate (-0.057%) when compared to low SDI, which identify and show the correlation between epilepsy outcomes and a country's level of prosperity (Fig. 3). [20] To this end, also reviewed a report on 1990-2017,[33] and 1990-2019,[31,32] cases of IE incidence, deaths, and DALYs at all ages at a standardized age rate were more in males as compared to females globally and based on some selected countries. At last, we searched for review data, which finally supported the selection of the present article title. We detailed maximal standard measures and data sources to overview and do the systemic analysis for GBD 2019: global, socio-demographic index, GBD including 40 countries prevalence, incidence, years of life lost, years lived with disability, disability-adjusted life-years, and deaths; we also

compared risk factor epilepsy (idiopathic categories) in all ages at an age-standardized rate (per 100 000 people) and both sexes (male and female) in parallel, which is viewed in this presented article.

6. CONCLUSION

In the conclusions, the article aims to enhance future population-based epidemiologic studies by promoting uniformity in terminology and methods and making individual comparisons easier. This enhances acquiring information that may be utilized in various situations to advance public health. However, this approach is meant to be adaptable, noting that public health infrastructure, requirements, and goals differ between countries, especially in contrast to developed and developing regions. The collection of the above data related to epilepsy can strengthen and decrease the burden of diseases in developed and low-income countries through the development of new medicines throughout the world. These data can be helpful to examine future elements and comparisons on the researcher's future topic between before, after, and end of the COVID-19 pandemic related to epilepsy GBD.

7. AUTHORS CONTRIBUTION STATEMENT

LK wrote, reviewed, and analyzed the data; AS estimated the data statistically; AST reviewed and finally approved by all authors for the final version of the manuscript.

8. CONFLICT OF INTERESTS

Conflict of interest declared none.

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