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Prevalence of Epilepsy in Children and Adolescents Worldwide: A Literature Overview

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Abstract

Background: Epilepsy in children is a significant public health concern. The study aims to synthesize evidence regarding the global prevalence and incidence rates of epilepsy among children and adolescents, as well as the associated risk factors.

Materials and Methods: In this overview, online databases such as PubMed, Scopus, EMBASE, Web of Science, and Google Scholar were searched for related studies up to May 2024. The selection procedure was conducted by two reviewers.

Results: In total, six studies were included in the analysis. Approximately 0.9 million children in Europe have active epilepsy, with a prevalence of 4.5 to 5.0 per 1,000. In Africa, the cumulative prevalence is 17.3 per 1,000, with active epilepsy at 6.8 per 1,000. Prevalence rates vary regionally from 3.2 to 8.1 per 1,000 in developed areas and from 3.6 to 44 per 1,000 in developing regions. The highest prevalence occurs in children aged 5 to 9 years, at approximately 374.8 per 100,000. The estimated annual incidence rate for children in Europe is around 70 per 100,000, with overall rates ranging from 41 to 187 per 100,000, particularly higher in underdeveloped countries during the first year of life. Common causes of epilepsy differ by region: developing countries often cite birth asphyxia and infectious diseases, while developed nations report brain tumors and traumatic injuries. Socioeconomic factors significantly influence these rates, leading to higher prevalence in low- and middle-income countries (LMICs).

Conclusion: The global burden of epilepsy among children is significantly higher in low- and middle-income countries, influenced by geographic and socioeconomic factors. This highlights the urgent need for early detection and targeted public health interventions, particularly since the highest incidence occurs during the first year of life.

Key Words: Children, Epilepsy, Iran, Prevalence, Worldwide.

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1- INTRODUCTION

Childhood epilepsy is a common neurological disorder characterized by recurrent, unprovoked seizures due to abnormal electrical activity in the brain. These seizures may present as generalized, involving both hemispheres and often leading to loss of consciousness or convulsions, or as focal, originating in a specific cortical region and resulting in localized motor, sensory, or awareness disturbances. The estimated prevalence varies globally depending on geographic and methodological differences, but studies suggest that approximately 1 in 200 children are affected (1–4). In the United States, about 450,000 children under 17 years of age live with active epilepsy (5), and the World Health Organization recognizes epilepsy as one of the most common chronic neurological disorders worldwide, disproportionately affecting children in low- and middle-income countries (6).

Childhood epilepsy encompasses a variety of epilepsy syndromes that manifest at different developmental stages, including both self-limited and pharmacoresistant forms. Self-limited syndromes, such as Benign Rolandic Epilepsy and Childhood Absence Epilepsy, typically have favorable outcomes, often resolving as the child matures without leading to significant long-term issues. In contrast, pharmacoresistant forms, including Lennox-Gastaut Syndrome and Dravet Syndrome, present greater treatment challenges and can result in developmental and cognitive difficulties. These conditions necessitate comprehensive management strategies to support affected children and their families (7, 8). Understanding these characteristics is essential for the effective management and treatment of childhood epilepsy.

The prevalence of childhood epilepsy varies significantly across different studies and regions. A Canadian study reported an overall prevalence of 8.1 per 1,000 live births, with notably higher rates among boys and preterm infants (9). In contrast, a pooled analysis from Africa indicated a higher burden, with a prevalence of 17.3 per 1,000 children, highlighting the challenges faced in low- and middle-income countries (10). Additionally, a study conducted in Sardinia found a lower prevalence of 2.67 per 1,000, emphasizing the geographic disparities in the burden of epilepsy (11).

Childhood epilepsy represents a significant global health concern, affecting approximately 0.5% to 1% of children worldwide. This equates to about one in every 150 children experiencing epilepsy during their first decade of life (10, 12). Recent findings suggest a prevalence of 2.3% among Iranian children, underscoring the necessity for targeted interventions (13). Furthermore, a larger population-based study reported a lifetime prevalence of 16.6 per 1,000 people, indicating that although some studies report lower rates, the overall burden of epilepsy remains substantial (14).

The prevalence and incidence rates of childhood epilepsy vary considerably based on geographical and socioeconomic factors, highlighting the need for targeted public health strategies that address the unique challenges associated with this condition in different regions (12, 15). Continued research and improved healthcare approaches are essential to tackle these disparities and enhance the management of childhood epilepsy globally.

Conducting a review study is vital for integrating the most recent articles and staying updated on the latest findings in childhood epilepsy research. By synthesizing current evidence, a review provides a comprehensive overview of existing knowledge, emphasizes recent advancements, and identifies gaps that require further investigation. This

integration ensures that new research is grounded in the latest evidence, thereby improving the development of effective treatment strategies. Additionally, a literature review helps prevent duplication of efforts by summarizing previous studies. Ultimately, such a review contributes to a deeper understanding of childhood epilepsy and enhances outcomes for affected individuals.

The study aimed to synthesize existing evidence on the global prevalence and incidence rates of epilepsy in children and adolescents while also exploring the associated risk factors.

2- MATERIALS AND METHODS

This overview includes all reviews, systematic reviews, meta-analyses, and recent research written in Persian or English that report the prevalence or incidence of epilepsy among children and adolescents under 18 years old worldwide. We searched the electronic databases of Scopus, EMBASE, Web of Science, PubMed, and Google Scholar for full-text articles without time restrictions up to May 2024. Two independent researchers conducted the search process, and any disagreements were resolved through discussion.

The search terms utilized in this study were "epilepsy," "seizure," "prevalence," "incidence," "children," "epidemiology," "global," and "worldwide," combined using the Boolean operators ‘AND’ and ‘OR.’ Data extraction was conducted independently by two reviewers using a researcher-developed template. This template captured essential information, including the author’s name, year and type of study, target population, prevalence and incidence of epilepsy, and main results.

The methodological quality of each review and systematic review was evaluated using the Assessment of Multiple Systematic Reviews (AMSTAR-2) instrument. AMSTAR-2 is a critical appraisal tool specifically designed to assess the methodological quality of systematic reviews (SRs), and meta-analyses (MAs) of healthcare interventions. This tool consists of 16 items, seven of which are considered critical for determining high-quality reviews. Each item is rated as "yes," "partial yes," "no," or "no meta-analysis conducted." Studies are categorized based on the number of "yes" answers they receive:

- High Quality: Studies with ≥13 “yes” answers
- Moderate Quality: Studies with 9–12 “yes” answers
- Low Quality: Studies with 5–8 “yes” answers
- Critically Low Quality: Studies with ≤4 “yes” answers (16-18).

The methodological quality of each retrospective cohort study was assessed using the Newcastle-Ottawa Scale (NOS), a recognized tool for evaluating non-randomized studies, including cohort and case-control studies. The NOS provides a structured approach to determine the validity and reliability of these studies. It uses a star system based on three key domains: Selection (how well study groups were chosen), Comparability (the comparability of cohorts), and Outcome (the assessment of outcomes and follow-up adequacy). Each item in the Selection and Outcome categories can earn up to one star, while Comparability can earn up to two stars. The overall quality is classified as good, fair, or poor based on the total number of stars, ensuring that the findings are credible and useful for clinical practice (19).

3- RESULTS

Finally, six related studies were included: one retrospective cohort study, two systematic reviews and meta-analyses,

one systematic analysis, and two reviews. Quality assessment using the AMSTAR-2 tool indicated that five systematic reviews were of moderate quality, while one systematic review and meta-analysis was rated as low quality and subsequently removed (13), leaving six studies for analysis. Quality assessment using the Newcastle-Ottawa Scale (NOS) tool indicated that the quality of the retrospective cohort study was good.

These studies collectively examined 344 individual studies, focusing on prevalence (six studies) and incidence (five studies). Conducted between 2005 and 2024, these systematic reviews have provided significant insights into the epidemiology of epilepsy, which remains a critical global health concern with varying prevalence and incidence rates across different regions. Key characteristics of the included studies are summarized in **Table 1** and in the following sections:

1. The systematic review from 2005 highlighted significant gaps in population-based studies across the continent, primarily focusing on data from the UK, Nordic countries, the Baltic region, and western Mediterranean countries. Notably, there was a lack of studies from large areas of former Eastern Europe and the eastern Mediterranean. The review estimated that approximately 0.9 million children and adolescents (prevalence of 4.5-5.0 per 1,000) have active epilepsy, along with 1.9 million adults aged 20-64 years (prevalence of 6 per 1,000) and 0.6 million elderly individuals aged 65 and older (prevalence of 7 per 1,000). Approximately 20-30% of individuals with epilepsy experience more than one seizure per month. The estimated annual incidence rates were around 130,000 new cases among children and adolescents (incidence rate of 70 per 100,000), 96,000 new cases in adults aged 20-64 years (incidence rate of 30 per 100,000), and 85,000 new cases in the elderly (incidence rate of 100 per 100,000). The review underscored that the distribution of both new and established cases varies significantly by country due to differences in age structure and healthcare access across Europe (20).

2. A review from 2015 highlights significant findings regarding the epidemiology of epilepsy in pediatric populations. It reveals that the incidence of epilepsy in children ranges from 41 to 187 per 100,000, with higher rates observed in underdeveloped countries, particularly during the first year of life. The prevalence is generally higher than the incidence, estimated to be between 3.2 to 5.5 per 1,000 in developed regions and 3.6 to 44 per 1,000 in developing areas. The etiology of epilepsy presents challenges, as only about one-third of affected children can be classified into specific syndromes. In developing countries, common causes include birth asphyxia and neonatal complications, while developed nations often cite brain tumors and traumatic injuries as prevalent causes. Overall, the review underscores that epilepsy is a significant global health concern among children, with notable variations influenced by geographic and socioeconomic factors. This necessitates further research to enhance prevention and treatment strategies (21).

3. The systematic analysis from 2019 for the Global Burden of Disease Study revealed that in 2016, approximately 45.9 million individuals globally had active epilepsy, with a prevalence of 621.5 per 100,000 population. Among children, the highest prevalence was observed in those aged 5-9 years, at 374.8 per 100,000. Epilepsy accounted for over 13 million disability-adjusted life years (DALYs), representing about 0.56% of total DALYs worldwide. While the age-standardized prevalence of idiopathic epilepsy showed a modest increase of around 6% from 1990 to 2016, significant improvements were

noted in mortality rates (a decrease of 24.5%), and DALY rates (a reduction of 19.4%), indicating better management and access to treatment over time. These findings highlight the ongoing burden of epilepsy among children and the need for enhanced healthcare strategies to address their specific needs (22).

4. A comprehensive overview from 2020 of the prevalence and incidence of epilepsy in children highlights that the incidence of epilepsy is highest during the first year of life, with rates declining thereafter. In children, the cumulative incidence of unprovoked seizures is notably high, with estimates indicating that approximately 60% to 70% of cases have no known cause. The overall lifetime prevalence of epilepsy is reported to be 7.60 per 1,000, with higher rates observed in low- and middle-income countries (LMIC) compared to high-income countries (HIC). Specifically, the prevalence in LMIC is 8.75 per 1,000, while in HIC it is 5.18 per 1,000. The study also discusses significant risk factors associated with pediatric epilepsy, including socioeconomic status and demographic variations. It notes that children from deprived backgrounds and those with a history of central nervous system infections or traumatic brain injuries are at increased risk. Furthermore, the findings emphasize the need for improved healthcare access and tailored interventions to address these disparities in epilepsy management among children (23).

5. A systematic review and meta-analysis from 2024 on epilepsy among children and adolescents in Africa revealed significant findings regarding its prevalence and incidence. The pooled prevalence of cumulative epilepsy was found to be 17.3 per 1,000 children, with active epilepsy at 6.8 per 1,000 and lifetime epilepsy at 18.6 per 1,000. The pooled incidence stood at 2.5 per 1,000 children, indicating that nearly one in 50 children in Africa suffers from this condition. The analysis highlighted that the incidence of childhood epilepsy is notably higher in low- and middle-income countries compared to high-income countries, primarily due to factors such as infectious diseases, perinatal injuries, and limited access to healthcare resources. The study emphasizes the urgent need for mass screening, improved treatment access, and effective follow-up care to address the stigma and healthcare gaps affecting children with epilepsy in the region (10).

6. A retrospective cohort study from 2024 investigates the prevalence of epilepsy among children born in Ontario, Canada, from 2002 to 2020. Analyzing data from over 2.3 million births, the study found an overall prevalence rate of 8.1 per 1,000 live births. It revealed that boys, preterm infants, and children with congenital malformations had higher rates of epilepsy. Additionally, the prevalence increased slightly over time, from 6.9 per 1,000 in the 2002 birth cohort to 7.3 per 1,000 in the 2012 cohort. These findings highlight significant disparities in epilepsy prevalence based on demographic and socioeconomic factors (9).

Table 1: Summary of included Studies on Epilepsy Prevalence and Incidence across Populations.

Author, study year, Reference	Type of study	Focus	Population	Prevalence per 1000	Incidence per 100,000	Quality Rating	Main results
Forsgren et al., 2005, (20)	Systematic review	Epidemiology of epilepsy in Europe	Children and adolescents	4.5-5.0	70	Moderate (AMSTAR-2)	Estimated 0.9 million children with active epilepsy; significant gaps in studies from Eastern Europe and the eastern Mediterranean; 20-30% experience multiple seizures monthly.
Camfield et al., 2015, (21)	Review	Epidemiology of epilepsy in pediatric populations	Children	3.2-5.5 (developed), 3.6-44 (developing)	N/A	Moderate (AMSTAR-2)	Incidence ranges from 41 to 187 per 100,000; higher rates observed in underdeveloped countries; challenges in etiology classification; common causes vary by region.
Beghi et al., 2019, (22)	Systematic analysis	Global Burden of Disease	General population	621.5	N/A	Moderate (AMSTAR-2)	Approximately 45.9 million individuals globally had active epilepsy in 2016; significant improvements in mortality and DALY rates over time; highest prevalence among children aged 5-9 years.
Beghi et al., 2020, (23)	Review	Global Prevalence and Incidence	General population	3.5-10.7	~61.4	Moderate (AMSTAR-2)	Lifetime prevalence varies globally; higher rates in low- and middle-income countries (LMICs) due to perinatal risks and infections; socioeconomic factors influence epidemiological patterns.
Biset et al., 2024, (10)	Systematic review and meta-analysis	Epilepsy among children and adolescents in Africa	Children	6.8 (active), 17.3 (cumulative), 18.6 (lifetime)	2.5	Moderate (AMSTAR-2)	Nearly one in 50 children in Africa suffers from epilepsy; higher incidence in LMICs due to infectious diseases and limited healthcare access; urgent need for mass screening and effective follow-up care.
Driollet et al., 2024, (9)	Retrospective cohort study	Prevalence of Epilepsy	Children	8.1	N/A	Good (NOS)	Analyzed data from over 2.3 million births; higher prevalence in boys, preterm infants, and those with congenital malformations; prevalence increased from 6.9 per 1,000 in the 2002 cohort to 7.3 per 1,000 in the 2012 cohort; highlights disparities based on demographic factors.

NOS: Newcastle-Ottawa Scale, AMSTAR-2: Assessment of Multiple Systematic Reviews.

4- DISCUSSION

This overview aims to synthesize evidence on the global prevalence and incidence rates of epilepsy in children and adolescents, along with associated risk factors. The epidemiology of epilepsy has been the subject of numerous systematic reviews and meta-analyses over the past two decades, revealing significant variations in prevalence and incidence rates across different regions. A systematic

review from 2005 highlighted that approximately 0.9 million children and adolescents in Europe have active epilepsy, with notable gaps in data from Eastern Europe and the eastern Mediterranean. The review estimated a prevalence of 4.5 to 5.0 per 1,000 among children and adolescents, 6 per 1,000 among adults aged 20 to 64, and 7 per 1,000 in the elderly (20). These figures underscore the variability in reported cases due to differences in healthcare access and demographic factors across countries.

Subsequent studies have focused on pediatric populations, revealing an incidence of epilepsy in children ranging from 41 to 187 per 100,000, particularly high in underdeveloped countries during the first year of life. A 2015 review indicated that while the prevalence is generally higher than the incidence—estimated between 3.2 and 5.5 per 1,000 in developed regions—many cases remain unclassified due to complex etiologies (21). In contrast, a comprehensive overview from 2020 reported a lifetime prevalence of 7.60 per 1,000, with lower rates in high-income countries compared to low- and middle-income countries (LMIC), where social determinants significantly influence outcomes (23).

Recent findings from Africa (2024) revealed a pooled prevalence of 17.3 per 1,000 children, with an active epilepsy rate of 6.8 per 1,000, highlighting the urgent need for improved healthcare access and resources in low- and middle-income countries (LMICs), where infectious diseases and perinatal injuries are prevalent causes (10). Additionally, a study conducted in Canada found a prevalence rate of 8.1 per 1,000 live births, emphasizing demographic disparities based on factors such as gender and birth conditions (9). Collectively, these studies illustrate that while progress has been made in managing epilepsy, there remains a critical need for targeted interventions and further research to address the ongoing challenges faced by affected populations globally.

A systematic review conducted in 2014 on the epidemiology of epilepsy revealed significant insights into the prevalence and incidence of this neurological disorder across different regions. This study highlighted substantial regional variations within Iran, showing a prevalence rate of 5% in central Iran, while northern Iran reported a notably lower rate of 1%, and eastern Iran had a prevalence of 4% (2).

Research spanning nearly two decades highlights that epilepsy is a significant global health concern, with notable variations influenced by geographic and socioeconomic factors. Despite improvements in management and treatment access over time, there remains an urgent need for enhanced healthcare strategies tailored to address the specific needs of diverse populations affected by this condition. The World Health Organization emphasizes the importance of coordinated action to ensure that individuals with epilepsy have access to necessary care and treatment, advocating for investment in reducing its burden and addressing knowledge gaps in epilepsy care and research (24). These findings underscore the critical need for continued research efforts aimed at improving prevention strategies and treatment access globally (25). Approximately 80% of people with epilepsy live in low- and middle-income countries, where a significant treatment gap exists, leading to poor health outcomes (26).

This gap is exacerbated by factors such as limited healthcare resources, cultural beliefs, and social stigma, which hinder timely diagnosis and treatment. In high-income countries, even newly diagnosed patients often experience delays in receiving appropriate care. Addressing these disparities is vital for improving outcomes for affected individuals

worldwide (9, 26, 27). Overall, while significant strides have been made in understanding the epidemiology of epilepsy, ongoing research is essential to fill existing gaps, particularly in underserved regions. Developing targeted public health interventions can effectively reduce the global burden of this condition, ensuring that all individuals with epilepsy receive the care they need to lead healthier lives (23, 28-30).

5- CONCLUSION

Approximately 0.9 million children and adolescents in Europe have active epilepsy, with a prevalence rate of 4.5 to 5.0 per 1,000. In Africa, the cumulative prevalence is significantly higher at 17.3 per 1,000 children, with an active epilepsy rate of 6.8 per 1,000. These rates vary regionally; in developed areas, prevalence ranges from 3.2 to 8.1 per 1,000, while in developing regions, it can reach as high as 3.6 to 44 per 1,000. The highest prevalence globally occurs in children aged 5 to 9 years, estimated at approximately 374.8 per 100,000. This data highlights the substantial burden of epilepsy among children and the urgent need for targeted public health strategies.

The estimated annual incidence rate for children and adolescents in Europe is about 130,000 new cases, or approximately 70 per 100,000. Incidence rates in children can range from 41 to 187 per 100,000, with notably higher rates in underdeveloped countries during the first year of life. Common causes of epilepsy differ by region; developing countries often cite birth asphyxia, neonatal complications, and infectious diseases, while developed nations report brain tumors and traumatic injuries as prevalent causes. Socioeconomic factors significantly influence these incidence rates, resulting in higher prevalence in low- and middle-income countries (LMICs) due to limited healthcare access and increased exposure to risk factors. Understanding these patterns is crucial for developing effective prevention and treatment strategies tailored to specific populations.

6- CONFLICT OF INTEREST: None.

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