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ABSTRACT

of the dissertation for the degree of
Doctor of Philosophy

EPIDEMIOLOGY, CLINICAL CHARACTERISTICS AND SOCIAL ASPECTS OF EPILEPSY IN THE CITY OF GANJA

Specialty: 3223.01- "Neurological Diseases"

Field of science: Medical Sciences

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INTRODUCTION

Relevance of the research. Epilepsy is a chronic neurological disorder characterised by variations in its clinical manifestations, aetiology and response to treatment.[1,2] Recurrent seizures may affect patients' daily activities, education, employment and social relationships.[3,4] Research on epilepsy should therefore extend beyond the clinical characteristics of seizures to encompass age, sex, aetiological and social factors. Such a comprehensive approach enables a more accurate assessment of patients' needs and supports the organisation of medical care.

The frequency of recorded epilepsy cases and the distribution of its clinical forms may change over time. These changes may be associated with population demographics, access to medical services, the use of diagnostic methods and patient registration practices. Comparing indicators from different periods is therefore important for understanding the epidemiological profile of the disorder. At the same time, the reasons for an increase in recorded cases should be interpreted cautiously, as improved diagnosis and the identification of previously undetected cases may also influence this indicator. A comparative study of data from Ganja for 2005–2009 and 2019–2023 is particularly relevant in this context.

Analysis of epilepsy across age groups is particularly important[5]. Seizures arising in childhood and adolescence may affect patients'

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education and their families' daily lives. Timely recognition of seizures, accurate determination of seizure type and specialist follow-up are essential for subsequent treatment[6]. Examining the distribution of focal and generalised epilepsy across age and sex groups may also help identify the groups that should be prioritised in early detection initiatives[7].

Investigating the aetiological characteristics of the disorder further underscores the relevance of this topic. Assessing the proportions of cases associated with genetic and structural factors, as well as cases of unknown aetiology, reveals the characteristics of epilepsy in the local patient population[8]. Joint analysis of family history and clinical examination findings enables more targeted patient follow-up[9]. Furthermore, the presence of cases with an unknown aetiology highlights the importance of continuing diagnostic evaluation[10].

Analysis of electroencephalographic (EEG) findings and treatment outcomes in patients with epilepsy also has considerable practical importance. Evaluating EEG data alongside clinical manifestations provides a more complete diagnostic picture.[11,12]

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Investigating the relationship between antiseizure medication use, blood drug concentrations and seizure frequency provides information on treatment response. Comprehensive analysis of these indicators may support the planning of individualised patient care[13].

The social aspects of epilepsy also require attention. Information on patients' employment status, educational attainment and marital status helps to identify the difficulties they face in daily life and their support needs.[14,15] Examining social indicators alongside clinical data is useful for planning awareness initiatives and measures to support social adaptation.

Thus, a comparative analysis of data from 650 patients with epilepsy registered in Ganja during two five-year periods is relevant from both scientific and practical perspectives. The study enables the distribution of epilepsy by age and sex, its clinical forms and aetiology, EEG and treatment indicators, and social characteristics to be assessed within a single framework.

The findings may provide a basis for improving early diagnosis, clinical follow-up, treatment and social support measures at the local level.

Study population and research subject. The study population consisted of patients with epilepsy living in Ganja who were registered during 2005–2009 and 2019–2023. The research subject was the analysis of the epidemiological indicators, clinical characteristics and social aspects of epilepsy. Patients underwent clinical, instrumental and laboratory examinations, and additional social surveys were conducted.

Aim of the study. The aim was to study the epidemiological indicators and clinical and social characteristics of epilepsy among the population of Ganja in order to facilitate improvements in treatment outcomes.

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Objectives of the study

1. To assess the prevalence and incidence of epilepsy in the population of Ganja, taking sex and age into account;
2. To analyse the prevalence and clinical indicators of epilepsy in Ganja based on registration data for 2005–2009 and 2019–2023;
3. To compare the findings of the epidemiological and clinical investigations and identify the factors influencing them;
4. To investigate seizure frequency and severity during antiseizure therapy using patients' follow-up records.

Research methods. The study was conducted at the Department of Neurology of Azerbaijan Medical University (AMU) using a unified protocol developed in accordance with the guidance on epidemiological studies of epilepsy issued by the Commission on Epidemiology and Prognosis of the International League Against Epilepsy (ILAE). The study involved patients with epilepsy in the population of Ganja. In the comprehensive clinical and epidemiological investigation, interviews were used to complete a specially designed observation form for each patient, together with general physical and neurological examinations. The course of epilepsy was assessed, and epilepsy and epilepsy syndromes were diagnosed according to the international classification of the ILAE. The epidemiological methods included complete statistical enumeration, door-to-door surveys and registration of cases presenting for medical care. The study also employed electrophysiological methods, including electroencephalography, and neuroimaging methods, including computed tomography and magnetic resonance imaging.

All data were coded and entered into a dedicated statistical form. Statistical processing was performed using the MS Excel 2019 spreadsheet application and the SPSS 26 statistical package, with discriminant analysis methods. Associations between qualitative characteristics in the selected groups were investigated through frequency analysis. For dichotomous variables (presence or absence of a characteristic), comparisons were conducted using Pearson's χ^2 test for tetrachoric (2×2) tables; for multi-cell tables with more than two categories, Pearson's χ^2 test for polychoric tables was used. Yates' correction was applied when the number of observations in any cell of a contingency table was less than 4. To evaluate the epidemiological indicators, clinical characteristics and social aspects of epilepsy in Ganja over the past 20 years, population rates for epilepsy types,

syndromes and other categories were compared for 2005–2009 and 2019–2023. These rates were calculated per 100,000 population, together with their standard errors, and compared using Student's t-test. In all analyses, the null hypothesis was rejected when $p < 0.050$.

Main Provisions Submitted for Defence

1. The prevalence and incidence of epilepsy in the population of Ganja and their differences by age and sex;
2. The frequency of the clinical forms of epilepsy and their social consequences;
3. The effectiveness of modern antiseizure therapy and long-term remission rates;
4. The importance of epidemiological data in organising medical and social care for patients with epilepsy.

Scientific novelty of the research

1. For the first time, we conducted a study of epilepsy in Ganja, Republic of Azerbaijan.
2. Against the background of the prevalence of non-communicable diseases in the country, a clinical and epidemiological investigation of epilepsy was conducted in accordance with international ILAE recommendations. Standardised estimates of epilepsy prevalence and incidence in the population of Ganja were obtained and compared by sex and age. The frequency of specific clinical forms and their risk factors were investigated within a contemporary conceptual framework.
3. For the first time, the study established a statistically significant relationship between blood concentrations of newer-generation antiseizure medications and seizure frequency. This finding scientifically demonstrates the greater reliability of blood concentrations of newer-generation antiseizure medications as biomarkers for therapeutic monitoring.

Theoretical and practical significance of the research. The findings will provide a scientific basis for planning and organising epilepsy care in Ganja. The data obtained will be used to establish an effective system for registering patients with epilepsy and to improve treatment and social rehabilitation opportunities.

Dissemination and implementation. The findings were presented at scientific and practical conferences and published in journals recommended

by the Higher Attestation Commission under the President of the Republic of Azerbaijan. The results may be applied in neurological and public health practice.

Institution where the dissertation was completed. The dissertation research was conducted at the Department of Neurology of Azerbaijan Medical University.

Material and technical resources. The study was conducted at the Department of Neurology of AMU using a unified protocol (2017) developed in accordance with the guidance on epidemiological studies of epilepsy issued by the Commission on Epidemiology and Prognosis of the ILAE.

Length of the dissertation sections and total length

The dissertation comprises 176 pages and consists of an introduction, five chapters, a summary, conclusions and practical recommendations. It contains 42 tables and 10 figures. The character counts of the individual sections are as follows: introduction, 12,281; Chapter I – (68,530); Chapter II – (10,848); Chapter III – (97,013); Chapter IV – (5,894); Chapter V – (12,232); summary – (25,454); conclusions – (1,252); and practical recommendations – (1,365). The bibliography contains 284 sources: 15 in Azerbaijani, 1 in Turkish, 24 in Russian and 244 in English. The total length of the dissertation is 214,869 characters.

MATERIALS AND METHODS

The study was analytical in design, clinical in approach, comprehensive in scope, scientific in nature, based on retrospective and prospective data, cross-sectional in duration, and clinic-based in setting.

The aim was to investigate the epidemiological indicators of epilepsy in the population of Ganja and the clinical and social characteristics of patients with epilepsy in order to improve their treatment outcomes.

The study population comprised patients with epilepsy living in Ganja. Clinical, instrumental and laboratory examinations and treatment were planned for the patients. Groups were defined according to age, sex, clinical form and disease course, and opportunities to reduce the medical and social burden were assessed on the basis of the significance of between-group differences.

In the studies conducted in Ganja during 2005–2009 and 2019–2023, the clinical method was based primarily on comprehensive history-taking, structured neurological examination and retrospective analysis of patient records. A total of 650 patients with epilepsy were included. Most patients were studied retrospectively. In addition, to obtain a more accurate assessment of the population distribution of epilepsy and patients' clinical and demographic characteristics, 20 patients were identified through a door-to-door epidemiological survey, and 285 patients were enrolled through prospective observation. The study therefore combined retrospective and prospective approaches with active epidemiological case-finding, enabling a more objective and comprehensive assessment of the clinical, aetiological and social characteristics of epilepsy. Data were collected primarily from outpatient and inpatient records. Standardisation of clinical protocols and the expansion of electronic registration systems improved the quality and completeness of patient histories and clinical data. This development provided an important basis for comparing the retrospective and prospective analyses. Ethical approval for the dissertation research was granted by the Ethics Committee of Azerbaijan Medical University under Protocol No. 39, dated 14 March 2025 (see appendices).

EEG was the principal method of neurophysiological assessment. Standard EEG was predominantly used in 2005–2009, whereas the increased use of long-term monitoring and video-EEG in 2019–2023 improved the accuracy of distinguishing focal from generalised epileptiform abnormalities. Although additional ancillary investigations, such as EEG–MRI correlation and metabolic screening, were reported in some studies, regional resource constraints limited their widespread use.

The data were coded, entered into a dedicated statistical form and processed in MS Excel 2019 and SPSS 26 using discriminant analysis methods. Associations between qualitative characteristics were assessed through frequency analysis. Comparisons were performed using Pearson's χ^2 test for tetrachoric tables in dichotomous situations and for polychoric tables in multi-cell situations. Yates' correction was applied when the number of observations in a table cell was less than 4.

In selected patients, blood concentrations of antiseizure medications were also determined from venous blood samples using standard laboratory methods. The relationship between drug concentration and seizure frequency was evaluated using graphical analysis, correlation analysis and second-

degree polynomial regression models. Model fit was assessed using the coefficient of determination, R^2.

RESULTS AND DISCUSSION

Comparative analysis of the age and sex distribution of patients with epilepsy registered in Ganja

A total of 322 patients were studied in the analyses conducted for 2005–2009: 187 were male (58.1%) and 135 were female (41.9%). Although males predominated overall, the difference was not pronounced. Analysis by age group showed that the proportion of males was particularly high in the 10–14-year (64.7%), 15–19-year (64.9%) and 20–29-year (64.7%) groups. The age groups in which females predominated were mainly those aged 30–39 years (50.0%) and 40–49 years (57.1%).

A total of 328 patients were examined in the analyses for 2019–2023: 173 were male (52.7%) and 155 were female (47.3%). Males predominated overall. Females predominated in the 30–39-year (65.4%), 40–49-year (57.9%) and 50–59-year (71.0%) age groups.

Thus, compared with 2005–2009, the age distribution by sex in 2019–2023 exhibited more dynamic and varied patterns (Figure 1).

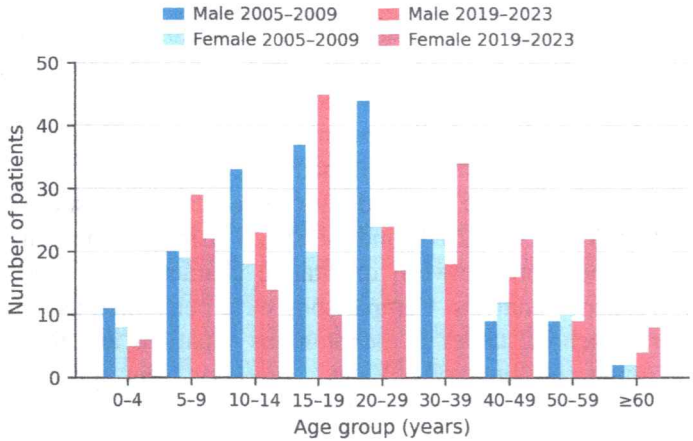


Figure 1. Comparative analysis by sex and age group of patients with epilepsy registered in Ganja in 2005–2009 and 2019–2023 (sex: $\chi^2 = 1.869$, $p = 0.172$; age groups: $\chi^2 = 25.076$, $p = 0.002$).

Comparative analysis of changes in age distribution within each sex

Differences across age groups within each sex were also investigated. Analysis of the tables for the two periods showed that, in 2005–2009, the age distribution did not differ significantly between males and females: $\chi^2(8) = 8.160$, $p = 0.418$. This finding confirms that the relative age-group proportions within the male (n = 187) and female (n = 135) columns were similar.

In contrast to the earlier period, the association between age group and sex observed in 2019–2023 was statistically significant: $\chi^2(8) = 38.492$, $p < 0.001$. This indicates that the age structure had begun to vary by sex, with different epidemiological patterns emerging for males and females at different stages of life.

Clinical and epidemiological trends among patients with epilepsy in Ganja

Comparison of the groups for 2005–2009 and 2019–2023 reveals clear changes by age and sex across different epilepsy types among patients registered in Ganja. In 2005–2009, the total number of patients with focal epilepsy was 208, comprising 113 males and 95 females. The largest number of cases occurred in the 20–29-year age group (47 patients), followed by the 30–39-year group (38 patients) and the 15–19-year and 10–14-year groups (34 patients each). There were 7 cases in the 0–4-year group and 4 cases in the group aged ≥60 years.

In 2019–2023, the total number of patients with focal epilepsy was 174, comprising 90 males and 84 females. The highest frequency was observed in the 30–39-year age group (36 patients), followed by the 15–19-year (31 patients) and 20–29-year (23 patients) groups. A decrease was recorded in children aged 0–4 years, while a very small increase was observed in patients aged ≥60 years.

In 2005–2009, generalised epilepsy was observed in a total of 31 patients: 20 males and 11 females. Most cases were recorded in the 15–19-year age group (7 patients), followed by the 5–9-year and 0–4-year groups (5 and 2 patients, respectively). In 2019–2023, the number of generalised epilepsy cases increased to 86, comprising 46 males and 40 females, with the male–female difference persisting as in the earlier period.

The combined type was identified only in the 2019–2023 group, with a total of 2 recorded cases, indicating that this type had not been registered in the earlier period.

There were 7 cases of unspecified epilepsy in 2005–2009, increasing to 19 in 2019–2023. In the age-group distribution, this increase was most prominent in the 15–19-year and 40–49-year groups. The analyses for 2005–2009 revealed differences in prevalence according to the proportions of symptomatic and idiopathic forms. A broadly similar trend was observed in the results for 2019–2023. Temporal localisation predominated in both periods, with a particularly notable increase in recent years, from 51.0% to 60.9%.

Population rates were compared for patients with focal and generalised epilepsy registered in 2005–2009 and 2019–2023.

In 2019–2023, the overall rate of generalised epilepsy increased substantially to 5.2 patients per 100,000 population. This increase may reflect both the expansion of diagnostic capabilities and changes in the true prevalence of the disorder.

Comparative analysis of the age and sex distribution of patients with epilepsy by seizure type

The distribution of seizure types among patients with epilepsy in Ganja was analysed for 2005–2009. Patients were grouped according to focal, generalised and unclassified seizures. The largest number of patients with seizures was recorded in the 20–29-year age group: 68 patients in total (21.1%), including 47 with focal seizures (22.3%), 18 with generalised seizures (17.6%) and 3 with unclassified seizures (33.3%).

Analysis by sex for 2005–2009 identified focal seizures in 116 males (55.0%), generalised seizures in 66 males (64.7%) and unclassified seizures in 5 males (55.6%). The corresponding figures for females were 95 (45.0%), 36 (35.3%) and 4 (44.4%), respectively. However, the difference between the sexes was not statistically significant ($\chi^2 = 2.698$, $p = 0.260$).

In 2019–2023, patients with epilepsy were likewise grouped according to focal, generalised and unclassified seizures in accordance with the ILAE classification. The highest number of focal seizure cases was observed in the 30–39-year age group (38 patients, 20.0%),

whereas generalised seizures were most common in the 5–9-year group (27 patients, 23.1%). Unclassified seizures were recorded most frequently in the 15–19-year group (6 patients, 28.6%). Generalised seizures predominated in early childhood (0–4 years), while both focal and generalised seizures were observed in the older population (≥60 years).

Distribution of epilepsy syndromes by sex and age

Comparative analysis of 2005–2009 and 2019–2023 revealed significant changes in the age-group distribution of epilepsy syndromes. In particular, the genetic epilepsy with febrile seizures plus (GEFS+) spectrum was more prevalent in the first period, predominantly affecting the 0–4-year (24.0%), 5–9-year (32.0%) and 10–14-year groups (7 patients, 28%). These age groups accounted for 84% of all cases. In 2019–2023, however, the genetic epilepsy with febrile seizures plus (GEFS+) spectrum declined sharply to only 4 cases, all recorded in children aged 0–4 years.

The proportion of Rolandic epilepsy increased substantially. It accounted for only 6.6% of all syndromes in 2005–2009, whereas this figure reached 21.3% in 2019–2023.

The proportion of Lennox–Gastaut syndrome was 9.2% in 2005–2009 and 14.9% in 2019–2023. Juvenile absence epilepsy (JAE) showed a modest increase.

Temporal lobe epilepsy was not recorded in 2005–2009 but accounted for 12.8% of all cases in 2019–2023.

Male predominance persisted in both periods.

The emergence of temporal lobe epilepsy syndrome in the records of the later period is associated with the introduction of high-sensitivity MRI, PET and other functional imaging technologies into clinical practice.

The role of heredity in patients with epilepsy in Ganja

The literature indicates that the causes of this disorder are diverse and complex, with brain injury, infections, structural abnormalities, metabolic changes and genetic factors playing important roles.

Medical records from 650 patients with epilepsy who attended various medical institutions in Ganja during 2005–2009 and 2019–2023 were analysed retrospectively. Family history was classified into

four categories: no family history of epilepsy; epilepsy in first-degree relatives; epilepsy in second-degree relatives; and epilepsy in third-degree relatives. According to the data for 2005–2009, 65.2% of patients had no recorded family history of epilepsy. Epilepsy in first-degree relatives was reported in 20.2% of patients, in second-degree relatives in 8.1%, and in third-degree relatives in 6.5%. Epilepsy in first-degree relatives was reported by 23.5% of male patients and 15.6% of female patients.

The findings for 2019–2023 indicate certain changes. The proportion of patients without a family history decreased to 54.9%, while the proportion with epilepsy in first-degree relatives increased to 29.6%. The corresponding figures were 14.3% for second-degree relatives and 1.2% for third-degree relatives. Comparison by sex showed that epilepsy in first-degree relatives was recorded in 26.6% of male patients and 32.9% of female patients. Statistical analysis showed that the differences were not significant ($\chi^2 = 4.426$, $p = 0.219$).

Thus, an increase in the proportion of patients with a positive family history was recorded in recent years, particularly in 2019–2023. The increased frequency of epilepsy in first- and second-degree relatives may be associated with greater attention to genetic factors, advances in genetic diagnosis and improvements in the quality of history-taking.

Comparative analysis of neurological examination findings in patients with epilepsy

Neurological examination findings were studied in 322 patients with epilepsy observed in Ganja during 2005–2009, with analysis by age, sex and clinical neurological signs.

Statistical analysis showed that increased reflexes were more frequent in 2019–2023, and this difference was statistically significant ($\chi^2 = 5.336$, $p = 0.021$). Although differences were observed in other signs, they were not considered statistically significant ($p > 0.05$).

Distribution of EEG abnormalities by age and sex in the patients with epilepsy studied

EEG findings in patients with epilepsy registered in 2005–2009 and 2019–2023 were analysed by age group. EEG abnormalities were

grouped into four main categories: normal EEG, mild diffuse abnormalities, attenuation of background activity, and regional or generalised epileptiform activity. The age-group distribution of EEG abnormalities showed different patterns in the two periods when assessed against the total patient population.

The EEG findings in the study material were also classified into three main categories—normal, borderline and pathological—and compared between 2005–2009 and 2019–2023. Pathological EEG findings accounted for the largest proportion of the overall observation material. This indicates that electroencephalographic abnormalities were common in patients diagnosed with epilepsy and that epileptiform activity in neuronal networks played an important role.

The results showed that the distribution of normal, borderline and pathological EEG findings remained similar in both periods, with pathological findings predominating. This further confirms the widespread occurrence of electroencephalographic abnormalities in patients with epilepsy and the diagnostic importance of EEG examination.

COMPARATIVE ANALYSIS OF DEMOGRAPHIC AND SOCIAL INDICATORS IN PATIENTS WITH EPILEPSY

Comparative analysis of marital status in patients with epilepsy aged over 18 years

Epilepsy is a complex condition closely associated not only with medical problems but also with patients' social adaptation, employment and quality of life. Investigating the sociodemographic characteristics of patients with epilepsy is therefore important for interpreting clinical outcomes and planning social rehabilitation. For this purpose, the marital status, employment status and educational attainment of patients aged over 18 years who were included in the study were compared across two periods: 2005–2009 and 2019–2023. This approach enables an assessment of possible changes over time in the social profile of patients with epilepsy.

Table 1. Comparative analysis of social and demographic indicators in patients with epilepsy aged over 18 years registered in different periods.

Social and demographic indicators		2005–2009		2019–2023		Total	
		n	%	n	%	n	%
Marital status	Married	84	48.6%	108	56.5%	192	52.7%
	Single	89	51.4%	83	43.5%	172	47.3%
Employment	Employed	63	36.4%	46	24.1%	109	29.9%
	Not employed	110	63.6%	145	75.9%	255	70.1%
Education	None	0	0.0%	0	0.0%	0	0.0%
	Secondary / secondary vocational	149	86.1%	175	91.6%	324	89.0%
	Higher	24	13.9%	16	8.4%	40	11.0%

Note: marital status, $\chi^2 = 2.325$, $p = 0.127$; employment status, $\chi^2 = 6.581$, $p = 0.01$; educational attainment, $\chi^2 = 2.803$, $p = 0.094$. χ^2 is a measure of the difference between groups; p is the probability that the difference is due to chance.

Analysis of marital status showed that, among patients registered in 2005–2009, 84 (48.6%) were married and 89 (51.4%) were single. In 2019–2023, 108 married patients (56.5%) and 83 single patients (43.5%) were registered. When data from both periods were combined, a total of 192 patients (52.7%) were married and 172 (47.3%) were single (Table 1).

Comparative analysis of employment status in patients with epilepsy aged over 18 years

Participation in employment is one of the principal indicators of social integration among patients with epilepsy. Analysis of employment status showed that, in 2005–2009, 63 patients (36.4%) were employed and 110 (63.6%) were not employed. In 2019–2023, 46 employed patients (24.1%) and 145 patients who were not employed (75.9%) were registered. When the results from both periods were combined, 109 patients (29.9%) were employed and 255 (70.1%) were not employed (Table 1).

Comparative analysis of educational attainment in patients with epilepsy aged over 18 years

The analysis showed that no patients without formal education were recorded in either period. In 2005–2009, 149 patients (86.1%) had secondary or secondary vocational education and 24 (13.9%) had higher education. In 2019–2023, 175 patients (91.6%) had secondary or secondary vocational education and 16 (8.4%) had higher education. The combined results for both periods showed that 324 patients (89.0%) had secondary or secondary vocational education and 40 (11.0%) had higher education (Table 1).

The findings confirm the importance of both medical and social rehabilitation for patients with epilepsy. Developing social programmes, increasing public awareness and providing suitable working conditions may contribute substantially to improving the quality of life of people living with epilepsy.

ONTEMPORARY APPROACHES TO TREATMENT WITH ANTISEIZURE MEDICATIONS

Statistics on antiseizure medication treatment among patients with epilepsy registered in Ganja in 2005–2009 and 2019–2023 are presented in Figure 2.

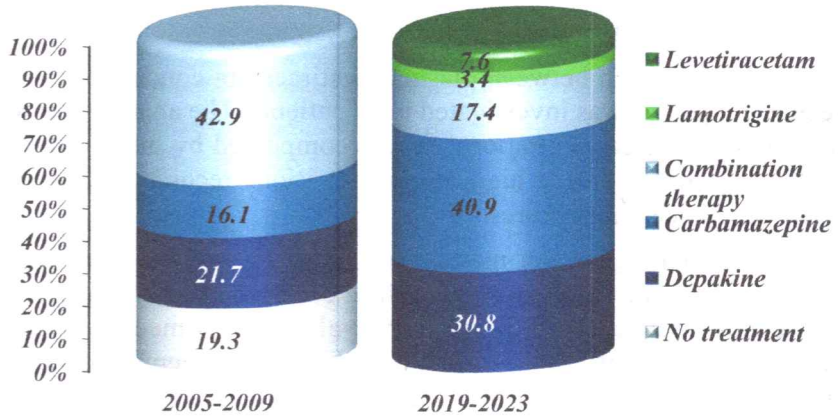


Figure 2. Treatment of patients with epilepsy registered in 2005–2009 and 2019–2023.

Analysis of the relationship between blood concentrations of Depakine and seizure frequency in 22 patients showed that an increase in drug concentration was not invariably accompanied by a reduction in seizures.

In 2019–2023, the relationship between carbamazepine concentration and seizure frequency was analysed in 28 patients. Drug concentrations in patients with infrequent seizures were generally stable and within the therapeutic range.

Overall, the findings indicated the absence of a direct linear relationship between plasma carbamazepine concentration and seizure frequency and highlighted the importance of individualised treatment approaches.

No statistically significant correlation was found between plasma drug concentration and seizure frequency during treatment with either Depakine or carbamazepine. However, the relationship between blood concentrations of newer-generation antiseizure medications and seizure frequency was investigated separately in some patients, yielding noteworthy findings.

For this purpose, the relationship between lamotrigine concentration and seizure frequency was examined in 11 patients. The findings showed that, at higher drug concentrations, seizures were either absent or infrequent.

The relationship between plasma levetiracetam concentration and seizure frequency was investigated in 25 patients. The analysis showed that higher drug concentrations were accompanied by more effective seizure control, with the highest concentrations recorded in patients who experienced no seizures.

Polynomial regression models (R^2 = 0.69–0.90) showed that a large proportion of the variation in drug concentration was explained by seizure frequency. The high R^2 values confirmed the strong predictive value of the models. The downward-opening parabolic shape of the regression curve indicated that a reduction in drug concentration beyond a critical point was accompanied by a sharp increase in seizure frequency.

The correlation observed between plasma concentrations of newer-generation antiseizure medications, such as lamotrigine and levetiracetam, and seizure frequency warranted more detailed statistical analysis. Regression analysis was therefore used to investigate the relationship between the variables.

Analysis of the results revealed a statistically significant, non-linear relationship between plasma drug concentration and seizure frequency. This relationship was assessed using a second-degree polynomial regression model and expressed by the following equation:

$$y = -1.5417x^2 - 3.2083x + 16.75$$

with a coefficient of determination of

$$R^2 = 0.6929.$$

The model showed that approximately 69% of the variation in plasma drug concentration was explained by seizure frequency, confirming the model's moderate-to-high predictive power and the significant effect of drug concentration on seizure frequency.

The relationship between plasma levetiracetam concentration and seizure frequency was analysed using a second-degree polynomial regression model.

The equation of the polynomial trend line was

$$y = -7.8167x^2 - 3.5167x + 48.5$$

with a coefficient of determination of $R^2 = 0.9058$.

These results provide strong quantitative confirmation of the relationship. The negative quadratic term in the regression model ($-7.8167x^2$) indicates that drug concentration declines rapidly as seizure frequency increases and that a non-linear inverse relationship exists between the variables. An R^2 value above 0.90 shows that the model explains approximately 90% of the variation in drug concentration through seizure frequency, confirming a strong statistical association.

Conversely, the persistence of seizures despite high therapeutic concentrations requires consideration of drug resistance, genetic variation and coexisting comorbid factors. In such cases, reassessment of the treatment strategy is considered necessary.

SUMMARY

The clinical and epidemiological study enabled a comprehensive assessment of the prevalence and clinical characteristics of epilepsy and the factors influencing it among the population of Ganja. Comparative analysis of 2005–2009 and 2019–2023 identified changes in the epidemiological indicators of epilepsy and their possible causes.

The findings showed that epilepsy was more frequently observed in children and adolescents in both periods, highlighting the importance of early diagnosis and preventive measures. Analysis by sex revealed an increasing trend in generalised epilepsy among males and an increase among females in almost all age groups. The comparative analysis demonstrated a particularly marked increase in the prevalence of generalised epilepsy. This increase may be associated not only with changes in the true prevalence of the disorder but also with expanded diagnostic capabilities, improvements in registration systems and the use of modern investigations such as EEG and MRI.

The findings showed that epilepsy is associated with social and genetic factors as well as biological mechanisms. Employment status, educational attainment and marital status were found to have a significant influence on patients' social adaptation and quality of life. Analysis of family history confirmed the important role of genetic factors in the aetiology of epilepsy.

Evaluation of the effectiveness of antiseizure therapy showed a statistically significant relationship between drug concentration and seizure frequency in patients treated with newer-generation medications. These findings further confirm the importance of individualised therapy and therapeutic monitoring in clinical practice.

A total of 650 patients with epilepsy were analysed. Males accounted for 55.4% of patients and females for 44.6%. Aetiologically, genetic factors and structural abnormalities were the principal causes of epilepsy: a genetic aetiology was identified in 40.2% of patients and a structural aetiology in 38.3%. Cases of unknown aetiology accounted for 19.7%.

According to the clinical classification, focal epilepsy predominated in the majority of patients. By epilepsy type, focal epilepsy accounted for 72.5% and generalised epilepsy for 22.2%. Among focal epilepsies, the symptomatic form predominated, accounting for 94.8%. In terms of localisation, temporal lobe lesions were recorded most frequently. Focal seizures also ranked first by seizure type, accounting for 61.7%, followed by generalised seizures at 33.7% and unclassified seizures at 4.6%.

The EEG findings indicated a high frequency of functional brain abnormalities in patients with epilepsy. Overall, EEG findings were normal in 33.1% of patients, borderline in 22.6% and pathological in 44.3%.

Treatment data showed that 30.0% of patients received combination therapy, 28.6% received carbamazepine and 26.3% received Depakine. Patients receiving no treatment accounted for 9.5%. The use of modern antiseizure medications, including lamotrigine and levetiracetam, was comparatively limited. In the 2019–2023 group, 11.0% of patients received modern treatment and 89.0% received standard treatment.

Thus, analysis of 650 patients showed that epilepsy in the study population was most frequently associated with genetic and structural aetiologies. Clinically, focal forms predominated, particularly symptomatic epilepsy and epilepsy of temporal lobe origin. The high proportion of pathological EEG findings demonstrates the diagnostic importance of this method in objectively confirming epileptic activity. Conventional antiseizure medications and combination therapy predominated in the treatment profile, while the use of modern medications remained more limited.

Overall, the findings established a systematic database on the epidemiological and clinical characteristics of epilepsy in Ganja. They have considerable scientific and practical significance for planning epilepsy services, supporting early diagnosis, improving treatment strategies and optimising social rehabilitation measures.

CONCLUSIONS

1. Both focal and generalised epilepsy were recorded more frequently in childhood and adolescence during both five-year periods. The proportion of focal epilepsy in these age groups was 44.7% in the first period and 37.3% in the second, while the corresponding proportions for generalised epilepsy were 56.7% and 46.3%. The overall proportion of generalised epilepsy increased by 18.0 percentage points, from 12.6% to 30.6% [4, 6].
2. The number of patients with generalised epilepsy per 100,000 population increased from 2.0 in 2005–2009 to 5.2 in 2019–2023. In 2019–2023, combined epilepsy was identified in one male patient aged 20–29 years and one female patient aged 50–59 years, whereas no cases of this type were observed in 2005–2009 [7].
3. Among patients with epilepsy, the proportion not employed increased from 63.6% to 75.9%, the proportion with secondary or secondary vocational education from 86.1% to 91.6%, the proportion married from 48.6% to 56.5%, and the proportion with a positive family history from 34.8% to 45.1%. Genetic (40.2%) and structural (38.3%) factors predominated aetiologically [10, 14].
4. A strong non-linear inverse relationship between drug concentration and seizure frequency was identified in patients treated with newer-generation antiseizure medications. The polynomial regression models were $y = -1.5417x^2 - 3.2083x + 16.75$ ($R^2 = 0.6929$) for lamotrigine and $y = -7.8167x^2 - 3.5167x + 48.5$ ($R^2 = 0.9058$) for levetiracetam [16, 18].

PRACTICAL RECOMMENDATIONS

1. The higher frequency of epilepsy observed in first-degree relatives of patients confirms the clinical importance of genetic predisposition. Regular follow-up, preventive neurological assessment and timely identification and elimination of risk factors from an early age are recommended for first-degree relatives of people diagnosed with epilepsy and for children born to consanguineous parents. This approach aims to prevent delayed diagnosis, expand opportunities for early intervention and improve the long-term prognosis.

2. Given the significant relationship between blood concentrations of newer-generation antiseizure medications and seizure frequency, regular therapeutic monitoring is recommended for patients receiving these medications to optimise dosing, assess treatment response and select individualised therapy.
3. Implementing education and support programmes is important for increasing patients' participation in education and employment. Such programmes help raise public awareness and reduce the stigma and discrimination experienced by people with epilepsy. As a result, patients' social integration is strengthened, their opportunities to form families are expanded, and their more active participation in society is supported.

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