

MAIN CONCERNS OF IGG POSITIVITY TO ECHINOCOCCOSIS IN ARMENIA DURING THE PERIOD 2015–2023 BASED ON THE DATA OF BLOOD CELLS LABORATORIES

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Summary. This retrospective study analyzed data from 928 patients who underwent IgG antibody testing for echinococcosis at Blood Cells Laboratories in Armenia from 2015 to 2023. Antibodies were detected using the Cobas e411-Roche Diagnostics automatic immunohematological device, employing the immunohemiluminescence method. Statistical analysis was conducted using SPSS version 13.0 for Windows, with a significance level set at $P < 0.05$. Results revealed a mean IgG positivity rate of 5.2%, with rates varying between 3.9% and 8.6% across the study period. Male patients constituted 54.2% of IgG positive cases. The mean age of IgG positive patients was 38.7 ± 1.5 years, with significant proportions observed in the 40–59 age group and among children aged 10–18 years. Echinococcosis affected various organs, with 115 cysts identified in the lungs, liver, and spleen. Most cysts were found in the lungs (46.1%) and liver (33.9%). Risk factors included animal contact, particularly among farmers with cattle and pets, as well as travel history to Russia for work.

The study highlights the higher IgG positivity rate compared to previous decades and emphasizes the importance of targeted interventions, especially among rural populations engaged in farming and livestock rearing. The mean cyst count per patient exceeding two underscores the severity of the disease and warrants comprehensive management strategies.

Key words: Echinococcosis, IgG positivity, IgG antibodies, Armenia, Cobas e411-Roche Diagnostics, SPSS, prevalence.

ОСНОВНЫЕ ПРЕДПОЛОЖЕНИЯ ПОЗИТИВНОСТИ IGG К ЭХИНОКОККОЗУ В АРМЕНИИ В ПЕРИОД 2015–2023 гг. ПО ДАННЫМ “BLOOD CELLS” ЛАБОРАТОРИИ

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Резюме. Это ретроспективное исследование проанализировало данные 928 пациентов, которые прошли тест на IgG антитела к эхинококкозу в лабораториях кровяных клеток в Армении с 2015 по 2023 год. Антитела были обнаружены с помощью автоматического иммуногематологического анализатора Cobas e411-Roche Diagnostics, использующего метод иммуногемилуминесценции. Статистический анализ проводился с использованием программного обеспечения SPSS версии 13.0 для Windows, с уровнем значимости $P < 0.05$. Результаты показали среднюю положительную частоту IgG на уровне 5,2%, с вариацией от 3,9% до 8,6% в течение всего периода исследования. Мужчины составляли 54,2% всех положительных случаев IgG. Средний возраст пациентов с положительными результатами IgG

составил $38,7 \pm 1.5$ лет, с значительной долей случаев в возрастной группе 40–59 лет и среди детей в возрасте от 10 до 18 лет. Эхинококкоз затронул различные органы, с обнаружением 115 кист в легких, печени и селезенке. Большинство кист были обнаружены в легких (46,1%) и печени (33,9%). Факторы риска включали контакт с животными, особенно среди фермеров с коровами и домашними животными, а также историю путешествий в Россию по работе. Исследование подчеркивает более высокую частоту положительных результатов IgG по сравнению с предыдущими десятилетиями и акцентирует внимание на необходимости целевых мероприятий, особенно среди сельских населенных пунктов, занятых фермерским хозяйством и разведением скота. Среднее количество кист на пациента превышало два, что подчеркивает серьезность заболевания и требует комплексных стратегий управления.

Ключевые слова: Эхинококкоз, положительность IgG, антитела IgG, Армения, Cobas e411-Roche Diagnostics, SPSS, распространенность.

Introduction. Echinococcosis refers principally to two severe zoonotic tapeworm diseases, cystic echinococcosis (CE) and alveolar echinococcosis (AE), caused by *Echinococcus granulosus sensu lato* and *Echinococcus multilocularis*, respectively [1]. CE is cosmopolitan and more common, although a few island countries have declared elimination [2,3]. In areas of endemicity, the annual CE incidence ranges from <1 to 200 per 100,000, whereas that of AE ranges from 0.03 to 1.2 per 100,000 [4].

Transmission of echinococcosis depends on carnivores as definitive hosts and various other animals as intermediate hosts. Human beings as accidental intermediate hosts can be infected with echinococcosis by directly ingesting eggs of *Echinococcus spp.* or contacting with contaminated environment indirectly [5].

Hydatid echinococcosis, due to *Echinococcus granulosus* or *E. multilocularis*, can occur almost everywhere, but most often in North and East Africa, Asia, South-West Europe, South America, the USA, Canada, Australia, and New Zealand [6-9].

The pattern of distribution for CE has remained essentially unchanged over the past 2 decades, with areas of high endemicity, including western China, Central Asia, South America, Mediterranean countries and eastern Africa, and the main risk factors being contact with dogs and raising livestock [10].

In the Republic of Armenia, early serological studies on echinococcosis (without distinction between alveolar and cystic) in 1970–1980 showed 4.9% IgG positivity in rural populations and 2.3% in urban populations [11].

Aim: this study aimed to fill a gap of knowledge by providing a quantitative measure of IgG positivity to *Echinococcus granulosus sensu lato* causing human cystic echinococcosis (CE) in Armenia during the period 2015–2023 based on the data of Blood Cells Laboratories.

Material and methods. We have collected and analyzed the materials of 928 patients (2015 to 2023 years) who passed the antibody (IgG) test against echinococcosis in Blood Cells Laboratories (which have of a lot branch in whole territory of Armenia). We have used registered data for these patients.

Antibodies were determined by Cobas e411-Roche Diagnostics automatic immunohematological device, the research method was immunohemiluminescence.

The data are expressed as mean $\pm$ SD. The statistical analysis was performed by Statistical Package for Social Sciences (SPSS, Chicago, Illinois, USA) version 13.0 for Windows. Statistical significance of differences was set to $P < 0.05$.

Results: 54.2 % of IgG-positive patients were male. IgG positivity rate among tasted patients during 2015-2023 years were variated between 3.9-8.6% (table 1). The mean IgG positivity rate was 5.2%.

Table 1 – IgG positive cases and tested population during 2015–2023 years

Years	Tasted patients	Number of IgG positive cases	Rate of positivity
2015	14	1	7.1%
2016	35	3	8.6%
2017	51	3	5.9%
2018	66	4	6.1%
2019	70	5	7.1%
2020	115	7	6.1%
2021	167	8	4.8%
2022	232	10	4.3%
2023	178	7	3.9%

The mean age of IgG positive patients was 38.7 ± 1.5 . The age-specific distribution of IgG positive echinococcosis among studied patients have following pattern. 50% of registered cases was observed in the age groups 40–59 years ($n=24$). 16.7% of IG positive cases was registered among children aged 10–18 years ($n=8$). It may be thought that a rarer detection of echinococcosis in children under 7 years of age depends on the fact that the disease is still in the latent period and is manifested in especially severe

cases of complications. The youngest patient observed among our patients was 6 years old child.

Echinococcosis can affect any organ. Total were registered 115 cysts (table 2) located in lungs, liver and spleen. 46.1% of all cysts were localized in the longs ($n= 53$), in the liver – 33.9% ($n=39$). The number is more than 48, because of multiple echinococcosis cases (i.e. in some patients multiple echinococcal cysts were revealed in the lungs, liver, spleen). The mean count of cysts per patients was 2.4 (only 3 patients have 1 cyst and all of them were located in the spleen).

Table 2 – Location of cysts

Years	Spleen	Liver	Lungs
2015	1	-	-
2016	1	3	2
2017	2	4	4
2018	3	2	6
2019	1	5	8
2020	3	7	8
2021	5	6	5
2022	5	7	10
2023	2	5	10
Total	23	39	53

Regarding risk factors, a total of 37 (77.1%) positive cases mentioned contact with animals. Most patients were farmers, with cattle and pets. Also 18 cases (37.5%) have been in Russia for working purposes. 81.25% cases were residents

in rural communities: mainly from Aragatsotn (10 cases), Gegharkunik (8 cases), Shirak (8 cases), Armavir (6 case) and Vayots Dzor (4 case) regions (Fig. 1).

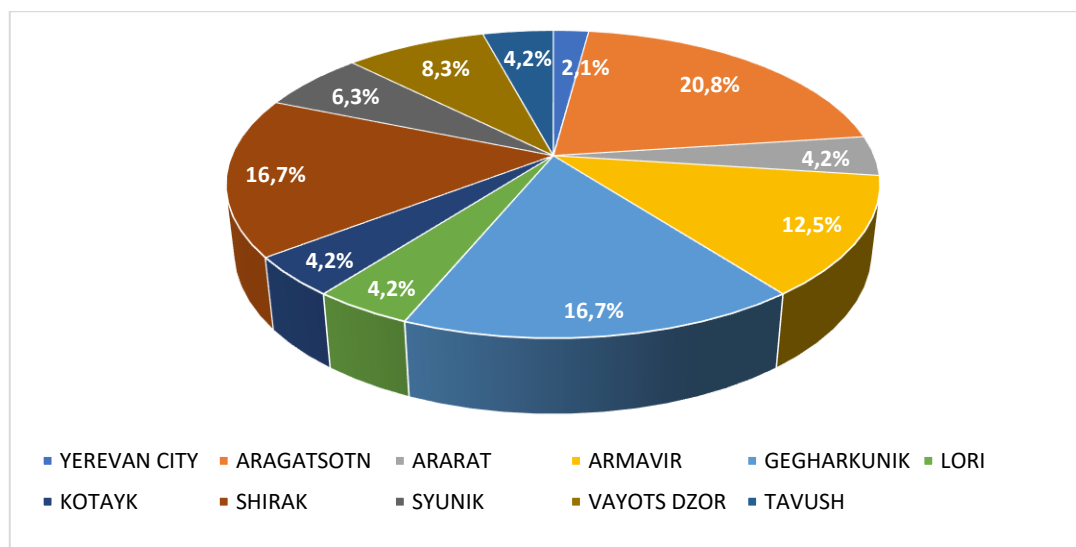


Figure 1. Regional distribution of IG positive echinococcosis cases during 2015-2023 years.

Discussion. The higher IgG positivity rate compared to previous decades indicates an increased prevalence. Risk factors included animal contact (77.1% reported contact), with most patients being farmers with cattle and pets. Additionally, 37.5% had travelled to Russia for work, and 81.25% resided in rural communities, particularly in specific regions of Armenia.

As it is seen, the IgG Positivity Rate is increased during 20215-2023. The increase in IgG positivity rate over the study period compared to previous decades could be explained by changes in agricultural practices, increased contact between humans and definitive hosts like dogs, or changes in environmental conditions that favour the life cycle of Echinococcus spp.

Our findings underscore the significance of rural and agricultural settings in the transmission of echinococcosis. Farming practices, especially those involving livestock and pets contributed to the risk. The socio-economic and cultural factors in rural Armenia might influence these findings, including livestock management practices and the role of pets in households.

The prevalence of IgG positivity among males and the significant proportion of cases in the 40–59 age group and among children aged 10–18 years are observed. These demographics align with occupational exposure, outdoor activities, and the potential for contact with the parasite's definitive hosts.

Our study's findings on IgG positivity for echinococcosis in Armenia can be contrasted with global data to provide context. Globally, human incidence rates for cystic echinococcosis can surpass 50 per 100,000 person-years, with prevalence levels as high as 5%–10% in hyperendemic regions such as parts of Argentina, Peru, East Africa, Central Asia, and China. In certain areas, the prevalence in livestock reaches 20%–95% [12].

In the European context, the notification rate for echinococcosis in the EU/EEA for 2020 was 0.15 per 100,000 populations, which is considerably lower than the rates reported in your study for Armenia, reflecting regional differences in the disease's prevalence [13].

Lastly, an Africa-wide meta-analysis pointed out that different diagnostic methods can yield varying results, and that methodological heterogeneity should be taken into account when comparing prevalence rates [14].

A critical factor in comparing data across studies is the methodology used for diagnosis. Advances in echinococcosis management have been achieved through a combination of serological tests and functional imaging, and improvements in test accuracy remain a focus for the global health community [15]. In contrast, your study utilized the Cobas e411-Roche Diagnostics automatic immunohematological device, which could lead to differences in detected rates due to variations in diagnostic sensitivity and specificity.

Implications for Public Health Policy. The findings from our study on IgG positivity to echinococcosis in Armenia during 2015–2023 have several implications for public health policy that could help in managing and mitigating the disease more effectively. Our findings will help to develop and implement a robust surveillance system for echinococcosis, incorporating mandatory reporting

for diagnosed cases. This system would allow for real-time tracking of disease trends and the identification of hotspots for targeted interventions.

Our data can be used for the development and launch of public awareness campaigns focusing on the prevention of echinococcosis, especially in rural and agricultural communities. These campaigns should educate the public about the modes of transmission of the disease, such as the importance of washing hands and food, and the risks of close contact with dogs and other animals that could carry the parasite.

Limitations. Our sample was limited to those who sought testing or were symptomatic, it may not represent the general population. This selection bias could affect the generalizability of the findings. Since the study mainly included patients from specific regions, the findings might not reflect the situation in other parts of Armenia. Also, the reliance on IgG positivity as the sole criterion for diagnosis could overlook cases where seroconversion has not yet occurred or has diminished over time. The study may not have captured detailed information on socioeconomic status, occupation, and personal behavior, which could be significant risk factors.

Further Research. To establish causality and observe the progression of the disease over time, prospective studies could be conducted. Future studies could include more varied regions to capture a comprehensive picture of the disease's prevalence across Armenia. The genetic diversity of *Echinococcus* strains in Armenia could be explored to understand potential variations in virulence and transmission. Also, there is a need to conduct in-depth research into how socioeconomic status, cultural practices, and occupation affect the risk and spread of echinococcosis.

Conclusion. Study results showed that IgG positivity rate is higher than last decades indicated by Gevorgyan [11].

Concerning the factors that contribute to risks, there were no notable distinctions based on gender. The majority of individuals included in the study were engaged in farming, particularly in raising cattle and having pets. It's important to highlight that this description mirrors the predominant characteristics of the Armenian populace, which predominantly participates in agricultural activities such as farming and livestock rearing due to the agricultural sector being a substantial component of the economy. The mean cyst counts per patient exceeding two emphasizes the severity of the disease and the importance of effective management strategies.

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For citation

Grigoryan A.S., Chopikyan A.S., Yerosyan S.G., Sargsyan L.G., Harutyunyan A.A., Kulikova K.A., Tadevosyan A.E. Main concerns of IGG positivity to echinococcosis in Armenia during the period 2015–2023 based on the data of Blood Cells laboratories. *Euroasian Health Journal*. 2024;2:15–20. <https://doi.org/10.54890/1694-8882-2024-2-15>

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