Turkiye Parazitol Derg 2024;48(2):89-95
DOI: 10.4274/tpd.galenos.2024.64326

The Impact of Human Cystic Echinococcosis in the Central Asian Region, 1990-2019

İnsan Kistik Ekinokokkozisinin Orta Asya Bölgesi'ndeki Etkisi, 1990-2019

Fakher Rahim[1], Karlygash Toguzbaeva[2], Kenesh O. Dzhusupov[3,4]

[1]Department of Medical Laboratory Technologies, Alnoor University, Mosul, Iraq
[2]Department of Public Health, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan
[3]Public Health Department, International Higher School of Medicine, Bishkek, Kyrgyzstan
[4]Public Health Department, Osh State University, Osh, Kyrgyzstan

Cite this article as: Rahim F, Toguzbaeva K, Dzhusupov KO. The Impact of Human Cystic Echinococcosis in the Central Asian Region, 1990-2019. Turkiye Parazitol Derg. 2024;48(2):89-95.

ABSTRACT

Objective: This research aims to update knowledge on the regional and national sickness burden attributable to cystic echinococcosis (CE) from 1990 to 2019, as well as epidemiology and disease control, with a particular emphasis on the People's Central Asian Regions.

Methods: We calculated the morbidity, mortality, and disability-adjusted life years at the global, regional, and national levels for CE in all central Asian countries from 1990 to 2019, and we analyzed the association between GDP per capita and the disease burden of CE.

Results: In 2019, the three greatest numbers of CE cases were recorded in Kazakhstan [23986; 95% uncertainty interval (UI); 19796; 28908]; Uzbekistan (41079; 18351; 76048); and Tajikistan (10887; 4891; 20170) among all 9 countries. The three countries with the greatest ASIR of CE were estimated to be Kazakhstan (127.56; 95% UI: 105.34-153.8), Uzbekistan (123.53; 95% UI: 58.65-219.16), and Tajikistan (121.88; 58.57-213.93). Kyrgyzstan, Tajikistan, and Uzbekistan had the biggest increases (125%, 97%, and 83%, respectively) in the number of incident cases of CE, whereas Georgia, Kazakhstan, and Armenia saw the largest decreases (45%, 8%, and 3%, respectively).

Conclusion: To reduce the illness burden caused by CE, our findings may help public health professionals and policymakers design cost-benefit initiatives. To lessen the impact of CE on society, it is suggested that more money be given to the region's most endemic nations. Echinococcosis, cystic, negative health effects, life-years lost due to disability, rate of occurrence as a function of age, rate of death as a function of age.

Keywords: Burden of disease, cystic echinococcosis (CE), age-standardized mortality rate, disability-adjusted life year (DALY), age-standardized incidence rate, Central Asia

ÖZ

Amaç: Bu araştırma, 1990'dan 2019'a kadar kistik ekinokokkoza (CE) atfedilebilecek bölgesel ve ulusal hastalık yükünün yanı sıra epidemiyoloji ve hastalık kontrolüne ilişkin bilgileri, özellikle Halkın Orta Asya Bölgeleri'ne vurgu yaparak güncellemeyi amaçlamaktadır.

Yöntemler: 1990'dan 2019'a kadar tüm Orta Asya ülkelerinde CE için küresel, bölgesel ve ulusal düzeyde morbidite, mortalite ve engelliliğe göre düzeltilmiş yaşam yıllarını hesapladık ve kişi başına GSYİH ile CE'nin hastalık yükü arasındaki ilişkiyi analiz ettik.

Bulgular: 2019 yılında en fazla sayıda CE olgusu Kazakistan'da kaydedildi [23986; %95 belirsizlik aralığı (ÜI); 19796; 28908]; Özbekistan (41079; 18351; 76048); ve Tacikistan (10887; 4891; 20170) 9 ülke arasında yer alıyor. CE'nin en büyük ASIR'sine sahip üç ülkenin Kazakistan (127,56; %95 UI: 105,34-153,8), Özbekistan (123,53; %95 UI: 58,65-219,16) ve Tacikistan (121,88; 58,57-213,93) olduğu tahmin edilmektedir. Kırgızistan, Tacikistan ve Özbekistan CE olgularının sayısında en büyük artışları yaşarken (sırasıyla %125, %97 ve %83), Gürcistan, Kazakistan ve Ermenistan ise en büyük düşüşleri (%45, %8, %8 gördü ve sırasıyla %3).

Sonuç: CE'nin neden olduğu hastalık yükünü azaltmak için bulgularımız halk sağlığı profesyonellerinin ve politika yapıcıların maliyet-fayda girişimlerini tasarlamasına yardımcı olabilir. CE'nin toplum üzerindeki etkisini azaltmak için bölgenin endemik ülkelerine daha fazla para verilmesi öneriliyor. Ekinokokkoz, kistik, olumsuz sağlık etkileri, engellilik nedeniyle kaybedilen yaşam yılı, yaşın bir fonksiyonu olarak ortaya çıkma oranı, yaşın bir fonksiyonu olarak ölüm oranıdır.

Anahtar Kelimeler: Hastalık yükü, kistik ekinokokkoz (CE), yaşa standardize edilmiş ölüm oranı, engelliliğe göre düzeltilmiş yaşam yılı (DALY), yaşa standardize edilmiş insidans hızı, Orta Asya

Received/Geliş Tarihi: 02.10.2023 **Accepted/Kabul Tarihi:** 04.06.2024

Address for Correspondence/Yazar Adresi: Kenesh O. Dzhusupov, Department of Public Health, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan
Phone/Tel: +996770153154 **E-mail/E-Posta:** k.dzhusupov@ism.edu.kg **ORCID ID:** orcid.org/0000-0002-2213-1373

Türkiye PARAZİTOLOJİ Dergisi

INTRODUCTION

The microscopic tapeworm, Taenia echinococcus, of which there are four species, is the causative agent of echinococcosis, a parasitic zoonotic illness that mostly affects dogs (1). Nine species of Echinococcus have been described so far; four pose a threat to humans. The most common of these four are *E. granulosus* and *E. multilocularis*, which are responsible for cystic echinococcosis (CE) and alveolar echinococcosis, respectively (2). The parasitic infection known as echinococcosis has already spread to all five continents, causing widespread illness in people and animals (3). It is likely one of the most significant parasitic illnesses in the world today. CE patients may have no signs of the disease until the hydatid cysts have progressed to a later stage (4). With a death rate of 2.2% after surgery and a recurrence rate of 6.5%, the outlook for untreated or poorly treated patients is bleak (5). The human CE incidence estimates range from 50 to 100 per 100,000 person-years in endemic foci, with frequencies of 5 to 10% in certain areas of Argentina, Peru, eastern Africa, Central Asia, and China (6,7). There is an annual loss of $760,000,000 owing to compounding interest since CE is a worldwide health concern that shortens people's lives by an estimated 184,000 disability-adjusted life years (DALYs) (8). The worldwide public health burdens and economic costs of this zoonotic parasitic disease are substantial (9). Recent research has shown that the illness is rapidly expanding in several regions throughout the globe (3).

Five of the ten former Soviet Republics in Central Asia -Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, and Turkmenistan- have seen a resurgence of CE after the fall of the Soviet Union in 1991 (10,11). The cattle industry has seen radical shifts due to this process. The decline in the value of meat has led to the closure of several large mechanical slaughterhouses. Veterinarian oversight of the slaughtering process has been compromised by the lack of government money to pay veterinarians' salaries and the closing of these massive slaughterhouses. The cumulative effect of these changes is a general tendency toward smaller farms and an increase in illegal home slaughter or slaughter at markets without veterinary monitoring. As a result of lax veterinary public health precautions and the careless slaughter of animals, echinococcosis has become widespread in the region (12). In Central Asia, the number of recorded cases of human CE has increased dramatically and persistently, with certain localities seeing surges of four- or five-fold. Human echinococcosis is now endemic in the livestock-rearing regions of southern and western Kazakhstan and the other four republics, with an overall incidence rate of more than 3 cases/100,000 per year and an incidence rate of more than 25 cases/100,000 in some districts (13-16).

The data release includes a comprehensive and detailed analysis of the extent of health loss in various local areas within the Central Asian region. On the other hand, the global burden of disease (GBD) data offers a global perspective on mortality and disability, including countries, periods, age groups, and genders. It is achieved by an examination of how the adverse health conditions and premature mortality resulting from various ailments and injuries contribute to the overall burden of disease in the Central Asian region, as well as within local communities. These deliverables aim to enhance the local population health monitoring activities in the Central Asian region, both now and in the future. Despite being a parasitic tropical illness, CE receives little attention despite its high disease, social, and economic effects globally. While significant progress has been made toward the World Health Organizations (WHO) ambitious goal of eradicating CE by 2030, several obstacles remain. Estimates of disease burden help organize eradication efforts, but data on the worldwide burden of CE in terms of death, morbidity, and DALYs was lacking until recently. This research aims to provide the most recent data on the regional and national disease burden attributable to CE from 1990 to 2019, together with information on epidemiology and disease management, emphasizing the people's central Asian locations.

METHODS

Design

The GBD research annually evaluates and analyzes the global burden of illness. GBD 2019 presents the most recent analysis of descriptive epidemiology for 204 nations and territories from 1990 to 2019. This list of illnesses and injuries is thorough individually and individually (17).

Study Area

The GBD super regions classify the Republic of Armenia as part of Central Asia, which consists of 8 other independent states. Included on this map are the countries of Azerbaijan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan, Georgia, Kazakhstan, and Uzbekistan. Natural disasters, like earthquakes and floods, as well as constant water shortages, threaten the lives of the people there. Furthermore, water disputes are a common cause of climate-related conflicts. Many lives are lost, property is destroyed, and resources are depleted when these calamities strike. The situation in Afghanistan and the aftereffects of Russia's conflict with Ukraine have contributed to the influx of new refugees into Central Asia in the spring of 2021. As of Friday, July 7, 2023, the United Nations estimates that the population of Central Asia is 77,706,704. The people who live in Central Asia make up less than one percent of the global population. Regarding population density, Central Asia is the fifth most populous area in all of Asia. Central Asia has a population density of 19 per km^2 (49 per mi^2). The entire land area is 3,926,790 km^2 (1,516,141 sq. miles); in 2019, 48.0% (or 35,681,394) of the population will live in cities. Central Asians, on average, are 27.6 years old (Figure 1) (18).

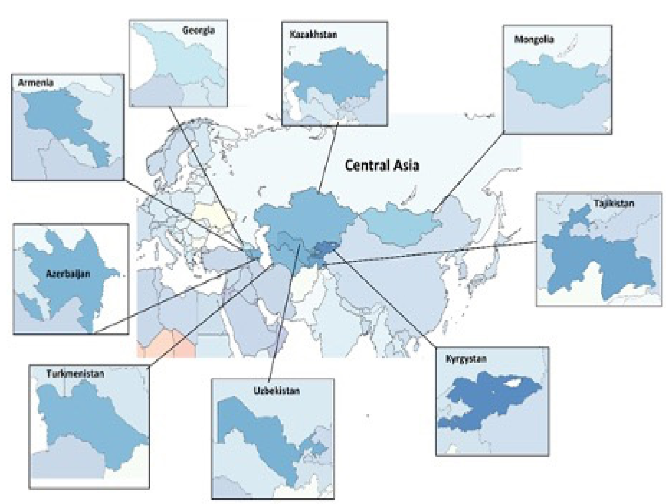

Figure 1. Study area

Data Source

Using data from the GBD 2019 retrieved from the Global Health Data Exchange tool (http://ghdx.healthdata.org/gbd-results-tool), we calculated the incidence, ASIR, mortality, ASMR, DALYs, and age-standardized DALY rate of CE in 9 countries from 1990 to 2019. From the GBD database, we retrieved information for each Central Asian nation from 1990 to 2019 on the incidence, prevalence, mortality, and DALYs of CE.

Death Rate Estimation

Previous studies (19,20) have examined the sources and management of cause-of-death (COD) data for the GBD project. The current dataset for COD has information from a cumulative count of 2809 sources across 21 nations, owing to the inclusion of 89 supplementary sources for the GBD 2021. In essence, COD data refer to documented information on the reasons behind mortality within a certain population or a specific subgroup of that population, often sourced through vital registration systems and similar repositories. The data pertaining to deaths in COD (cause of death) were subjected to a mapping process, whereby each death entry in the dataset was assigned a cause of death according to the GBD classification system, or alternatively, a garbage code. Additionally, before to the modeling phase, the age and sex categories were normalized via the use of aggregation or disaggregation techniques. The inclusion of HCE in the GBD list of valid underlying causes of death was undertaken to address the issue of fatalities that were initially assigned to causes of death that are either inappropriate or unsuitable as the underlying cause of death (referred to as "garbage code" deaths). In order to address the potential influence of stochastic temporal or geographical patterns, a Bayesian noise-reduction approach was used to the data pertaining to unusual causes of death or cases with small sample sizes. The age-, sex-, year-, and location-specific death rates of inflammatory bowel disease (IBD), Crohn's disease (CD), and ulcerative colitis (UC) were computed using the cause of death ensemble modelling (CODEm) approach, as described in detail in another source (8). The CODEm algorithm is a systematic Bayesian approach that employs ensemble modeling to analyze geospatial and temporal data. It generates and evaluates sub-models of two distinct types: Linear mixed-effects models and spatiotemporal Gaussian process regression models. These sub-models are designed to predict two response variables, namely the logarithm of mortality rate and the logarithm of cause of death fraction (expressed as a logit). Additionally, CODEm incorporates predetermined combinations of potential predictive covariates in its modeling process. The primary linear mixed-effects model consisted of sub-models that included covariate and age as fixed effects, and super-region, region, country, and age as nested random effects. The selection and assessment of variables by IBD modelers were determined by the robustness of the existing scientific data supporting their association with IBD. If the predictive variables of a sub-model exhibited a statistically significant link ($p<0.05$) and were epidemiologically valid in terms of the predicted direction of association with the response variable, the algorithm assessed the sub-model and included it into the ensemble. The evaluation of the prediction performance for each sub model included randomly deleting 15% of the whole data set. The selection criteria for exclusion were based on the cause-specific missingness patterns observed for ages and years across different geographic locations. The evaluation of the model's predictive validity outside of the training set involved the utilization of root-mean-squared error sum, trend error, which refers to the proportion of predictions accurately predicting the direction of the time trend between adjacent points, and coverage of the predicted 95% uncertainty interval. The performance of each sub-model was assessed by 20 measurements. The sub-models that exhibited the highest performance were assigned weights and then included into ensemble models. These ensemble models were then subjected to identical testing protocols. To get the CODEm estimates of mortality across the whole spectrum of IBD, the estimates of death specifically attributed to CD and UC were adjusted using the cause of death correct approach (CoDCorrect). The CoDCorrect tool is a core processing tool for the GBD study. Its purpose is to ensure the accuracy of mortality data by verifying that the sum of fatalities for each age group, sex, year, and geographic location aligns with the overall number of deaths attributed to all causes (20).

Secondary Analyses

Two more analyses were conducted. Initially, a decomposition analysis was conducted to ascertain the proportion of the observed change in prevalence of IBD between 1990 and 2021 that could be attributable to demographic factors such as population aging, as well as epidemiological factors such as alterations in sickness rates based on age and sex. In this research, we used the demographic methodology developed by Das Gupta (8). In order to ascertain the general incidence of HCE, we took into account two hypothetical scenarios. In the "population growth scenario", we made predictions regarding the expected number of prevalent cases by maintaining the age-sex distribution of the population and the age-sex-specific prevalence of HCE at their 1990 values while allowing for changes in population growth observed between 1990 and 2021. The second scenario, referred to as the "population growth and population aging scenario", closely resembled the first scenario. However, it assumed that the age-sex-specific prevalence of IBD would remain constant in 2021, as in 1990. This scenario accounted for both population growth and changes in population age-sex structure between 1990 and 2021. The disparity between the GBDs estimate of prevalent cases in 1990 and the projected 2021 under the first counterfactual scenario was used to determine the population growth that may be ascribed to causative causes. Through a comparative analysis of the forecasts for 1990 and 2021, we have successfully ascertained the extent to which population aging may be attributable to changes in demographic patterns. The attribution of any changes in age- and sex-specific prevalence, which could not be explained by demographic shifts such as population growth and aging, was attributed to epidemiological factors.

Next, we compared the national socio-economic development, quantified by the socio-demographic index (SDI) estimates provided by GBD, and the changes in prevalence of inflammatory bowel disease (IBD) across different regions and time periods. The SDI is a comprehensive measure incorporating many indicators, including the total fertility rate among women under 25, the average years of education for those aged 15 and above, and the per capita income distribution throughout a country. The classification process included categorizing 21 countries and territories into distinct quintiles based on their SDI scores. These quintiles were high, high-middle, medium, low-middle, and low. Further details on constructing and evaluating a SDI may be found in other resources.

Standardization

We calculated age-standardized incidence and death rates using the WHO's world standard population to facilitate comparisons across populations with varying ages.

Statistical Analysis

Thirty years of data were analyzed statistically to reveal patterns. We assessed the pace of change over time by calculating the annual percentage increase or decrease in the age-adjusted incidence and death rates. We also did a sub-regional study to examine the prevalence of CE in various Central Asian nations.

Ethical Considerations

The data utilized in this research was secondary. Hence, permission from any relevant ethics bodies was unnecessary. Each participant's information is private yet accessible to the public in the GBD research data. In order to fully grasp the impact of CE on Central Asia, this technique offers a rigorous and systematic approach.

RESULTS

Global Scenario

The global and Central Asian epidemiological picture of CE illness is shown in Table 1 from 1990 to 2019, broken down by gender. The estimated annual percentage change (EAPC) is 0.54% [95% uncertainty interval (UI): 0.42 to 0.7], while the total number of cases worldwide has climbed from 134980 (95% UI: 93141-195144) in 1990 to 207368 (95% UI: 137807-303233) in 2019. Deaths from CE have decreased worldwide from 2.839 (95% UI: 2.218 to 3.497) in 1990 to 1.349 (95% UI: 987 to 1.762) in 2019, with an EAPC of 0.52% (95% UI: 0.66% to 0.34%). In addition, the number of DALYs lost due to CE worldwide decreased from 210,044 (95% UI: 166,434 to 261,084) in 1990 to 122,457 (95% UI: 89,244 to 168,556) in 2019, with an EAPC of 0.42% (95% UI: 0.57% to 0.23%) (Table 1). Table 1 shows that between 1990 and 2019, females made up a larger proportion of CE sufferers than men. For 2019, the rates of new cases, deaths, and DALYs due to CE were all trending downward (Table 1). From 1990 to 2019, the EAPC for the number of incident cases of CE was +0.18% (95% UI: +0.24% to 0.12%), +4.64% (95% UI: -4.85% to -4.43%), and -3.38% (95% UI: -3.54% to 3.26%) (Table 1).

Central Asia

Table 2 shows that out of the nine countries studied in 2019, Kazakhstan had the largest number of CE cases with 23986 (95% UI: 19796-28908), followed by Uzbekistan with 41079 (18351-76048), and finally Tajikistan with 10887 (4891-20170). As shown in Table 2, the three countries with the highest ASIR of CE were Kazakhstan (127.56; 95% UI: 105.34-153.8), Uzbekistan (123.53; 95% UI: 58.65-219.16), and Tajikistan (121.88; 58.57-213.93). Also, Table 2 shows that although the number of incident instances of CE increased by the greatest percentage in Kyrgyzstan (125%), Tajikistan (97%), and Uzbekistan (83%), it decreased by the greatest percentage in Georgia (45%), Kazakhstan (8%), and Armenia (3%). As for the ASIR of CE, the highest gain was recorded in Kyrgyzstan [EAPC =1.3%, 95% UI: (0.94% to 1.67%)],

Table 1. Comparison of number of global CE, age-standardized rates (ASR), Annual rate of change (ARC), and EAPC of incidence, mortality, and DALYs between 1990 to 2019

Item	Incidence, number (95% UI)		Mortality, number (95% UI)		DALYs, number (95% UI)	
	1990	2019	1990	2019	1990	2019
CE incidence, mortality, and DALYs						
Global						
Overall	134980 (93141-195144)	207368 (137807-303233)	2839 (2218-3497)	1349 (987-1762)	210044 (166434-261084)	122457 (89244-168556)
Male	55004 (36334-84605)	83318 (52851-127144)	1480 (1105-1879)	726 (455-1030)	103864 (78388-133209)	58532 (40465-81788)
Female	79977 (56335-113027)	124050 (84455-175220)	1359 (995-1776)	623 (385-879)	103864 (78388-133209)	63925 (43062-87764)
Central Asia	65909 (43716-102773)	95102 (56969-152588)	27 (17-38)	15 (9-21)	21147 (12039-36064)	30110 (15271-54362)
Age-standardized rates (ASR), incidence, mortality, and DALYs						
Global						
Overall	2.65 (1.87-3.7)	2.6 (1.72-3.79)	0.06 (0.04-0.07)	0.02 (0.01-0.02)	3.82 (3.05-4.7)	1.56 (1.14-2.15)
Male	2.12 (1.43-3.1)	2.09 (1.34-3.21)	0.06 (0.04-0.08)	0.02 (0.01-0.03)	3.74 (2.86-4.75)	1.49 (1.04-2.1)
Female	3.17 (2.28-4.31)	3.1 (2.1-4.38)	0.05 (0.04-0.07)	0.02 (0.01-0.02)	3.9 (2.99-4.94)	1.62 (1.08-2.25)
Central Asia	103.28 (68.82-152.04)	100.32 (61.06-159.16)	0.05 (0.03-0.07)	0.02 (0.01-0.03)	33.74 (19.48-56.19)	31.68 (16.44-56)
Annual rate of change (ARC), and estimated annual percent change (EAPC)						
	ARC (95% UI)	**EAPC (95% UI)**	**ARC (95% UI)**	**EAPC (95% UI)**	**ARC (95% UI)**	**EAPC (95% UI)**
Global						
Overall	0.54% (0.42-0.7)	-0.18% (-0.24, -0.12)	-0.52% (-0.66, -0.34)	-4.64% (-4.85, -4.43)	-0.42% (-0.57, -0.23)	-3.38% (-3.5, -3.26)
Male	0.51% (0.39-0.7)	-0.08% (-0.13, -0.02)	-0.51% (-0.7, -0.24)	-4.54% (-4.75, -4.32)	-0.44% (-0.62, -0.21)	-3.47% (-3.6, -3.35)
Female	0.55% (0.43-0.71)	-0.24% (-0.31, -0.18)	-0.54% (-0.73, -0.27)	-4.78% (-4.99, -4.57)	-0.40% (-0.58, -0.15)	-3.3% (-3.44, -3.17)
Central Asia	0.45% (0.28 - 0.67)	-0.2% (-0.28, -0.12)	-0.45% (-0.07, -0.01)	-3.6% (-4.1, -3.1)	0.42% (0.21-0.67)	-0.35% (-0.42, -0.27)

CE: Cystic echinococcosis, DALY: Disability-adjusted life year, UI: Uncertainty interval

Table 2. Country-wise comparison of the number of global CE, age-standardized rates (ASR), Annual rate of change (ARC), and EAPC of incidence, mortality, and DALYs between 1990 to 2019

Item	Incidence, number (95% UI)		Mortality, number (95% UI)		DALYs, number (95% UI)	
	1990	2019	1990	2019	1990	2019
CE incidence, mortality, and DALYs						
GBD regions						
Armenia	1902 (873-3500)	1849 (862-3383)	0.55 (0.29-0.83)	0.22 (0.12-0.35)	639 (267-1300)	621 (255-1261)
Azerbaijan	3958 (1726-7618)	55004 (36334-84605)	1.46 (0.8-2.23)	0.71 (0.38-1.1)	1335 (556-2640)	2066 (815-4215)
Georgia	381 (313-468)	210 (176-251)	1.01 (0.52-1.58)	0.33 (0.17-0.52)	188 (124-268)	98 (63-143)
Kazakhstan	26055 (21264-31968)	23986 (19796-28908)	3.66 (2.37-5.34)	1.44 (0.78-2.22)	7572 (4751-11273)	6931 (4467-10420)
Kyrgyzstan	2757 (2259-3389)	6211 (5183-7653)	3.11 (1.79-4.54)	1.43 (0.8-2.16)	949 (629-1334)	1870 (1176-2745)
Mongolia	1036 (433-2102)	1858 (815-3484)	0.93 (0.48-1.47)	0.46 (0.23-0.77)	375 (164-772)	635 (256-1338)
Tajikistan	5535 (2492-10858)	10887 (4891-20170)	3.89 (2.17-5.76)	2.37 (1.39-3.5)	1950 (874-3732)	3579 (1496-7224)
Turkmenistan	1825 (775-3600)	2822 (1231-5170)	0.88 (0.43-1.44)	0.40 (0.22-0.63)	624 (260-1252)	934 (354-1880)
Uzbekistan	22460 (9914-43740)	41079 (18351-76048)	11.13 (7.41-14.84)	7.32 (4.53-10.55)	7517 (3214-15371)	13377 (5362-27592)
Age-standardized incidence rates (ASIRs), and estimated annual percent change (EAPC)						
GBD regions	**ASIR 1990 (95% UI)**	**ASIR 2019 (95% UI)**	**Num change (95% UI)**		**EAPC (95% UI)**	
Armenia	56.48 (26.55-101.85)	56.11 (25.8-100.3)	-0.03% (-0.21-0.21)		-0.01% (-0.03-0)	
Azerbaijan	56.26 (25.42-99.52)	55.83 (25.38-102.43)	0.57% (0.25-0.9)		-0.02% (-0.04--0.01)	
Georgia	6.52 (5.35-8.01)	5.26 (4.42-6.3)	-0.45% (-0.51--0.39)		-1.04% (-1.23, -0.85)	
Kazakhstan	164.09 (135.28-197.75)	127.56 (105.34-153.8)	-0.08% (-0.14--0.01)		-1.22% (-1.44, -0.99)	
Kyrgyzstan	68.56 (56.57-82.4)	95.61 (80.36-116.11)	1.25% (1.08-1.45)		1.3% (0.94-1.67)	
Mongolia	55.98 (25.19-100.22)	55.52 (25.61-100.56)	0.79% (0.4-1.29)		0% (-0.02-0.01)	
Tajikistan	123.34 (60.01-214.46)	121.88 (58.57-213.93)	0.97% (0.71-1.33)		-0.03% (-0.04--0.02)	
Turkmenistan	56.57 (26.03-101.9)	55.86 (25.25-99.31)	0.55% (0.21-0.91)		-0.04% (-0.07--0.01)	
Uzbekistan	124.35 (57.81-220.68)	123.53 (58.65-219.16)	0.83% (0.57-1.23)		-0.03% (-0.05--0.01)	

CE: Cystic echinococcosis, DALY: Disability-adjusted life year, GBD: Global burden of disease, UI: Uncertainty interval

while the largest decreases were recorded in Kazakhstan [EAPC =1.22%, 95% UI: (1.44% to 0.99%)] and Georgia [EAPC =-1.04%, 95% UI: (1.23% to -0.85%)] (Table 2).

The trends of the number of cases, age-standardized mortality, and DALY rates have shown mixed patterns throughout Central Asian countries (Figure 2).

Between 1990 and 2019, neglected tropical disease and malaria (NTD & M) jumped from the 22nd to the 21st spot on Central Asia's list of leading risk factors (Figure 3A). This was due to a decrease in the DALY rate from 164.11 (95% UI: 98.36 to 272.99 age-standardized DALY rate per 100,000 population for both sexes) to 77.78 (95% UI: 52.3 to 111.05). Change in DALY rate from baseline: 7.67 (95% UI: 5 to 11.75 age-standardized DALY rate per 100,000 population for both sexes) to baseline: 8.94 (95% UI: 4.97 to 15.55) (Figure 3B) Central Asia jumped from third to first place among GBD super regions.

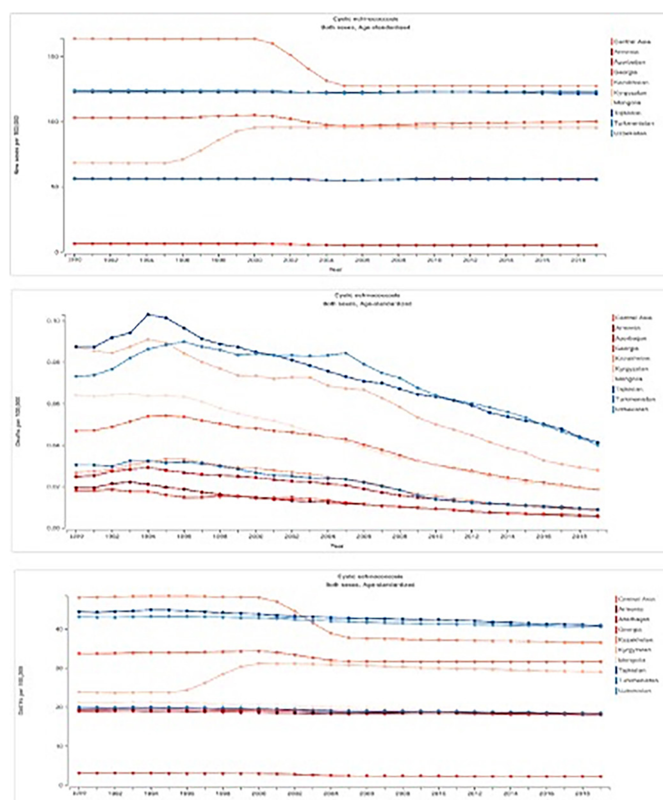

Figure 2. The trends of number of CE cases, age-standardized mortality and DALY rates cases in different Central Asian nations

CE: Cystic echinococcosis, DALY: Disability-adjusted life year

DISCUSSION

In order to devote appropriate healthcare resources, public health professionals and policymakers require a solid knowledge of the evolving epidemiology and sickness burden of CE. This research looked at the prevalence, mortality, and DALY rate of CE in 9 different Central Asian nations between 1990 and 2019. The global disease burden from CE may then be estimated. There were 95,102 cases of CE recorded in nine countries in 2019, a significant rise from the 65,909 cases reported in 1990 (45.18 percent higher: 95,102/207,368). Several countries in central Asia, including Kyrgyzstan, Uzbekistan, and Tajikistan, have reported declines in CE incidence, death, and DALY rate during the previous three decades, from 1990 to 2019. Nonetheless, Georgia, Kazakhstan,

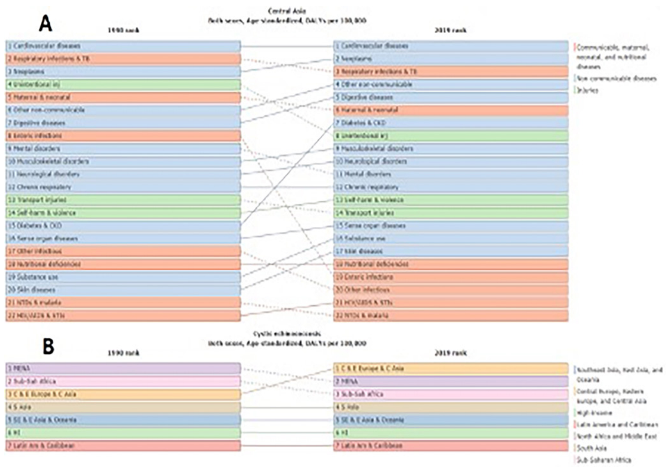

Figure 3. Comparison of CE with other leading risks factors in Central Asia by causes (A) and location (B) in 1990 and 2019, for both sexes, age-standardized DALY rate per 100,000 population
CE: Cystic echinococcosis, DALY: Disability-adjusted life year

and Armenia had the highest drop. In Kazakhstan, the estimated 2016 CE incidence rate was higher than the 1990 rate reported rate (1.4 cases per 100,000 population vs. 4.7 cases per 100,000 people), suggesting a shift in the CE pattern in these nations (21). A high humidity index, moderate temperatures, and a prolonged vegetative phase make the soil in southern and central Asia optimal for *E. granulosus* egg survival (22). Therefore, environmental variables could play a role. Two, it is common practice in pastoral areas to feed dogs the raw offal of sick calves as a diet component (3-6). In addition, the coasts of the Mediterranean, China, Europe, the Middle East, and South America have some of the highest infection rates in the world (8,23). Much of Central Asia's borders are with countries where CE is widespread (24). The expansion of businesses related to livestock raising has helped enhance regional trade and cattle transportation thanks to recent policy changes. This may have increased the circulation of infected intermediate animals, contributing to the illness's active spread (25,26). Increased mobility and better physician awareness of CE diagnosis, treatment, and control are needed since an increased number of immigrants from high-endemic countries and areas may be responsible for the rise in CE cases in low-endemic locations (27). The area is especially susceptible to the effects of natural disasters. This is because of the varied topography of Central Asia, which includes mountains, steppes, deserts, and significant river systems, all of which are affected by global warming. While some nations are more prepared than others, lowering the likelihood of natural disasters has become an important goal for all of the countries in the area. Central Asia has made great strides in the past few years but still needs to improve its disaster management infrastructure. The current situation in Afghanistan may cause an increase in the number of Afghans seeking refuge in Central Asian countries, with Tajikistan being the country most affected. The key to managing freshly arriving migrants demands to have regional contingency plans, stockpile, and replenish necessary assets. In addition, we found a decline in the regional age-standardized mortality and DALY rate of CE, which may be attributable to WHO's publication of the updated roadmap for neglected tropical diseases 2020 (28), and the signing of the London Declaration on Neglected Tropical Diseases in 2012 (29).

Study Limitations

There are several caveats to this research. While several changes were made to the GBD 2019 data's source, processing, and evaluation to increase data accuracy comparability, some degree of bias remains in the data's integrity and correctness. Second, the analysis may have been biased since disability weights for liver cancer were used instead of CE weights because they were the only ones accessible in the GBD 2019 data. Lastly, alveolar echinococcosis data was not provided at GBD 2019, whereas data on CE was. Validation of this study's conclusions requires more research that addresses these limitations.

CONCLUSION

Overall, our results show that the prevalence of CE diseases increased throughout central Asia between 1990 and 2019. Our findings may help public health authorities and policymakers design cost-benefit initiatives to reduce the illness burden caused by CE. It is suggested that most endemic nations in the area get more health funding in order to lessen the impact of CE. The improved diagnostic tools and more public and medical knowledge of CE may contribute to the growing incidence rate. This notion is bolstered by the fact that just around two instances in the sample were relapses, even though the majority were new cases. The burden of CE nationwide may be reduced with early diagnosis through ultrasound screening and preventative measures among high-risk populations.

* Acknowledgments

We offer our deepest thanks to the institutions that provided technical support for the development and implementation of this study.

* Ethics

Ethics Committee Approval: The data utilized in this research was secondary. Hence, permission from any relevant ethics bodies was unnecessary.

Informed Consent: Not necessary.

* Authorship Contributions

Concept: F.R., K.T., K.O.D., Design: F.R., K.T., Data Collection or Processing: F.R., K.T., K.O.D., Analysis or Interpretation: F.R., K.T., K.O.D., Literature Search: F.R., K.T., K.O.D., Writing: F.R., K.O.D.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Agudelo Higuita NI, Brunetti E, McCloskey C. Cystic Echinococcosis. J Clin Microbiol. 2016; 54: 518-23.
2. Lymbery AJ. Phylogenetic Pattern, Evolutionary Processes and Species Delimitation in the Genus Echinococcus. Adv Parasitol. 2017; 95: 111-45.
3. Wen H, Vuitton L, Tuxun T, Li J, Vuitton DA, Zhang W, et al. Echinococcosis: Advances in the 21st Century. Clin Microbiol Rev. 2019; 32.

4. Özdemir T, Sayan A, Candan B, Köylüoğlu G. Clinical features and treatment of ruptured pulmonary hydatid cyst in children. Turk J Pediatr. 2020; 62: 578-83.

5. Stojković M, Weber TF, Junghanss T. Clinical management of cystic echinococcosis: state of the art and perspectives. Curr Opin Infect Dis. 2018; 31: 383-92.

6. McManus DP, Zhang W, Li J, Bartley PB. Echinococcosis. Lancet. 2003; 362: 1295-304.

7. Deplazes P, Rinaldi L, Alvarez Rojas CA, Torgerson PR, Harandi MF, Romig T, et al. Global Distribution of Alveolar and Cystic Echinococcosis. Adv Parasitol. 2017; 95: 315-493.

8. Torgerson PR. Economic effects of echinococcosis. Acta Trop. 2003; 85: 113-8.

9. Widdicombe J, Basáñez MG, Entezami M, Jackson D, Larrieu E, Prada JM. The economic evaluation of Cystic echinococcosis control strategies focused on zoonotic hosts: A scoping review. PLoS Negl Trop Dis. 2022; 16: e0010568.

10. Gottstein B, Deplazes P. Alveolar echinococcosis: what triggers emergence in North America, Central Europe and Asia? Curr Opin Infect Dis. 2021; 34: 440-6.

11. Pomfret R. Central Asian Economies: Thirty Years After Dissolution of the Soviet Union. Comp Econ Stud. 2021; 63: 537-56.

12. Eckert J, Deplazes P. Biological, epidemiological, and clinical aspects of echinococcosis, a zoonosis of increasing concern. Clin Microbiol Rev. 2004; 17: 107-35.

13. Zhang W, Zhang Z, Wu W, Shi B, Li J, Zhou X, et al. Epidemiology and control of echinococcosis in central Asia, with particular reference to the People's Republic of China. Acta Trop. 2015; 141: 235-43.

14. Abdybekova A, Sultanov A, Karatayev B, Zhumabayeva A, Shapiyeva Z, Yeshmuratov T, et al. Epidemiology of echinococcosis in Kazakhstan: an update. J Helminthol. 2015; 89: 647-50.

15. Shaikenov BS, Torgerson PR, Usenbayev AE, Baitursynov KK, Rysmukhambetova AT, Abdybekova AM, et al. The changing epidemiology of echinococcosis in Kazakhstan due to transformation of farming practices. Acta Trop. 2003; 85: 287-93.

16. Babadjanov AK, Yakubov FR, Ruzmatov PY, Sapaev DS. Epidemiological aspects of echinococcosis of the liver and other organs in the Republic of Uzbekistan. Parasite Epidemiol Control. 2021; 15: e00230.

17. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study. 2019. Lancet 2020; 396: 1204-22.

18. Worldometer. Central Asia Population, 2020.

19. Collaborators GDaI. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020; 396: 1204-22.

20. Foreman KJ, Lozano R, Lopez AD, Murray CJ. Modeling causes of death: an integrated approach using CODEm. Popul Health Metr. 2012; 10: 1.

21. Polat P, Kantarci M, Alper F, Suma S, Koruyucu MB, Okur A. Hydatid disease from head to toe. Radiographics. 2003; 23: 475-94; quiz 536-7.

22. Thevenet PS, Jensen O, Drut R, Cerrone GE, Grenóvero MS, Alvarez HM, et al. Viability and infectiousness of eggs of Echinococcus granulosus aged under natural conditions of inferior arid climate. Vet Parasitol. 2005; 133: 71-7.

23. Torgerson PR. The emergence of echinococcosis in central Asia. Parasitology. 2013; 140: 1667-73.

24. Casulli A. Recognising the substantial burden of neglected pandemics cystic and alveolar echinococcosis. Lancet Glob Health. 2020; 8: e470-e1.

25. Walker R, Blackburn J. Biothreat Reduction and Economic Development: The Case of Animal Husbandry in Central Asia. Front Public Health. 2015; 3: 270.

26. Ziarati M, Zorriehzahra MJ, Hassantabar F, Mehrabi Z, Dhawan M, Sharun K, et al. Zoonotic diseases of fish and their prevention and control. Vet Q. 2022; 42: 95-118.

27. Borhani M, Fathi S, Lahmar S, Ahmed H, Abdulhameed MF, Fasihi Harandi M. Cystic echinococcosis in the Eastern Mediterranean region: Neglected and prevailing! PLoS Negl Trop Dis. 2020; 14: e0008114.

28. World Health Organization. Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021-2030. 2020.

29. Elphick-Pooley T, Engels D, Uniting to Combat N. World NTD Day 2022 and a new Kigali Declaration to galvanise commitment to end neglected tropical diseases. Infectious Diseases of Poverty. 2022; 11: 2.