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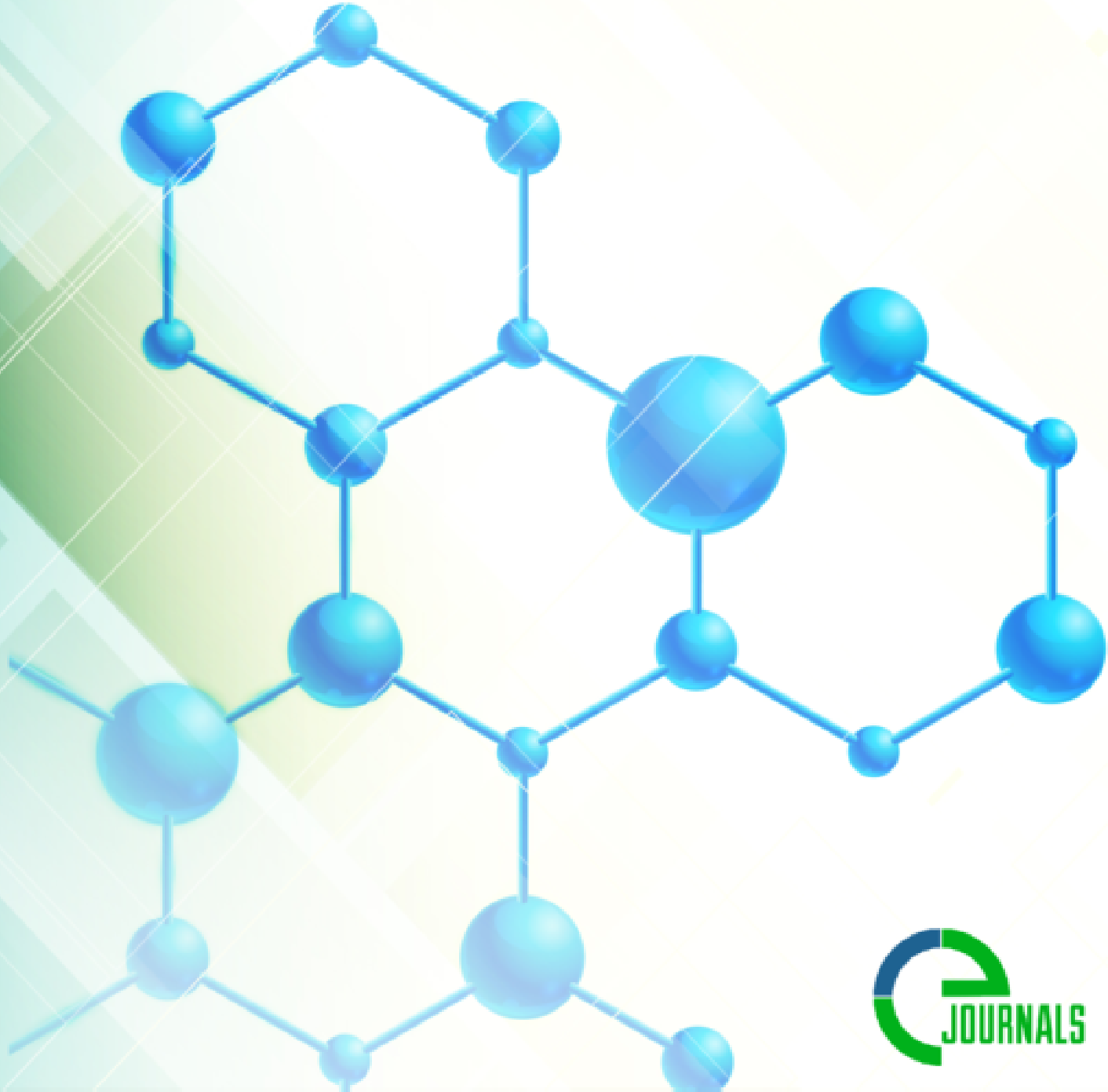
# MOLECULAR MEDICINE



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# CARDIOVASCULAR DISEASE AMONG ARAL SEA REGION POPULATION

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*Abstract: The increase in the appearance and epidemic of many diseases is one of the most significant repercussions of many of the world's lakes drying up. In order to address this, the current study set out to comprehensively assess the impacts of lake drying on human health and especially to cardiovascular system.*

*Keywords: Environmental problems; Aral sea; Cardiovascular disease; Uzbekistan; Kazakhstan; Lakes drying*

Methods.

The current systematic review was designed and conducted in 2022. The data was taken from PubMed, Google Scholar, and Web of Science database. We used Publish and Perish software to find appropriate number of publications and to remove duplicates. In this systematic review, articles and information up to July 2022 were used.

Results.

This systematic review includes unique 11 studies with 12665 participants. Studies were conducted in the North Aral Sea (Kazakhstan n=6) and South Aral Sea (Uzbekistan n=5).In 5 studies, participants were children.The vast majority of the studies are cross-sectional and retrospective studies which indicate that the main cardiovascular diseases are hypertension, arrhythmias, cardiomyopathies and inflammatory disease of circulatory system.

Conclusion.

Almost all studies highlighted the harmful impact of the drying Aral Sea on human health and especially to the cardiovascular system. However, most studies are cross-sectional and case-control studies. Therefore, to obtain more reliable data to conduct longitudinal and long term cohort studies highly required. Furthermore, we would ask the international communities and local governments to take more comprehensive approach to address this global phenomenon.

**Introduction**

The Aral Sea Basin (ASB) which encompasses the Aral Sea, is shared between five countries: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The ASB is mainly fed by two main tributaries: the Amu Darya from the North and Syr Darya from the East. The Aral Sea was once the fourth largest lake in the world and the largest saline endorheic drainage basin in Central Asia. The total area of the Aral Sea in 1960 was 68,478 km2 with a water capacity of 1093 km3. Since then it has drastically reduced due to diminishing water inflow. The water level decreased from 53.40 m to 41.02 m during the period 1960-1986. In 1986, the KokAral Desert was formed which separated the Aral Sea into the North Aral Sea (NAS) and South Aral Sea (SAS) (1)

Drying of a lake causes problems and those of saline lakes foster the worst problems. The reduction in the water-filled area exposes a part of the former lake bottom covered by salt-crusts that are rich in various minerals like sodium chloride, magnesium, calcium, sulphates, borate, lithium, and potassium. (1)

The Aral Sea region - the territory, adjoining to the dying Aral Sea and undergoing its influence, is the large region with the population of 1 million 529 thousands. Aral Sea

disappearance is a well-known ecological disaster. An arid, sharply continental climate, high mineralization, pollution and a shortage of drinking water in Aral Sea region harm human health.(3)This time, the result amounts to a drying out of the lake, which is the most significant event, at least in the last few thousand years, and will soon become the most significant in the last 10,000 years.

Today, the sea covers just over a third of the area it covered in 1960 and the salinity of the sea water has risen from 10 g/l to approximately 35 g/l, a level comparable to that of the world's oceans (Glantz, 1999; Glazovsky, 1995). Salinisation of agricultural land resulting from over irrigation as well as the wind transport of salts from the exposed sea bed compounds the environmental problems. (5)

Of the most important effects of lakes, drying is the emergence and increasing prevalence of dis-eases that brings unwanted experiences to hu-mans. Prevalence of diseases in neighbouring regions of Aral Lake is the epitome of the dis-cussed subject matter. Raised dusts from the basin of Lake Owens in California, the US, contained elements like sodi-um sulfate, sulfur, arsenic, chrome, cobalt, nickel, lead and etc. and caused allergy and respiratory diseases, asthma, sinus infection, headache, ear infection, bronchitis, eye pain, sore throat, coughing, fatigue, lung cancer and cardiovascular diseases.(6)

Dry and hot climate, winds, water shortages, dust storms that raise and spread salt, pesticides and other toxic chemicals over hundreds of kilometres, which are used in the fields adversely affect the health of the population living in the region.(7)

A number of studies have indicated an increase in cancer, respiratory and digestive system diseases, urolithiasis, arterial hypertension, allergic diseases, among the population near the crisis zone.()

Methods

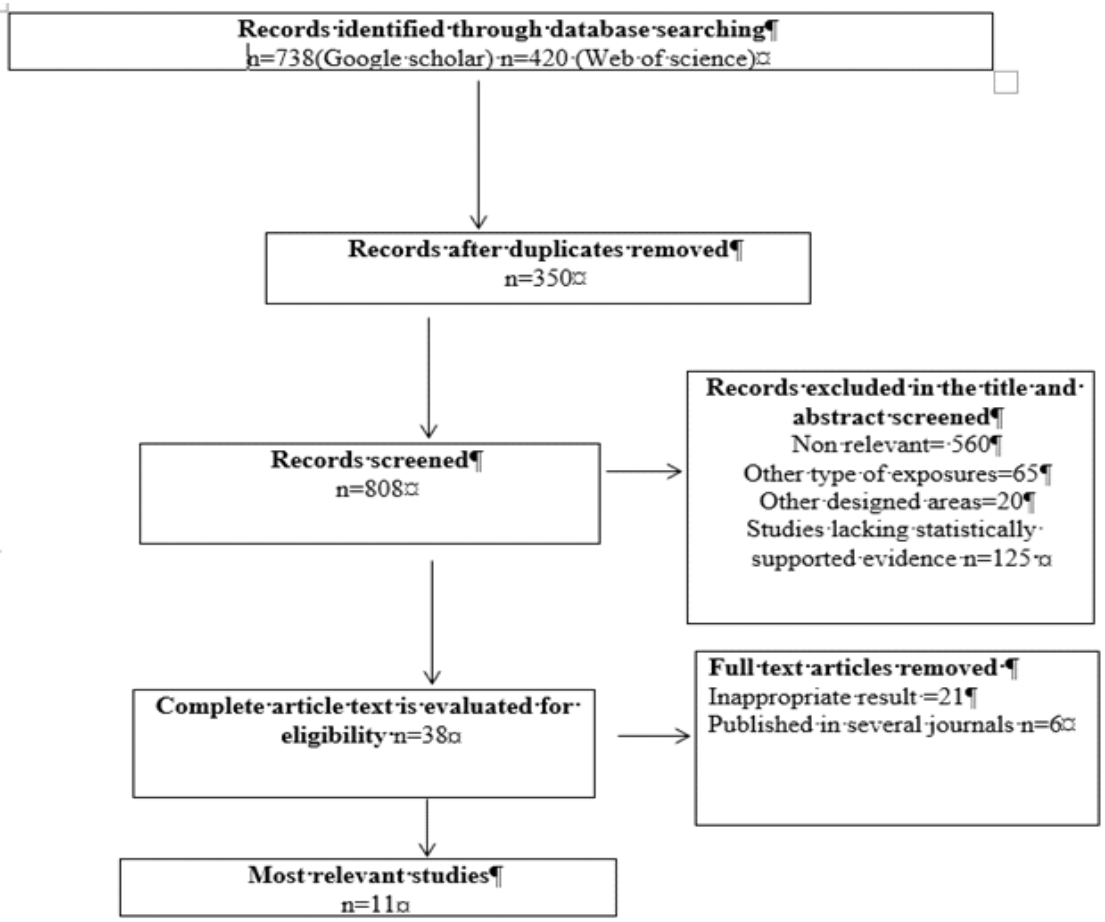
Search strategy

According on the review methodology from the book "Systematic Reviews to Support Evidence-Based Medicine," this systematic review was carried out in 2022.We comprehensively searched Google scholar, PubMed and Web of Science database to collect suitable articles which are associated with Aral sea region and cardiovascular diseases. In this study Publish or Perish software is used to find an appropriate number of studies and to remove duplicates from different database. Furthermore, additional studies were used manually by analysing reference list of the articles.

Inclusion and exclusion criteria

The study includes the articles which met the following criteria: were carried out in environmentally catastrophic and crisis zone of Aral Sea region or neighbourhood, target population were patients in the hospital, or general population of the North and South Aral sea region; or reported risk estimates for cardiovascular disease, coronary heart disease or stroke, arrhythmias and cardiomyopathies. Moreover, we decided to include the articles in Russian language since there is only limited articles in English and many scientists in the region are likely to publish their articles in Russian language.

We excluded articles which have been conducted in other regions from Aral Sea region or target population and outcomes different from any types of cardiovascular disease. Additionally, papers that were not the product of research initiatives (but rather were just the author's own opinions on the subject or remained a hypothesis) were disqualified.




**Quality assessment and data extraction**

To assess quality of the articles the researchers used Newcastle-Ottawa scale for assessing cohort study quality. To summarise data we extracted data according table 1 which included: Firth author, the country of the study, population source, study design, number of participants and health problems and summary of the study.

**Data analysis**

Reporting and data analysis were carried out manually. The results were categorize using content analysis. It is a technique for analysing qualitative data that has been taken directly from articles. The research technique called content analysis is used to identify the existence of specific words, topics, or concepts in a given set of qualitative data (i.e. text). Researchers can quantify and examine the occurrence, significance, and connections of such specific words, themes, or concepts using content analysis.

| Study or lead author | Country | Population source | Study design | Baseline survey | Total follow-up years | No of participants | Health problems | Conclusion | Quality of the study |
|---|---|---|---|---|---|---|---|---|---|
| Tashenova G | Kazakhstan | General | Cross-sectional | 2020 | 1 | 757 | Hypertension, hpotension And arrhythmias | The study shows that cardiovascular disease Are common among children | Fair |
| Rzaev R M | Uzbekistan | University students | Cross-sectional | 2015-2017 | 3 | 126 | Arrythmias | The heart rate of students of the region May depend on seasonal change | Fair |
| Khudainazarova S.R | Uzbekistan | School pupils | Cross-sectional | 2022 | 1 | 36 | Arrythmias | Heart rate variations in children Can be predictors of other illneses | Poor |
| Sakiev K.Z | Kazakhstan | General | Retrospective | | 1 | 538 | Hypertension and coronary Heart disease | The data shown highlights that digestive ,genitourine system and cardiovascular disease is | Good |
| Ibrayeva A.D | Kazakhstan | General | Cross-sectional | | 1 | 9240 | Hypertension and ischemic Heart disease | Cardiovascular disease in Aral sea neighbourhood Is almost the same with control group | Good |
| Akhmedova D.I. | Uzbekistan | Hospital | Cross-sectional | 2015-2017 | 3 | 86 | Cardiomyopathy and Arrythmia | Environmental factors one of the reason of developing Cardiomypathy and arrythymias | Fair |
| Akhmedova D.I. | Uzbekistan | Hospital | Cross-sectional | 2020 | 1 | 96 | Cardiomyopathy | There is a lik between change in microelements In hair and cardiomyopathy | |
| Shukurova D | Uzbekistan | Hospital | Cross-sectional | | 1 | 132 | Hypertension and Nephrosclerosis | The patients in the Aral sea region are characterized By low adherence to treatment | Fair |
| Shadetova A.Z | Kazakhstan | General | Cross-sectional | 2016 | 1 | 804 | Hypertension and arrhythmias | There is a linear increase of hypertension and Arrythmias in environmental crisis zone | Fair |
| Choy.S.V | Kazakhstan | Hospital | Cross-sectional | 1999-2002 | 3 | 423 | Cardiovascular disease | Children living in various ecologically unfavourable regions Have interrelation between of chronic diseases quantity, SAD And cytogenetic parameters | Good Fair |
| Davletgildeeva Z.G | Kazakhstan | General | Cross-sectional | 2013 | 1 | 427 | Congenital heart disease, inflammatory Disease of the heart muscle and Coronary heart disease, arrhythmias | The incidence of cardiovascular disease Among children in Aral Sea region is very high | Fair |

**Results**

Initially, we searched relevant articles and publications from Google Scholar, PubMed and Web of Science database. From 1158 records 350duplicates were removed. In the next stage, we excluded non-relevant articles by title and abstract screening and finally most appropriate 11 studies with 12665 participants were selected.Studies were conducted in the North Aral Sea (Kazakhstan n=6) and South Aral Sea (Uzbekistan n=5). In 5 studies, participants were children. Sample groups for 4 studies were chosen in local hospitals meanwhile 2 studies conducted their survey among school children and university students. The vast majority of the studies are cross-sectional and retrospective studies which indicate that the main cardiovascular diseases are hypertension, arrhythmias, cardiomyopathies and inflammatory disease of circulatory system. Interestingly, the

**Discussion**

Associations between environmental risk and cardiovascular disease outcomes

The exact biological mechanisms of these adverse effects are still unclear. (7)However, three main pathways have been proposed by researchers to explain this relation, including: (8) direct interaction between particles or their components and the cardiovascular system, (9) oxidative stress and inflammation (begins with pulmonary inflammation, progresses to a systemic inflammatory state of oxidative stress, as well as prothrombotic responses by vascular endothelial cells and platelets with expression of inflammatory cytokines, cellular adhesion molecules, and coagulation factors), and (10) stimulation of the autonomic nervous system (i.e., parasympathetic nervous system withdrawal and/ or sympathetic nervous system activation). Also, previous studies have found that it is possible to study this relation by looking at blood markers of inflammation (such as high-sensitive C reactive protein; hs-CRP; an acute-phase protein produced in the liver) and coagulation (such as fibrinogen; it plays a key role in the clotting cascade, where its conversion to fibrin stabilizes blood clots after injuries and has procoagulant and pro inflammatory properties, and promotes athero-thrombosis). (10)

Nervous, cardiovascular, and respiratory systems based on epidemiological data are sensitive human system in exposure to air pollutants. Short-term and long-term exposure to criteria pollutants can be disorders with respect to the function of large organs in the body such as lung, eyes, brain, and heart. According to the result of several studies, the most important symptoms of PM10, O3, NO2, SO2, metals, and PAHs increases morbidity and mortality including coughing, asthma attacks, respiratory, and cardiovascular disease, eye irritation, and heart stroke in humans. According to Middleton et al. the effect of short-term dust storms increased the cardiovascular visits. Based on result of these different studies, the most important complications of inhaling air pollution is a decreased circulating level of endothelial progenitor cells, platelet activation, increased fibrinogen, coronary artery disease , promoting vascular inflammation created in effect exposure to air pollution (11)

**Strength and limitations of the study**

This study is the first systematic review which discusses the adverse effect of the drying Aral Sea to the cardiovascular system of the inhabitants of the region. This systematic review focuses only cardiovascular disease regardless of the type and severity of the illnesses. Only individual level analyses of exposure to dust and various chemical compounds in the crisis area of the drying Aral Sea have been included in the study. However, there are still some limitations of the study. There are limited number of studies which addressed to this issue. Furthermore, most of the researches are cross-sectional and retrospective studies which focus on the limited group of population which are suffering from pre-existing cardiovascular diseases. Therefore, further randomised clinical and long term cohort and cross-sectional epidemiological studies are needed.

Moreover, further request would be to international organisations and policymakers to address this environmental catastrophe to decrease non-communicable diseases including cardiovascular diseases.

**Conclusion**

Almost all studies highlighted the harmful impact of the drying Aral Sea on human health and especially to the cardiovascular system. However, because most studies were cross-sectional and retrospective, which had a low level of evidence, and small number of sample groups in particular geographic area, they were unable to offer us convincing evidence that would allow us to accept or reject with a high degree of certainty the negative effects of lake drying on human health. Therefore, to obtain more reliable data to conduct longitudinal and long term cohort studies are highly required. Furthermore, we would ask the international communities and local governments to take more comprehensive approach to address this global phenomenon.

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