Arch Iran Med. March 2022;25(3):182-190

doi 10.34172/aim.2022.31

http://www.aimjournal.ir

ARCHIVES OF IRANIAN MEDICINE

Open Access

Systematic Review

Adverse Impacts of Imposing International Economic Sanctions on Health

Mohammad Hossein Asgardoon, MD, MPH[1,2]; Mohammad Hosein Amirzade-Iranaq, DDS[1,3]; Ahmad Mehri[4]; Seyed Mohammad Piri, MD, MPH[1]; Parisa Jalali[1]; Zahra Ghodsi, PhD[1]; Hamid Reza Dehghan, MD[5]; Vafa Rahimi-Movaghar, MD[1,6-10]; Payman Salamati, MD[1*]

[1]Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, Tehran, Iran
[2]Iranian Student Society for Immunodeficiencies, Students' Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran
[3]Universal Network of Interdisciplinary Research in Oral and Maxillofacial Surgery (UNIROMS), Universal Scientific Education and Research Network (USERN), Tehran, Iran
[4]Department of Epidemiology, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[5]Research Center for Health Technology Assessment and Medical Informatics, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[6]Universal Scientific Education and Research Network (USERN), Tehran, Iran
[7]Brain and Spinal Cord Injury Research Center, Neuroscience Institute, Tehran University of Medical Sciences, Tehran, Iran
[8]Department of Neurosurgery, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran
[9]Institute of Biochemistry and Biophysics, University of Tehran, Tehran, Iran
[10]Visiting Professor, Spine Program, University of Toronto, Toronto, Canada

Abstract

Background: International economic sanctions (IES) influence a country's economic development and the overall welfare of a nation's population.

Methods: An electronic search of PubMed, Embase and Web of Science was conducted until July 31, 2019. Additionally, a list of references to related articles was reviewed. Key search terms were "Economics", "Health", "Sanction", and their equivalents with no language or time restriction.

Results: Totally, 8624 records were identified of which 2869 duplicates were deleted. Finally, 24 papers met the inclusion criteria and were selected for drafting. The number of papers included for evaluating each factor included healthcare (n=16) and pharmaceutical industry (n=10). Nine and eight studies examined the effect of sanctions imposed on Iran and Iraq, respectively. France, Haiti, Serbia, Cuba, Syria, and other areas such as Africa were also evaluated. Sanctions lead to a decrease in immunization rates and government health care expenditures. Sanctions increase infant and under-five mortality rate, road traffic injuries and fatalities, severe malnutrition, infective diseases, neurologic and visual disorders, as well as shortage of medical or dental instruments and a variety of medicines. Sanctions have adverse impacts on female labor and are associated with disabling hospitals, dispersing medical workers, and facilities for radiation therapy.

Conclusion: The health status of sanctioned nations in terms of healthcare, and pharmaceutical industry was adversely affected in targeted countries.

Keywords: Boycott, Drug industry, Economic sanction, Embargo, Health care sector

Cite this article as: Asgardoon MH, Amirzade-Iranaq MH, Mehri A, Piri SM, Jalali P, Ghodsi Z, et al. Adverse impacts of imposing international economic sanctions on health. Arch Iran Med. 2022;25(3):182-190. doi: 10.34172/aim.2022.31

Received: June 9, 2021, Accepted: September 22, 2021, ePublished: March 1, 2022

Introduction

International economic sanctions (IES) are defined as one or more international actors (implementing sanctions) imposing financial, trade, and economic restrictions, on one or more other countries (the target of sanctions), in order to punish these countries, depriving them of performing certain exchanges or forcing them to accept certain norms.[1] IES have different aspects. Sometimes these sanctions include trade issues such as restricting international travel to certain countries, blocking bank accounts, banning countries from exporting to other countries, and imposing tariffs to reduce economic and banking activities.[2,3]

The indirect consequences of these restrictions are not as visible as war casualties and may affect other dimensions.[4] One of these complex dimensions is the relationship between health aspects and the economic situation of that country.[5]

The adverse effects of IES on health dimensions can be investigated. Studies have shown that sanctions lead to poor nutrition, increased infant mortality among the 1–4 year-old, and reduced number of foods in sanctioned countries.[6] Although studies have shown that sanctions can affect wellbeing, human rights, mental and social health indicators, but given the wide range of health dimensions, only a few studies have evaluated the adverse impact of sanctions on other health aspects such as access to medicines, scientific progression, healthcare, and

***Corresponding Author:** Payman Salamati, MD; Sina Trauma and Surgery Research Center, Sina Hospital, Hassan Abad Square, Imam Khomeini Avenue, Tehran, Iran. Tel: +98-21-66757001-5; Fax: +98-21-66757009; Email: psalamati@tums.ac.ir, salamatip@gmail.com

international health collaboration. This study aims to determine the effects of IES on the healthcare system and the pharmaceutical industry in targeted countries by systematically reviewing all relevant published studies.

Materials and Methods

Search Strategy

An electronic search of PubMed, Embase and Web of Science was conducted until July 31, 2019 (Supplementary file 1) by an expert (H.D). Additionally, a list of related articles among references was reviewed. No language or time restriction was considered for the literature search. The PubMed search syntax was performed using Emtree terms, medical subject headings (MeSH), and free text words. This syntax was adapted to other databases. The key search terms were "Economics", "Health", "Sanction", and their equivalents. The PubMed search strategy is shown in Supplementary file 1. To increase the sensitivity of the search strategy, American and British spelling differences were taken into account.

Selection Method

All published articles on economic sanctions were tested using a search strategy. Four reviewers (MH.A, A.M, M.AI, P.J) independently screened the titles/abstracts of the studies after deduplication. Two independent reviewers reviewed each record in one group. Considering the inclusion and exclusion criteria, the four reviewers, every two in one group, reviewed independently the full text of eligible papers. The discrepancies regarding the eligibility of studies were resolved by another person (Z.G).

Inclusion and Exclusion Criteria

All studies which reported the adverse impacts of IES on health were included in this study. Case series with at least 10 cases were included in our review but the case reports were excluded. Among publications describing any types of sanctions and their impacts, only the data of countries with "economic" sanctions were obtained for the evaluation. Comparing studies which reported using a similar database, we included the study with a greater study population and less missing data in our review. The exclusion criteria were secondary studies, gray literature, letter to editors, conference posters, books, and conference abstracts. Studies for which the full text was not found despite contacting the corresponding author in three consecutive weeks for three time-intervals were also excluded from the review.

Outcomes

Clinical and social outcome measures were evaluated. The main outcome of the study was "health" and the secondary outcomes were "scientific progression, international health collaboration, health workforce, poverty, healthcare system, pharmaceutical industry, international grants, and development assistance".

Scientific Progression

An episode in science is progressive when at the end of the episode, there is more knowledge than at the beginning. It is measured by innovation, membership, publication, and conference attendance.[7] International health collaboration is defined as informal engagement of individuals in consultations, participating in conferences, or site visits, creating complementary research agendas, or advising.[8] The health workforce in the literature is attributed to the people who are involved in actions with the main goal of improving health. It is measured by the number of health workers (doctors, nurses, midwives, dentists, and pharmacists per 100 000 population).

Poverty from a health standpoint is defined as the inadequacy of the required amount of food consumption, self-health, and access to the health care system. Poverty is measured as the poverty line which was originally introduced as a person or family income of $1 per day.[9] Using purchasing power parity exchange rates, the poverty line was reset to $1.90 per day by the World Bank. Relative poverty, as an outcome measure, is defined as 50% less income than the average median income.[10] Healthcare is defined as services provided to individuals or communities by agents of the health professions or health services to promote, maintain, monitor, or restore health and is not limited to medical care, which implies therapeutic action by or under the supervision of a physician.[11]

The pharmaceutical industry discovers, develops, produces, and markets drugs or pharmaceuticals for use as medications to be (self)administered to patients, aiming to cure, vaccinate, or relieve a symptom.[12] International grants provide financial resources, usually in the form of money, and are measured by the number of international grants delivered to medical researchers or the number of international grants delivered to medical researchers.[13] Development assistance for health (DAH) has been defined as "financial and in-kind contributions made by channels of development. Assistance – that is, by institutions whose primary purpose is providing development assistance to improve health in developing countries".[14] It is measured by the number or amount of development assistance for health which is delivered to the countries.

Data Extraction

We utilized pre-developed forms. From each study, we collected general information (first author, year of study, country), methods (study setting, study type, sample size, follow up period), participants (age, gender), poverty, healthcare, pharmaceutical industry, medical devices industry, scientific progression, international health collaboration, health workforce, international grants, development assistance for health, and duration of the economic sanction. Four review authors extracted data independently, every two in one group, (MH.A, A.M, M.AI, P.J.). The fifth person re-examined the input data (M.P.); there were questions that were answered by focus discussions and reference to the original article. To

evaluate and compare the outcome measures of people under economic sanctions, we grouped the extracted factors.

Assessment of Methodological Quality

Overview of the existing literature based on resource limitations and purpose of the scoping review was conducted without quality assessment. No study was found to discuss four outcomes including poverty, international health collaboration, development assistance for health, and international grants. Two studies[15,16] were found for health workforce and one study[17] for scientific progression. Therefore, the aims of the study were reduced to evaluating the adverse impacts of IES on the pharmaceutical industry, and healthcare.

Statistical Analysis

In this study, we used the thematic analysis method to compare and classify the heterogenous studies included for the scoping review.

Results

Results of the Search

A total of 8624 records were identified through the database search, of which 2869 duplicates were deleted. A total of 5616 out of 5755 studies were excluded in the title/abstract screening phase. The full texts of the remaining 139 articles were reviewed in detail, 114 of which were excluded due to the following reasons: type of study (n = 73), not related (n = 33). We contacted the corresponding authors of studies with unavailable full texts in three consecutive weeks for three-time intervals. In case of no response, they were excluded from the review (n = 8). We found no article for evaluating the following outcomes: international health collaboration, international grants, poverty, and development assistance. Two studies[15,16] were found for health workforce and one study[17] for scientific progression, which the authors decided to exclude from the study due to lack of a sufficient number of studies conducted. Finally, 24 papers met the inclusion criteria and were selected for drafting (Figure 1).

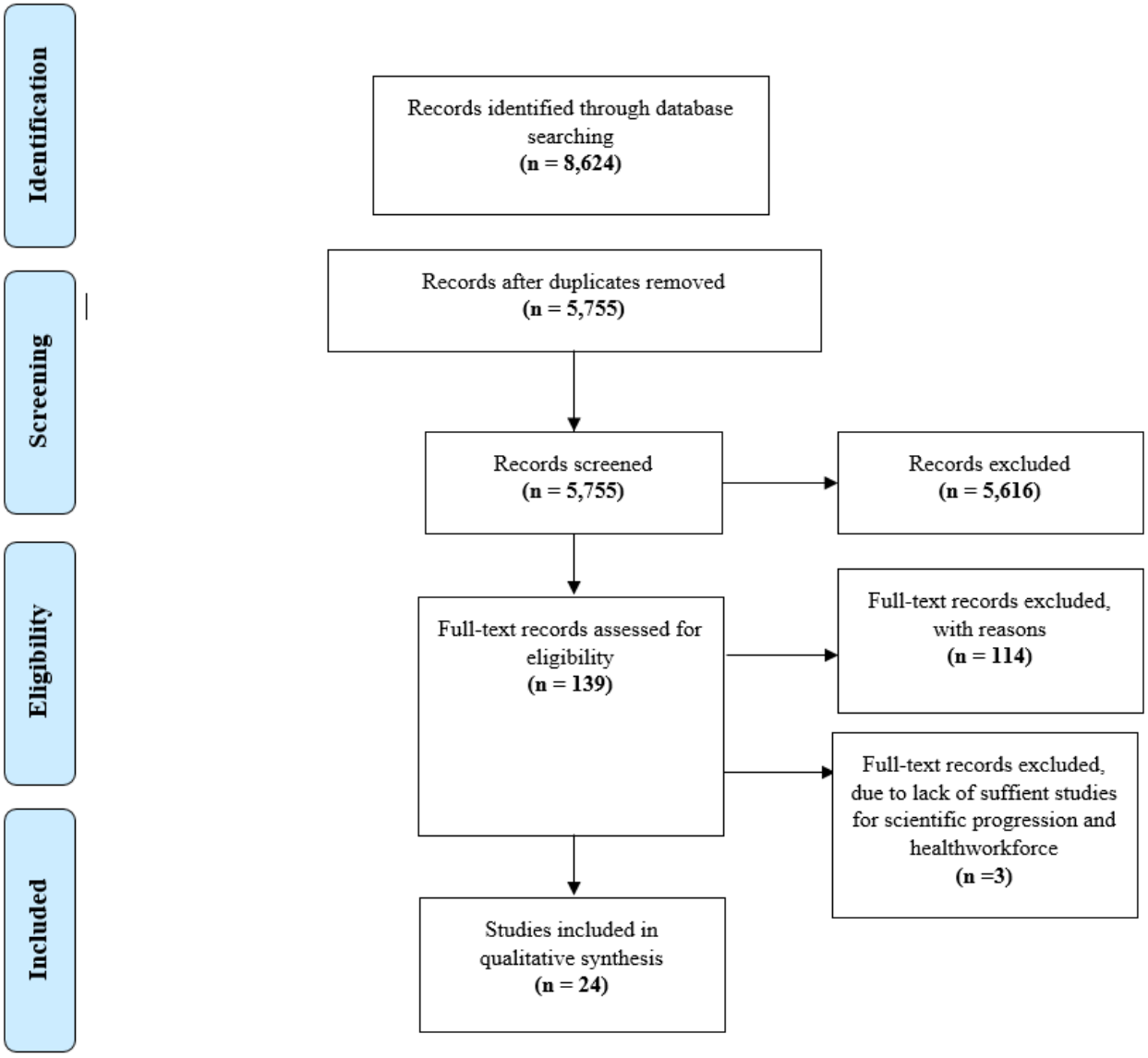

Figure 1. Study flow diagram, PRISMA 2009 Flow Diagram.

Adverse Impacts of International Economic Sanctions on Healthcare

Sixteen studies have been reported to evaluate the impacts of IES on healthcare which are summarized in Table 1.[15,16,18-31]

The majority of published studies investigating the economic crises' effect on health have focused on immediate (rather than long-term) health impacts during or shortly after the crisis. Long-term health consequences, like chronic diseases, which need more follow-up have

Table 1. Adverse Impacts of International Economic Sanctions on Healthcare

First Author & Year	Type of Study	Key Findings
Abbas, 2008[15]	A descriptive cross-sectional study	• 20% of females had a positive family history of congenital disabilities and inherited conditions. Reports of congenital disabilities and inherited conditions in the woman's family also showed a similar incidence in the family of the man when the intended spouses are close relatives. • It was recommended that strategies and policies for improving prenatal health should be a priority in Iraq at the national and international levels in the rebuilding process.
Kim, 2019[16]	An ecologic study	• Sanctions accelerate females' HIV infection rate by two methods: (1) Decreasing the public resources for health facilities and health care and (2) changing the employment status. • Sanctions affect women's labor status, and in turn, their health, and reduced female labor participation can affect other health issues related to women.
Djordjevic, 2003[18]	A descriptive cross-sectional study	The trichinellosis outbreak was purposed to result from the previous war, political upheaval, and international economic sanctions.
van der Werff, 2012[19]	Cross-sectional	The population under the nineties' economic situation who were in their infancy or early childhood were inversely associated with allergic rhinoconjunctivitis occurrence and asthma attacks later in childhood.
Đurić, 2008[20]	Cross-sectional	Road traffic injuries and fatalities were more frequent during IES and military activity than sanctions with no military activity.
Daponte, 2000[21]	Cross-sectional	They found that after controlling for child and maternal characteristics when IES were entered into the proportional hazard equation, the risk of dying increased significantly.
Amin, 2005[22]	Cross-sectional	• Infantile tremor syndrome was unknown in the region before 1990; however, following the UN sanctions and the sanctions imposed by the Iraqi government, the residents' economic state deteriorated and new cases of young children and infants' malnutrition appeared. • Meat and peas as high-protein diets in the area became increasingly expensive and unaffordable for the majority of people. Also, lack of fruits and vegetables leads to vitamin deficiencies which all support the etiology of their nutritional status.
Ameri, 2017[23]	A descriptive cross-sectional study	• From 2010 to 2015, 70%, of cobalt-60 decreased, from 25 to 8 units. • The available Iranian radiation therapy facilities are significantly far from international standards.
Allen, 2012[24]	A quantitative cross-national study	• An insignificant decrease in food supply level and a significant decrease in government health care costs was observed over the conflict years and IES. • Sanctions could increase mortalities but their effect on mortality is less than military conflicts. • Resource reduction could have a significant impact on the population's welfare and their capability of living a healthy life. • Sanctions adversely affected the health care budgets in countries which were involved in military wars and conflicts such that reports indicate that during minor and major sanctions, a 25% and 16% decrease was observed, respectively.
Ahmed, 2007[25]	A descriptive cross-sectional study	• DMFT index was reported to be 1.3 in the low, 1.8 in the middle, and 1.7 in the high socioeconomic class. • Filled teeth as another variable for economic inequality revealed significant differences in high socioeconomic class compared to other classes ($P<0.001$).
Jamel, 2004[26]	An analytical cross-sectional study	• In children 6-7 years old, the DMFT index was 4.8 ± 4.0 before and 2.3 ± 2.4 after UNS. • In children from 11 to 12 years old, the DMFT index was 4.2 ± 3.8 and 1.6 ± 2.9 before and after UNS. • In 14- to 15-year-old children, DMFT was 5.3 ± 4.4 and 1.9 ± 1.8 before and after UNS. • After UNS, children from urban groups with higher socioeconomic status had more decayed than filled teeth.
Kim, 2018[27]	An ecologic study	Sanctions were associated with weak immune systems in pregnancy due to lack of sufficient food, health systems degradation, lowered school attendance, decrease in health resources, and lack of specific medications; therefore, it adversely affected HIV/AIDS status and increased AIDS-related mortalities in children.
Mladenovich, 2009[28]	Cross-sectional	• Loss of sight and lower visual acuities (<20/400) were more observed in the age group who were born and lived over the years of IES, military conflicts, or war. • A significant increase in the rate of premature retinopathy was reported in two age cohorts. It was associated with maternal anxiety, fear, chronic stress, and substance abuse which itself was indirectly associated with IES, military conflicts, and wars and directly associated with the health care system burdens.
Reid, 2007[29]	A longitudinal cohort study	• The mortality rate and severe malnutrition among children under two years of age increased in Haiti during IES although the study population had continuous access to humanitarian help. • From 1992 to 1994 in Haiti, the under 1 mortality rate was highest, which overlaps the IES period, and these statistics were significantly different during 1995 to 1996 ($P<0.01$), the time after the release of sanctions and also before imposing IES ($P=0.06$).
Ali, 2000[30]	A descriptive cross-sectional study	• An increase in the infant mortality rate was observed from 47 to 108 per 1000 live births over ten years from 1984-1989 to 1994-1999. • An increase in the under-five mortality rate was observed from 56 to 131 per 1000 live births during those years.
Ascherio, 1992[31]	Cross-sectional	A threefold increase in the under-five mortality rate of Iraqi children was observed during the Persian Gulf war and the sanctions (The age-adjusted relative mortality rate of 3.2 for after war period comparing to before the war era).

DMFT: decayed, missing, and filled teeth; IES, International economic sanctions; UNS, United Nations sanctions.

been less evaluated.

The decayed, missing, and filled teeth (DMFT) index was investigated in two studies[25,26] in Iraq. The results revealed that after the end of the sanctions, sugar products returned to the market and became commonly available to the whole population. In the second study,[26] the DMFT index was reported in different age groups before and after the sanctions (Table 1). They concluded that caries experience in children and sugar consumption drastically reduced after implementing the UNS.[26]

Kim, in a model analysis of 71 developing countries, revealed that sanctions increase children's new HIV infection and their AIDS-related death rates.[27] In another model analysis of 84 developing countries, Kim revealed that sanctions affect women's labor status, leading to change in their health status, affecting other health issues related to women.[16]

The data source of published articles that evaluated the impacts of sanctions on health is not reliable; also there were simultaneous economic crises beside sanctions in Iraq which altogether limits the available reports on the effect of economic sanctions on mortality.[21] In this regard, in an Iraqi study, individual child records after the 1991 Persian Gulf War were reviewed to examine the effect of sanctions on Iraqi children's mortality. The results revealed that the children's mortality rate increased significantly over the economic sanctions, and a higher mortality risk was observed than the pre-sanctions period. The effect of sanctions on child survival exceeded the effect of confounders such as gender, mother's education, presence of siblings, urban residence, and mother's age at the child's birth.

Adverse Impacts of International Economic Sanctions on the Pharmaceutical Industry

Ten studies have been reported to evaluate the impacts of sanctions on the pharmaceutical industry, summarized in Table 2.[15,27,32-38]

In an Iranian study, about 3300 various dosage forms of around 1400 drug molecules available in the Iran drug list were classified based on their respective ATC codes and six different statistical forecasting models. They reported that the Iranian pharmaceutical market had undergone a couple of significant ups and downs in the past two decades due to governmental financial support policies, national currency devaluation, extensive drug shortages, and sanctions (Table 2). An Iranian interrupted time series evaluating the impacts of sanctions on drug availability for multiple diseases such as asthma, diabetes, multiple sclerosis, and cancer showed that sanctions adversely affected drug availability. The study reported that imported drugs and those dependent on imported raw materials were more affected by economic sanctions.[33]

Discussion

The present study provides evidence of the adverse effects of IES on health in two aspects: healthcare, and the pharmaceutical industry. We reviewed 26 eligible articles from the early 8,624 records identified through the database search and then classified the adverse effects of sanctions on health issues into three distinct categories. In the initial assessment of the location of each study, eight studies[15,21,22,25-27,30,31] focused specifically on the Iraqi population. Nine studies[23,32-37,39,40] examined the effect of sanctions imposed on Iran. Due to the many sanctions imposed by the United States on Iran, the number of these studies is also high. The other studies examined the effects of sanctions on other countries, such as France,[17] Haiti,[6,29] Serbia,[18,20,28] Cuba,[19,38] Syria[41-44] and other areas like Africa.[14]

Among the countries that impose sanctions, the U.S. has the highest rate of sanctions against others. This finding

Table 2. Adverse Impacts of International Economic Sanctions on the Pharmaceutical Industry

First Author & Year	Type of Study	Key Findings
Abbas, 2008[15]	A descriptive cross-sectional study	The prevalence of anemia (Hb: 10–11.99 g/dL) among the study population was high (62.8%); 0.4% of the study population had deficient level of Hb (8.0–9.99 g/dL), and only 36.8% (one-third) of the study population had normal hemoglobin levels.
Kim, 2018[27]	An ecologic study	Sanctions caused specific drug shortages, which lead to an increase in AIDS-related death rates in children.
Yektadoost, 2018[32]	A descriptive cross-sectional study	The Iranian pharmaceutical market is projected to grow 6.6% annually over the next 5-year period (2017–2022), which would exceed the last five years (CAGR 2011–2016) by 0.5% reaching $7.857 billion by 2022.
Kheirandish, 201[83]3	Interrupted time-series	• The market availability of almost half of the studied drugs was significantly decreased. • Six of the affected drugs were only imported and the local companies did not produce them and one of the drugs was generic.
Ghiasi G., 2014[34]	A descriptive cross-sectional study	19% and 42%. reduction in the availability of imported and generic asthma medications were observed in the country due to IES while there was already lack of some imported medications during 2012.
Setayesh, 2016[35]	A descriptive cross-sectional study	Although efforts for implementing humanitarian goods' trade like export control exemptions have been done for certain pharmaceuticals and medical devices, Iran increasingly faced necessary medical and pharmaceutical shortages probably due to the hesitance and lack of cooperation of several pharmaceutical companies and international banking institutions to do business with countries under IES.
Asadi-Pooya, 2019[36]	A descriptive survey	Following reimposing and intensifying IES on Iran, the majority (53%) of individuals suffering from or with past medical history of epilepsy faced significant difficulties in finding and purchasing their drugs.
Asadi-Pooya, 201[53]7	A retrospective chart review study	About one-third of patients with epilepsy had poor drug adherence, increasing the risk of uncontrolled seizures (pseudo-intractability) or even status epilepticus.
Drain, 201[03]8	Narrative review	Travel restrictions and trade embargos restricted medical imports and travel to Cuba.
Karimi, 2014[40]	A descriptive cross-sectional study	Over four years, from 2009 to 2012, the accessibility of iron chelator therapies such as deferoxamine and Exjade decreased considerably for patients with thalassemia.

FFP, fresh frozen plasma; HJHS, Hemophilia Joint Health Score; NCDs, non-communicable diseases; UNS, United Nations Sanctions; IES, International economic sanctions.

was almost expected. This destructive effect is more significant in the aspect that the United States is a leading country. Along with this, Peksen[45] showed that sanctions will have more destructive effects if imposed by the United States on another country. Most of the studies evaluated in the present study have focused on countries subject to long-term sanctions, and the resulting health effects could also be linked to healthcare.[15,16,24-27,29-31]

The impact of IES on various health indicators has been reported in many studies[29-33] from mortality indicators to life expectancy and proper nutrition and healthy drinking water status. The common denominator among all these studies is that IES jeopardize health indicators by worsening nutrition and access to healthy food, increasing mortality, and reducing life expectancy. These results are accompanied by results of some studies that suggest that upcoming IES, including medical and humanitarian exceptions, could lead to an extreme increase in unintentional infant mortality.[29] Moreover, sanctions imposed on the Syrian economy in 2001 have increased costs and reduced the purchasing power of households, especially those with children, pregnant women, and the elderly.[43,44]

Undoubtedly one of the indirect effects of sanctions was to raise one of today's global concerns, such as HIV/AIDS, in vulnerable populations; women and children. Our reviewed articles identified in two separate studies[25,34] how sanctions help increase the rate of HIV/AIDS in both aspects of healthcare and the pharmaceutical industry (Table 1). On the other hand, although no study has been conducted in this field, it is predicted that sanctions can affect early diagnosis of the disease and its screening by reducing the availability of diagnostic kits.

Two studies[27,28] reported that the main factors that have affected the DMFT index have been the deteriorating economic situation of the people and the cost of living after the sanctions in Iraq. Lack of access to essential amenities was another reason for an increase in DMFT after the sanctions. Our results are in agreement with the findings of another study[46] which states that reduced income due to sanctions is associated with reduced purchasing power and less utilization of health services, thus reducing the use of preventive care in general. However, it is inevitable to mention that in our scoping review, we have only reported the limited published articles which evaluated the effects of sanctions on health; therefore, only two studies[25,26] on DMFT and its association with economic sanctions, both conducted in Iraq, cannot be considered as a general outcome, highlighting the need for further studies in this field.

Another point which was obtained from the articles is that in most of the reviewed studies, the focus is more on the vulnerable population such as infants,[22,27,47] children,[25,27,29,37] pregnant women,[22] homeless persons,[39] and people with comorbidities[19,23,34,36,40,48,49] who can be affected by any kind of sanctions. These results are in agreement with the findings of another study that has considered sanctions in different areas with different intensities.[50]

The effects of sanctions on access to health always had two sides. The direct effects have been due to the imposition of certain restrictions on the part of a country's structure, while its indirect effects could, for example, have indirectly led to food supply safety, civil wars, protests, and ethnic strife and thus to the migration of educated people.[15] Studies have shown that the effect of sanctions on pharmaceutical products is more pronounced on market availability and short access to basic amenities.[34,40] It was also shown in a study that existing Iranian facilities for radiation therapy significantly differ from international standards.[23]

Although there is limited published evidence, UN reports confirm the findings of the available studies by mentioning the adverse impacts of economic sanctions on the health of the countries. In this regard, Ban Ki Moon, the General Secretary, in 2012 declared that IES on Iran significantly affected the general population, which lead to a severe rise in inflation and increased energy prices and commodity costs; moreover, the rate of unemployment increased and essential products such as medicine became less available. He stated that the sanctions also appeared to be affecting humanitarian operations in the country. He mentioned that companies with the license to import food and medicine inside Iran were encountering problems to find third-country banks to make the transactions.[51] Specifically, the number of working and street children increased from 2009–2013 who had limited access to healthcare and education according to the UN Economic and Social Council.[52] The UN General Assembly reported that IES had negative impacts on the health and quality of life of people in Iran, particularly the elderly and children groups. From 2012 to 2013, the medications necessary for the management of diseases such as cardiovascular diseases, malignancies, thalassemia, hemophilia, multiple sclerosis, and HIV/AIDS were not accessible. Unfortunately, the international agreement regarding the humanitarian exemptions for food, medicines, and medical supplies was not fulfilled.[53] The IES had adverse impacts on the life of refugees in Iran, as well as the costs of humanitarian and operational assistance of the UN, reported by the UN Refugee Agency.[54] The UN Secretary-General declared that some groups of the society such as female-headed families and unemployed women were vulnerable to Iran's economic decline in recent years because both female-headed families and unemployed women are economically dependent and more probable to face poverty.[55]

So far (July 22, 2021), COVID-19 has unfortunately affected almost 190 countries, with more than 188 million cases and 4 million deaths globally according to data from the World Health Organization (WHO).[56,57] Meanwhile, over 3.4 million people have been infected in Iran, and 86,000 deaths have been reported. Some of the other aspects of health which are affected by IES including access

to essential medicines and equipment, such as respirators and protective equipment for healthcare workers have been repeatedly highlighted by human rights reports.[56] According to the UN reports, IES have been adversely affecting the medical efforts in other countries such as Venezuela, Cuba, Zimbabwe, and the Democratic People's Republic of Korea.[56]

Sanctions and civil wars are sometimes closely linked. Most of the included studies which were under sanctions, had previously suffered from civil or foreign wars. Also, an increase in the number of post-war refugees and internally displaced[42,58] has led to poor access to health services. These cases are in line with Silver's study[59] which reported that «personality trauma» can affect people's feelings and attitudes in various psychological, physical, and economic dimensions. Sanctions are imposed in different countries with different situations and infrastructures. Sanctions are imposed for political reasons and health policymakers may not be able to play a role in such decisions; nevertheless, health professionals can be sensitive, identify the risk factors and try to reduce the probable damages. Finally, the important question which future studies should answer is how to prevent the harm of IES on the health of the nations, specifically for the more vulnerable groups such as children and pregnant women.

The majority of records retrieved by this research were observational studies describing the effects of sanctions without any integrated data. The main limitation of these observational and uncontrolled studies is potential confounders related to data gathering and inclusion for performing the content analysis for the study outcomes. The health status of a nation is associated with multiple factors, including scientific progression, international health collaboration, health workforce, poverty, healthcare system, pharmaceutical industry, international grants, and development assistance which have also been shown to be affected by economic sanctions. Unfortunately, these factors are unmeasurable or hard to measure qualitatively; moreover, adjustment was performed only in a few studies and among these studies, only several and not all of the factors were adjusted. Most of the studies did not control any kind of potential confounders; nevertheless, there were studies that stratified various factors but they were not controlled while performing the analysis. Selection bias is another methodological concern regarding confounders as the study population was not randomly included. Another limitation of our review is the lack of sufficient studies found for two outcomes of our study: scientific progression and health workforce.

In conclusion, sanctions aim to force governments but directly affect the health status of nations and populations. Health exceptions and international aids, regardless of amounts and quality, proved to be insufficient. We conclude that the health status of sanctioned nations in terms of healthcare and pharmaceutical industry are adversely affected in targeted countries. Sanctions are not the only reason for health insufficiency and difficulties.[60] Underlying issues, including the effects of civil wars,[4,27] dictatorships,[61] post-war anarchy, insufficient drug supplies,[38] health infrastructure,[62] workforce, and financial[63] resources have significant adverse impacts on health indices.[38] More studies need to be conducted to evaluate the effect of sanctions on international health collaborations, international grants, scientific progression, health workforce, and development assistance in target countries.

Authors' Contribution

MHA, MHAI, AM, SMP and PJ: Material preparation and data collection. PS, HRD, and MHA: Design of the work. HRD: design the search strategy. ZG: Communication with team members and corresponding author. MHA developed the initial draft of the manuscript, with supervision of PS and VRM; other authors provided feedback on prior drafts. All authors contributed to the study's conception and design. All authors read and approved the final manuscript.

Conflict of Interest Disclosures

All authors declare that they have no conflict of interest.

Ethical Statement

This study was approved by the Ethics Committee of Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences with reference number 98-01-38-346.

Acknowledgments

This study was supported by Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences with the grant number 98-01-38-41021.

Supplementary Materials

Supplementary file 1 contains Table S1.

References

1. Hufbauer GC, Schott JJ, Elliott KA. Economic Sanctions Reconsidered: History and Current Policy. Vol 1. Peterson Institute; 1990.
2. Davis L, Engerman S. History lessons: sanctions-neither war nor peace. J Econ Perspect. 2003;17(2):187-97. doi: 10.1257/089533003765888502.
3. Lopez GA, Cortright D. Economic sanctions in contemporary global relations. In: Economic Sanctions. Routledge; 2018. p. 3-16.
4. Alnasrawi A. Iraq: economic sanctions and consequences, 1990-2000. Third World Q. 2001;22(2):205-18. doi: 10.1080/01436590120037036.
5. Morin K, Miles SH. The health effects of economic sanctions and embargoes: the role of health professionals. Ethics and Human Rights Committee. Ann Intern Med. 2000;132(2):158-61. doi: 10.7326/0003-4819-132-2-200001180-00013.
6. Gibbons E, Garfield R. The impact of economic sanctions on health and human rights in Haiti, 1991-1994. Am J Public Health. 1999;89(10):1499-504. doi: 10.2105/ajph.89.10.1499.
7. Bird A. What is scientific progress? Noûs. 2007;41(1):64-89. doi: 10.1111/j.1468-0068.2007.00638.x.
8. Meslin EM, Garba I. International collaboration for global public health. In: Public Health Ethics: Cases Spanning the Globe. Cham: Springer; 2016. p. 241-84.
9. Sumner A. Meaning versus measurement: why do 'economic' indicators of poverty still predominate? Dev Pract. 2007;17(1):4-13. doi: 10.1080/09614520601092485.
10. Ferreira F, Jolliffe DM, Prydz P. The international poverty

line has just been raised to $1.90 a day, but global poverty is basically unchanged. How is that even possible? 2015. Available from: https://blogs.worldbank.org/developmenttalk/international-poverty-line-has-just-been-raised-190-day-global-poverty-basically-unchanged-how-even.
11. World Health Organization (WHO). Delivering Quality Health Services: A Global Imperative for Universal Health Coverage. WHO; 2018. Available from: https://apps.who.int/iris/handle/10665/272465.
12. Kola I, Landis J. Can the pharmaceutical industry reduce attrition rates? Nat Rev Drug Discov. 2004;3(8):711-5. doi: 10.1038/nrd1470.
13. Mendes PH, Martelli DR, de Souza WP, Quirino Filho S, Martelli Júnior H. Profile of medical researchers with scientific productivity grants from the Brazilian National Research Council (CNPq). Rev Bras Educ Med. 2010;34(4):535-41. doi: 10.1590/s0100-55022010000400008.
14. Zhao Y, Micah AE, Gloyd S, Dieleman JL. Development assistance for health and the Middle East and North Africa. Global Health. 2020;16(1):14. doi: 10.1186/s12992-020-0545-z.
15. Abbas WA, Azar NG, Haddad LG, Umlauf MG. Preconception health status of Iraqi women after trade embargo. Public Health Nurs. 2008;25(4):295-303. doi: 10.1111/j.1525-1446.2008.00709.x.
16. Kim Y. Economic sanctions and HIV/AIDS in women. J Public Health Policy. 2019;40(3):351-66. doi: 10.1057/s41271-019-00173-6.
17. Bégaud B, Verdoux H. Did the US boycott of French products spread to include scientific output? Bmj. 2004;329(7480):1430-1. doi: 10.1136/bmj.329.7480.1430.
18. Djordjevic M, Bacic M, Petricevic M, Cuperlovic K, Malakauskas A, Kapel CM, et al. Social, political, and economic factors responsible for the reemergence of trichinellosis in Serbia: a case study. J Parasitol. 2003;89(2):226-31. doi:10.1645/0022-3395(2003)089[0226:spaefr]2.0.co;2.
19. van der Werff SD, Polman K, Ponce MC, Twisk JW, Junco Díaz R, Gorbea MB, et al. Childhood atopic diseases and early life circumstances: an ecological study in Cuba. PLoS One. 2012;7(6):e39892. doi: 10.1371/journal.pone.0039892.
20. Đurić P, Peek-Asa C. Economic sanctions, military activity, and road traffic crashes in Vojvodina, Serbia. Inj Prev. 2008;14(6):372-6. doi: 10.1136/ip.2008.019240.
21. Daponte BO, Garfield R. The effect of economic sanctions on the mortality of Iraqi children prior to the 1991 Persian Gulf War. Am J Public Health. 2000;90(4):546-52. doi: 10.2105/ajph.90.4.546.
22. Amin NM, Zeki JM. Infantile tremor syndrome in Iraqi Kurdistan. Indian J Pediatr. 2005;72(10):839-42. doi: 10.1007/bf02731110.
23. Ameri A, Barzegartahamtan M, Ghavamnasiri M, Mohammadpour R, Dehghan H, Sebzari A, et al. Current and future challenges of radiation oncology in Iran: a report from the Iranian society of clinical oncology. Clin Oncol (R Coll Radiol). 2018;30(4):262-8. doi: 10.1016/j.clon.2017.12.021.
24. Allen SH, Lektzian DJ. Economic sanctions: a blunt instrument? J Peace Res. 2013;50(1):121-35. doi: 10.1177/0022343312456224.
25. Ahmed NA, Åstrøm AN, Skaug N, Petersen PE. Dental caries prevalence and risk factors among 12-year old schoolchildren from Baghdad, Iraq: a post-war survey. Int Dent J. 2007;57(1):36-44. doi: 10.1111/j.1875-595x.2007.tb00116.x.
26. Jamel H, Plasschaert A, Sheiham A. Dental caries experience and availability of sugars in Iraqi children before and after the United Nations sanctions. Int Dent J. 2004;54(1):21-5. doi: 10.1111/j.1875-595x.2004.tb00248.x.
27. Kim Y. Economic sanctions and child HIV. Int J Health Plann Manage. 2019;34(2):693-700. doi: 10.1002/hpm.2727.
28. Mladenovich D, Langeggen I. The impact of war and economic sanction on the incidence of retinopathy of prematurity in Serbia. J Vis Impair Blind. 2009;103(3):162-72. doi: 10.1177/0145482x0910300305.
29. Reid BC, Psoter WJ, Gebrian B, Wang MQ. The effect of an international embargo on malnutrition and childhood mortality in rural Haiti. Int J Health Serv. 2007;37(3):501-13. doi: 10.2190/mr65-2605-1285-0406.
30. Ali MM, Shah IH. Sanctions and childhood mortality in Iraq. Lancet. 2000;355(9218):1851-7. doi: 10.1016/s0140-6736(00)02289-3.
31. Ascherio A, Chase R, Coté T, Dehaes G, Hoskins E, Laaouej J, et al. Effect of the Gulf War on infant and child mortality in Iraq. N Engl J Med. 1992;327(13):931-6. doi: 10.1056/nejm199209243271306.
32. Yektadoost A, Ebrahimi F, Mashouf M, Hadidi N, Nassiri Koopaei N, Kebriaeezadeh A. Trend Analysis of Medicine Consumption Based on Therapeutic Categories in Iran: 2000-2016. J Res Pharm Pract. 2018;7(2):95-103. doi: 10.4103/jrpp.JRPP_17_96.
33. Kheirandish M, Varahrami V, Kebriaeezade A, Cheraghali AM. Impact of economic sanctions on access to noncommunicable diseases medicines in the Islamic Republic of Iran. East Mediterr Health J. 2018;24(1):42-51. doi: 10.26719/2018.24.1.42.
34. Ghiasi G, Rashidian A, Kebriaeezadeh A, Salamzadeh J. The impact of the sanctions made against iran on availability to asthma medicines in Tehran. Iran J Pharm Res. 2016;15(3):567-71. doi: 10.22037/ijpr.2016.1892.
35. Setayesh S, Mackey TK. Addressing the impact of economic sanctions on Iranian drug shortages in the joint comprehensive plan of action: promoting access to medicines and health diplomacy. Global Health. 2016;12(1):31. doi: 10.1186/s12992-016-0168-6.
36. Asadi-Pooya AA, Azizimalamiri R, Badv RS, Yarali B, Asadollahi M, Homayoun M, et al. Impacts of the international economic sanctions on Iranian patients with epilepsy. Epilepsy Behav. 2019;95:166-8. doi: 10.1016/j.yebeh.2019.04.011.
37. Asadi-Pooya AA, Tavana B, Tavana B, Emami M. Drug adherence of patients with epilepsy in Iran: the effects of the international economic sanctions. Acta Neurol Belg. 2016;116(2):151-5. doi: 10.1007/s13760-015-0545-6.
38. Drain PK, Barry M. Global health. Fifty years of U.S. embargo: Cuba's health outcomes and lessons. Science. 2010;328(5978):572-3. doi: 10.1126/science.1189680.
39. Deilamizade A, Esmizade S. Economic sanctions against Iran, and drug use in Tehran, Iran: a 2013 pilot study. Subst Use Misuse. 2015;50(7):859-68. doi: 10.3109/10826084.2015.978673.
40. Karimi M, Haghpanah S. The effects of economic sanctions on disease specific clinical outcomes of patients with thalassemia and hemophilia in Iran. Health Policy. 2015;119(2):239-43. doi: 10.1016/j.healthpol.2014.12.011.
41. Sen K, Al-Faisal W. Reforms and emerging noncommunicable disease: some challenges facing a conflict-ridden country--the case of the Syrian Arab Republic. Int J Health Plann Manage. 2013;28(3):290-302. doi: 10.1002/hpm.2193.
42. Doocy S, Sirois A, Anderson J, Tileva M, Biermann E, Storey JD, et al. Food security and humanitarian assistance among displaced Iraqi populations in Jordan and Syria. Soc Sci Med. 2011;72(2):273-82. doi: 10.1016/j.socscimed.2010.10.023.
43. Jasarevic T. Syria Humanitarian. Geneva, Switzerland: World Health Organization; 2012.
44. Sen K, Al-Faisal W, AlSaleh Y. Syria: effects of conflict and sanctions on public health. J Public Health (Oxf). 2013;35(2):195-9. doi: 10.1093/pubmed/fds090.
45. Peksen D. Economic sanctions and human security: the public health effect of economic sanctions. Foreign Policy Anal. 2011;7(3):237-51. doi: 10.1111/j.1743-8594.2011.00136.x.

46. Fakheran O. Economic sanctions and dental public health in Iran. J Oral Health Oral Epidemiol. 2019;8(1):52-4. doi: 10.22122/johoe.v8i1.443.
47. Al-Nuaimi MA, Hamad RA, Lafta RK. Effects of witnessing or exposure to community violence on mental health of Iraqi men. Qatar Med J. 2015;2015(1):10. doi: 10.5339/qmj.2015.10.
48. Aloosh M. How economic sanctions compromise cancer care in Iran. Lancet Oncol. 2018;19(7):e334. doi: 10.1016/s1470-2045(18)30427-3.
49. Shahabi S, Fazlalizadeh H, Stedman J, Chuang L, Shariftabrizi A, Ram R. The impact of international economic sanctions on Iranian cancer healthcare. Health Policy. 2015;119(10):1309-18. doi: 10.1016/j.healthpol.2015.08.012.
50. Neuenkirch M, Neumeier F. The impact of US sanctions on poverty. Journal of Development Economics. 2016;121:110-9. doi: 10.1016/j.jdeveco.2016.03.005.
51. Nichols M, Charbonneau L. UN chief says sanctions on Iran affecting its people. 2012. https://www.reuters.com/article/us-iran-sanctions-un-idUSBRE89412Z20121005.
52. UN Economic and Social Council. Concluding observations on the 2nd periodic report of the Islamic Republic of Iran, adopted by the Committee at its 50th session, 29 April-17 May 2013: Committee on Economic, Social and Cultural Rights. 2013. Available from: https://digitallibrary.un.org/record/751986?ln=en.
53. UN General Assembly. Situation of human rights in the Islamic Republic of Iran (A/68/503). UN. 2013. Available from: https://digitallibrary.un.org/record/759270?ln=en.
54. UN Refugee Agency. UNHCR global appeal 2014-2015. 2016. Available from: http://www.unhcr.org/528a0a2fb.html.
55. UN Secretary-General. Situation of human rights in Iran. 2014. Available from: https://digitallibrary.un.org/record/779945?ln=en.
56. United Nations' Report. Ease sanctions against countries fighting COVID-19: UN human rights chief 2021. Available from: https://news.un.org/en/story/2020/03/1060092.
57. World Health Organization. WHO Coronavirus (COVID-19) Dashboard 2021. Available from: https://covid19.who.int/.
58. Morton MJ, Burnham GM. Iraq's internally displaced persons: a hidden crisis. JAMA. 2008;300(6):727-9. doi: 10.1001/jama.300.6.727.
59. Silver CB. Traumatic memories and the need to punish: the boycott of Israeli academics. Psychoanal Rev. 2008;95(3):387-416. doi: 10.1521/prev.2008.95.3.387.
60. Barnett-Vanes A, Hassounah S, Shawki M, Ismail OA, Fung C, Kedia T, et al. Impact of conflict on medical education: a cross-sectional survey of students and institutions in Iraq. BMJ Open. 2016;6(2):e010460. doi: 10.1136/bmjopen-2015-010460.
61. Hamid HI, Everett A. Developing Iraq's mental health policy. Psychiatr Serv. 2007;58(10):1355-7. doi: 10.1176/ps.2007.58.10.1355.
62. Aziz C. Struggling to rebuild Iraq's health-care system. War, sanctions, and mismanagement have left health system in shambles. Lancet. 2003;362(9392):1288-9. doi: 10.1016/s0140-6736(03)14618-1.
63. Al Hilfi TK, Lafta R, Burnham G. Health services in Iraq. Lancet. 2013;381(9870):939-48. doi: 10.1016/s0140-6736(13)60320-7.