

Review Article

A One Health Analytical Review of Human and Animal Health Outcomes (2015–2024) and Relationship to Environmental Pollution and Health Security in Wasit Governorate Iraq

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Abstract - One of the most serious challenges to human health is environmental pollution and biosecurity, which directly or indirectly affects both human and animal health. Environmental pollution is considered an increasing threat to community health security. Therefore, the study aimed to analyses the reality of environmental health pollution in Wasit Governorate and to assess repercussions on skin and immune diseases in both animals and humans. The study's dependent variable relied on the analytical review method, though integrating secondary data that depends on reports from organizations, including the WOA (OIE). 2021, and the Iraqi Ministries of Health and Environment, as well as scientific researchers indexed within approved global databases from 2015 to 2024. The results showed that in air, water and soil pollution levels in Wasit Governorate exceed global standards significantly when compared to neighboring countries. This is further supported by the increased prevalence of skin diseases and immune disorders in humans. In addition, the health effects observed are highly significant in animals, which serve as early bioindicators of environmental degradation in the region. Therefore, the study can conclude that environmental pollution In general and especially in Wasit Governorate, represents a major and decisive risk factor that threatens health security. Thus, for focusing on and adopting integrated policies that link human, veterinary and environmental health to achieve sustainable development in health security in Wasit Governorate.

Keywords - Environmental pollution, immune disorders, One Health, Health security, Sentinel animals, Iraq.

1. Introduction

In recent decades, the most pressing environmental issues and environmental pollution have garnered increasing global concern, largely due to widespread industrial expansion and unregulated urbanization in countries, which have had serious effects on human health and the stability of societies in general [1]. Therefore, The One Health concept has emerged as an internationally recognized framework that acknowledges the close interconnection between human health, animal health, and the environment pollution can be considered one of the most serious of these problems facing society, due to its pivotal role in increasing the burden of chronic and infectious diseases, especially skin and immune disorders [2],[3]. This integrated approach has been strongly advocated by the World Health Organization (WHO), the World Organization for Animal Health (WOAH), the Food and Agriculture Organization (FAO), and the United Nations Environment Program (UNEP) to address complex environmental and public health challenges[8]. as well as the decline in quality

of life and the threat to health security. In general, in Iraq, and especially in Wasit Governorate, sources of environmental pollution have increased due to successive wars, unsustainable industrial activities and as oil wells, inadequate waste management, and weak environmental legislation. Recent evidence indicates that environmental pollution cannot be adequately understood by examining human health alone, as animals often serve as early biological indicators of environmental hazards due to their continuous exposure to contaminated ecosystems. Wasit governorate's geographical location and the economic conditions it has endured have also led to complex environmental challenges, including air, water, and soil pollution [4],[20]. The persistence of these health and environmental problems without effective solutions has exacerbated the issue for humans, animals, and all communities, both urban and rural. This has made health security one of the most important strategic issues [12], no less important than food or water security in Wasit governorate. Although some scattered and limited studies have addressed



certain aspects of pollution in general [5],[6],[17], there is no comprehensive study linking environmental pollution and health security in communities within a "One Health" framework that encompasses humans, animals, and the environment.

Recent international studies have consistently demonstrated that long-term exposure to environmental pollutants, including particulate matter (PM_{2.5} and PM₁₀), heavy metals, and contaminated water and soil, is associated with increased risks of respiratory diseases, dermatological disorders, immune dysfunction, and chronic inflammatory conditions in both humans and animals [34]. Previous investigations conducted in Iraq and neighboring countries have primarily focused on individual pollution sources [23], air quality assessment, or specific health outcomes without

comprehensively integrating environmental, veterinary, and public health evidence [10],[18]. Likewise, several studies have emphasized the value of animals as sentinel species capable of providing early warning signals of environmental degradation before similar health effects become apparent in human populations [33]. These findings highlight the importance of adopting multidisciplinary analytical approaches that incorporate environmental monitoring with veterinary and public health surveillance to better understand pollution-related health risks. Although many studies have examined environmental pollution in Iraq or assessed its impact on human health separately, to further illustrate the scientific contribution and novelty of this review, Table 1 summarizes the key differences between previous studies and the current study.

Table 1. Comparison between previous studies and the present review, highlighting the scientific contribution of the current study

No	Section /Aspect	Preceding studies	Current study
1	Research aria	Most studies evaluated individual environmental pollutants or specific health outcomes separately, such as air pollution or dermatological diseases [2],[9],[10] and [23].	Provides an integrated analytical review linking environmental pollution with human and animal health within the One Health framework.
2	Environmental parameters	Primarily focused on air pollution (PM _{2.5} , PM ₁₀) or heavy metals individually.[9], [10],[34].	Simultaneously evaluates air, water, soil, heavy metals, and pollution related to industrial activities and war remnants.
3	Health outcomes	Most reports concentrated on human diseases, particularly respiratory and skin disorders (Refs. 2, 9, 20).	Assesses both human and animal health outcomes, including dermatological, respiratory, and immune disorders.
4	Animal health	Animal data were generally reported independently or considered only as veterinary observations (Ref. 29).	Uses animal health as an early sentinel indicator of environmental degradation within the One Health concept.
5	Data	Individual studies relied on single datasets or specific populations (Refs. 9, 10, 23).	Integrates evidence from WHO, UNEP, Iraqi Ministries, veterinary surveillance reports, and peer-reviewed publications.
6	Study limitation	Most investigations evaluated limited time periods or specific events.	Reviews evidence over a continuous ten-year period (2015–2024), allowing evaluation of temporal trends.
7	Scientific contribution	Described pollution or disease associations within a single discipline.	Integrates environmental, veterinary, and public health evidence to support environmental monitoring and health security policies using the One Health framework.

As shown in Table 1, this current review expands the scope of previous research by integrating multidisciplinary evidence within a One Health framework, providing a broader understanding of environmental pollution and its effects on human, animal and environmental health security in Wasit Governorate, Iraq.

This study aims to fill this knowledge gap by compiling evidence drawn from environmental monitoring studies, veterinary surveillance, and public health statistics.

2. Materials and Methods

Study Design The current study was designed using an analytical review methodology, linking quantitative and qualitative data to reveal indicators of widespread environmental pollution that cause various diseases, including dermatological diseases and autoimmune diseases in Wasit Governorate. The study also relied on a set of concepts related to pollution exposure, exposure time, duration of exposure to pollutants, and autoimmune diseases in humans and animals, considering that human and animal health is a vital bio-indicator for the early detection of environmental degradation.

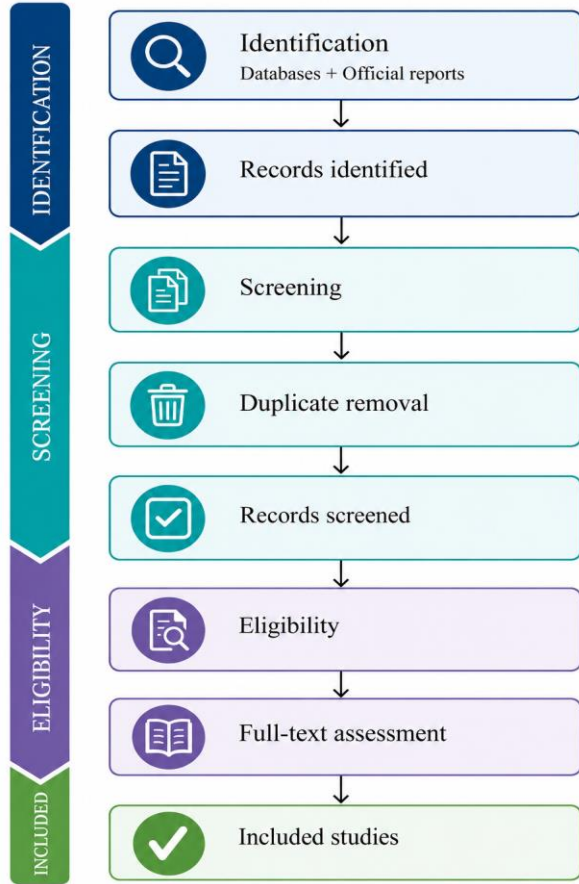


Fig. 1 Schematic representation of the literature identification, screening, eligibility assessment, and inclusion process adopted in the present review

2.1. Research Approach

A systematic literature search was conducted to identify relevant publications addressing environmental pollution, environmental health, the One Health concept, animal health, and health security. Electronic databases and publications in internationally recognized databases (Scopus, PubMed, Web of Science, Google Scholar, and ScienceDirect) were searched for studies published between January 2015 and December 2024. In addition, official reports from the (WHO), the World Organization for Animal Health (OIE), (UNEP), and the Iraqi Ministry of Health and Environment were reviewed. The search strategy employed a combination of medical subject headings (MeSH).

2.2. Study Indicators

The study focused on key indicators and categorized them into two sections: indicators specific to environmental pollution, including the concentration of fine particulate matter such as PM_{2.5} and PM₁₀, as well as heavy metals such as lead, cadmium, and mercury, and their concentration in the environment, such as water and soil. Chemical pollutants resulting from war remnants were also taken into consideration. Regarding health indicators 2021 [11],[12]. Inclusion criteria comprised peer-reviewed articles,

governmental and international reports, and scientific publications addressing environmental pollution and its impact on human with animal health within the One Health framework. The current study relied on the prevalence rates of diseases caused by health pollutants, such as dermatitis and allergies, as well as immune disorders and autoimmune diseases, and the rates of visits to hospitals and specialized clinics in general in Iraq, and especially in Wasit Governorate.

2.3. Data Sources

The data collected included information from multiple reliable and documented sources, including reports issued by the WHO 2023 and the Regional Office for the Eastern Mediterranean (EMRO) [7] for the study years. Reports from the (UNEP) 2022[8] were also included. These are considered international reports. Regarding local records and reports in Iraq, the current study relied on data issued by the Iraqi Ministry of Health and Environment [6] In general, in Iraq, and especially in Wasit Governorate, which focuses on pollution levels, the specific causes of pollution, and their role in skin diseases and immune disorders such as eczema, atopic dermatitis, and psoriasis, which are considered distinctly immune-related diseases [9] [10]. Additionally, data from research studies published in international databases related to pollution, immune disorders, and their effects on the skin of both animals and humans were utilized. The extracted variables included publication year, country, study design, environmental pollutants investigated, target population, health outcomes, animal species, principal findings, and reported implications for environmental and public health. The extracted information was subsequently organized into thematic categories to facilitate qualitative comparison and synthesis.

2.4. Statistical Analysis

The current study employed descriptive statistics, relying on comparative analysis of the data. Variables were presented using frequencies and percentages based on estimated ranges, analyzing time periods and their associated pollution indicators, as well as the health burden during those periods. The values reported in Iraq were compared with global and regional standards issued by the World Health Organization [34],[35]. Therefore, descriptive statistical analysis was used [13]

3. Results

The current study revealed that environmental pollution in general, in Iraq, and especially in Wasit Governorate, affects not only humans but also animals, whether domestic, farm, or wild. The data showed that continuous and long-term exposure to various types of pollutants, including airborne and water pollutants, as well as those present in the soil from war and industrial waste, leads directly to immune disorders and chronic skin and respiratory diseases in both humans and animals. Furthermore, veterinary reports confirmed the presence of high levels of fine particulate matter and heavy

metals in the environment, indicating that animals serve as early bioindicators of environmental degradation, as shown in Table 2. Pollution levels in general, in Iraq, and especially in Wasit Governorate, exceed normal limits compared to globally reported concentrations, particularly in terms of air

and soil pollution. This demonstrates the link between pollution and immune, skin, and even respiratory diseases, which is a dangerous indicator for public health and biosecurity.

Table 2. Comparison of Iraq's environmental pollution index with global standards and its impact on health

Effects of health	Standard in the World	Wasit Governorate	Environmental Index	Pollution type
Asthma of risk, allergic skin, and immune disorders	$5 \geq$	40-67	PM2.5 ($\mu\text{g}/\text{m}^3$)	Air
Dermatitis, irritation of the respiratory system	$20 \geq$	110-145	PM10 ($\mu\text{g}/\text{m}^3$)	Air
Contagious skin diseases	0	$40\% \leq$ (Surface water)	E. coli	water
Psoriasis, neurological disorders, AND immunosuppression	$0.5 \geq$	2-5	Pb (mg/kg)	Soil
Autoimmune diseases, oxidative stress	0	$\uparrow$ in specific areas	Remnants of war and Industrial	Chemical

The relationship of increased pollution levels in Iraq in terms of the time impact affecting air and water pollution during the period (2015-2024), according to reports from the WHO 2025, as well as reports from the Iraqi Ministry of Health and Environment from Wasit Governorate in 2025[10]. The diseases resulting from environmental pollution and

related to human health pose a clear and present threat to Iraqi society, especially to children and adults. A clear correlation can be observed between the duration of exposure to environmental pollutants, such as water and air, and the types of diseases resulting from them, as shown in Table 3.

Table 3. The effect of environmental pollution on age and the types of pollution that cause disease

Environmental Factor	Age	%	Diseases
Air and water	Children	15-20	Eczema
PM2.5 to PM10	All age	15-25	Atopic dermatitis
Heavy Metals	Adults	4-6	Psoriasis
Time exposure to pollutants	Adults	3-5	Autoimmune diseases

This table also details the cumulative quantitative impact and effect on health, including the causes of infectious and immune diseases, and the types of environmental pollutants.

Table 4. The effect the environmental pollution on animal health in Iraq

Prestage	Record Pollution Effect	Environmental Effect	Majer Pollution	Animal Type
20-34	Respiration daises, low immunity	$50 \mu\text{g}/\text{m}^3 \leq \text{PM2.5}$	Air	cows and sheep
15-30	Dermatitis, Liver disorders	Heavy metals (Lead, Cadmium...)	Water	cows and sheep
10-15	Highly mortality rate	Ammonia and derivatives	Chemical material	Poultry
20-30	Allergic Dermatitis	PM10	Air	dogs and cats
Non specific	Autoimmune diseases and congenital malformations	Metals toxic	War remnants Factory waste	Undomesticated animals

Furthermore, the direct impact of environmental pollution on animals serves as an early warning sign of health and environmental degradation, as shown in the table 4 and see Fig

2. Pollution directly affects humans, which is one of the most important factors impacting both food and health security.

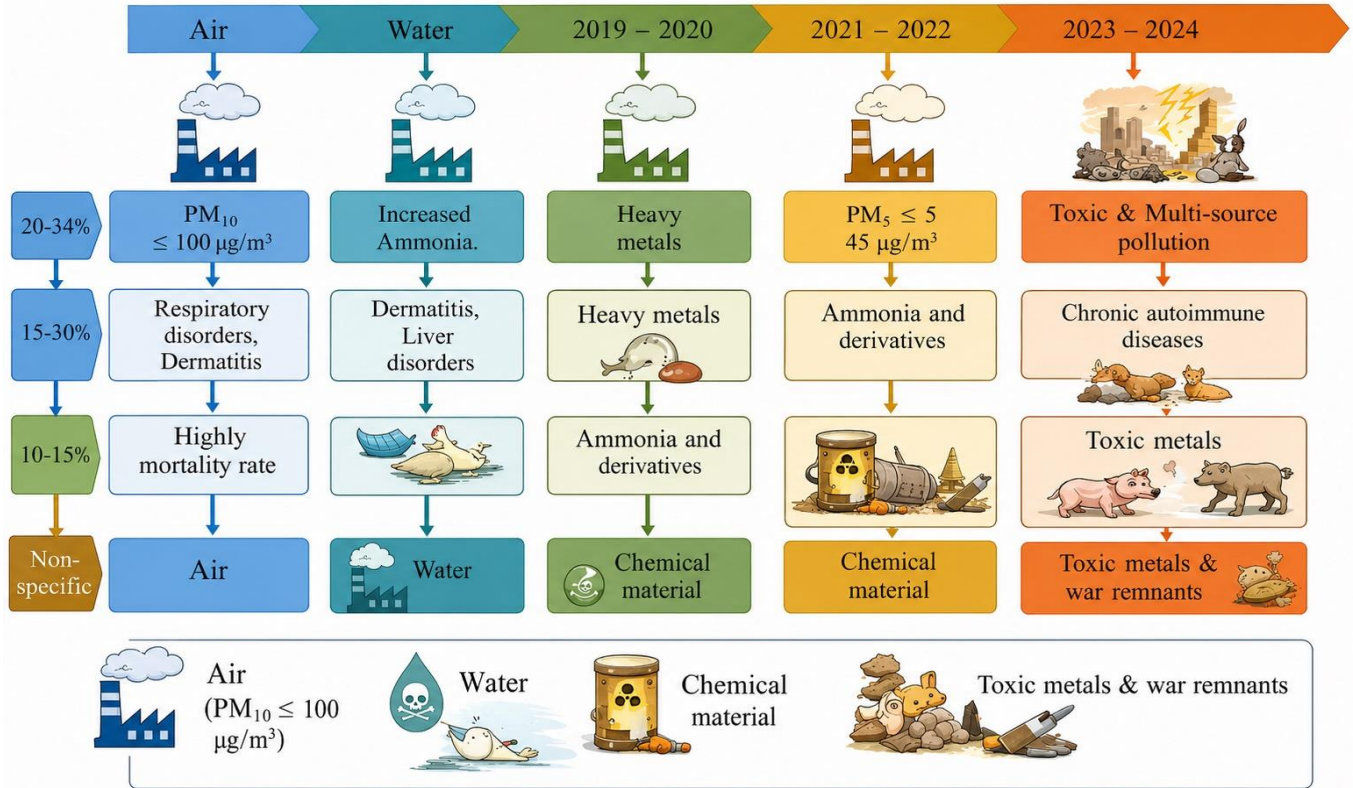


Fig. 2 The effect of environmental pollution on animal health in Iraq (2015-2024)

The temporal effect of exposure to environmental pollutants on both humans and animals has a clear effect on public health, as illustrated in Tables 5-6, with see Fig 2, which in turn affects society as a whole. The appearance results in the current study, covering the period from 2015 to

2024, reveal a clear temporal increase in environmental pollution levels in Iraq, accompanied by a corresponding and gradual rise in the burden of skin and immune diseases in both humans and animals.

Table 5. Long-term Effect of Environmental Pollution on Animal Health

Indicator	Years	Health Effects	Prevalent Pollutant	Associated Environment	Animals Type
Air pollution	2015-2016	Autoimmune diseases, Respiratory disorders	PM ₁₀ ≤ 100 µg/m ³	Air	cows and sheep
Soil pollution	2017-2018	Reduced immunity, increased mortality	Increased ammonia.	Chemical pollutant	Poultry
food contamination	2019-2020	Dermatitis, Hepatoses	heavy metals	Water	cows and sheep
Zoonotic diseases	2021-2022	Seborrheic dermatitis, Alopecia	PM _{2.5} ≤ 45 µg/m ³	Air	dogs and cats
Food security	2023-2024	Autoimmune diseases and congenital malformations	Toxic metals	War remnants Factory waste	Wild, farm animals

The health effects are observed to progress from mild acute conditions to serious chronic disorders with continued exposure to environmental pollution.

Table 6. Comparison of environmental pollution on animal and human health in Iraq

Health indicator	Years	health effects on human	indicator in animal	Pollution Index	Associated environmental pollutant
Animal air indicator	2015-2016	↑ Respiratory disorders, Dermatitis	↑ Respiratory disorders in cows and sheep	$PM_{10} \leq 100 \mu g/m^3$	Air
both that affects humans and animals	2017-2018	↑eczema, Seborrheic Dermatitis	Autoimmune diseases in Poultry and increased mortality,	Increased ammonia 2.5/pm	Chemical pollutant
By food and water	2019-2020	Contagious Skin Diseases	Hepatitis, Dermatitis in sheep	heavy metals	Water
All pollution effects	2021-2022	Psoriasis, Autoimmune diseases	Seborrheic dermatitis, dogs and cats	$PM_{2.5} \leq 45 \mu g/m^3$	Air
Effect For health and food security	2023-2024	↑Autoimmune diseases	Autoimmune diseases and congenital malformations in wild animals	Toxic metals	Multi-source pollution

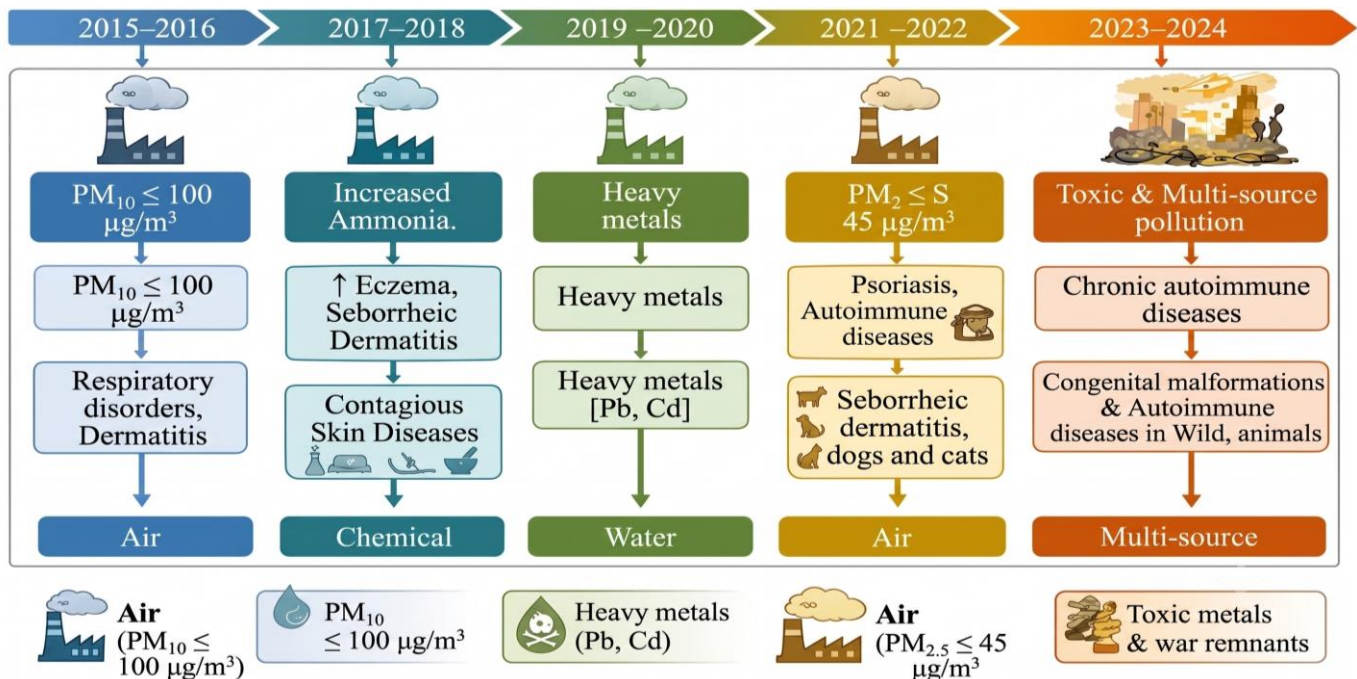
Therefore, the long-term cumulative effect of environmental pollution reflects disease conditions, and these changes, resulting from years of exposure to the environmental pollutant, represent an important and dynamic risk factor that increases the risk to health security and calls for early preventive interventions to ensure a reduction in the impact on society.

The study also explains the temporal effect of environmental pollution on the health of both animals and humans in general, in Iraq, and especially in Wasit Governorate, considering animals as an early indicator of

environmental pollution. The results showed a high rate of health problems in animals, followed by a direct impact on humans. This is considered a key indicator of environmental degradation in Wasit /Iraq, based on its direct impact.

4. Discussion

The following study focused on environmental pollution in general, in Iraq, and especially in Wasit Governorate, which has a direct impact on food and health security, affecting not only humans and animals but also the broader ecosystem, as reported in 2026[14][30].

**Fig. 3 The effect of environmental pollution on animal and human health in Iraq (2015-2024)**

Reliability and Consistency of Secondary Data in this study reviewed evidence from multiple secondary data sources, including peer-reviewed scientific publications, reports from international organizations (the World Health Organization, the United Nations Environment Programme, and the World Organization for Animal Health), and official Iraqi government reports. These sources were selected because they represent the most reliable and comprehensive information available on environmental pollution and its health effects in Iraq. However, differences in data collection methods, reporting standards, geographic coverage, and publication years may lead to variations in reported findings. For example, international organizations often use standardized monitoring protocols and internationally accepted definitions, while national reports may reflect local monitoring systems, resource availability, and regional priorities. Despite these methodological differences, the overall consistency of trends reported across independent sources strengthens the reliability of the conclusions in this study.

The convergence of evidence demonstrating increasing environmental pollution and its adverse effects on human and animal health indicates that the main findings are robust and not attributable to a single dataset or reporting system. This aligns with 2025 [15],[17] global and regional research trends that confirm the ongoing environmental damage impacts health security in one way or another. Furthermore, pivotal changes over time observed in various domesticated and wild animals can be considered a vital indicator of environmental degradation in Wasit Governorate, in generally in southern of Iraq, particularly in sentinel species, as the researcher mentioned 2025[16],[18]. Therefore, the data in the current study showed varying temporal impacts on health disorders, especially skin, respiratory, and immune disorders, among others, across all animals. The study also examined the results for the period (2015–2024) regarding the temporal and cumulative relationship between levels of environmental pollutants, particularly fine particulate matter at concentrations of PM_{2.5} and PM₁₀, and the number of heavy metals, and the impact on the development of various diseases, from acute to chronic and complex disorders agree with the researcher 2025 [19].

Therefore, the results, consistent with WHO 2023 reports [20], confirm that long-term exposure to high concentrations of PM_{2.5} may be linked to an increase in allergies, inflammatory skin diseases, and immune system disorders, particularly in countries with fragile ecosystems, as the researcher mentioned in 2025 [21]. Therefore, the recorded pollution levels in Iraq are high compared to internationally recommended levels, which explains the recent increase in cases of eczema, seborrheic dermatitis, psoriasis, and autoimmune diseases, agree with 2025 [22]. Regarding recent studies in Iraq, especially in southern Iraq, such as the 2021 and 2025 [10],[23], environmental pollution, particularly

air pollution in cities near pollution sources such as industrial areas, has led to increased hospitalizations, especially for skin and immune system diseases, particularly among the elderly and children, as the researcher mentioned in 2025 [24]. This pollution contaminates water with toxic heavy metals that negatively impact human health. Furthermore, inadequate waste management systems in hospitals and factories, along with the remnants of war, have directly contributed to the increased environmental and health pollution in general, in Iraq, and especially in Wasit Governorate, compared to neighboring countries.

When comparing Iraq to neighboring countries such as Iran, Kuwait, and Turkey, the results confirmed their consistency with studies by 2025 and 2026 [14],[25] conducted in those countries, which indicate high levels of air pollution and increased soil contamination with heavy metals. This leads to a rise in skin diseases and weakened immunity in 2023[26] in Turkey. However, the most significant point is that these levels are even higher. In general, in Iraq, and especially in Wasit Governorate. Other contributing factors include climate change, armed conflicts, and weak environmental legislation, as mentioned in 2018[27]. While pollution is widespread globally, mostly usually localized and controlled at its source, unlike in Iraq, where temporal pollution is more prevalent than in other countries, as in 2022 [28].

The current study also confirmed the crucial role of animals as sentinel species and their importance as indicators of environmental health pollution, which the researchers previously mentioned by the Committee on Animals as Monitors of Environmental Hazards 1999 [33], and confirmed by 2024[29]. Veterinary data further supported the finding that animals of all kinds, both domestic and wild, are affected by environmental pollution. This includes the emergence of respiratory disorders, congenital malformations, skin conditions, and various autoimmune diseases similar to those seen in humans.

This aligns with previous research that considers animal health an important early warning system for environmental health degradation, a finding corroborated by the United Nations Environment Programme 2022[8] reports in various regions with environmental pollution. However, the current study, which aligns with previous research, confirms the importance of animals in detecting environmental pollution due to their shorter and more controllable life cycles. Furthermore, direct exposure to pollution is easier for animals compared to humans, leading to the faster onset of toxicity symptoms before they appear in humans. Neglecting animal health and failing to prioritize it negatively impacts early warning systems for environmental pollution affecting human health. Animals are the primary carriers of pollutants within the food chain, directly contributing to the health and food security of the community.

Regarding the long-term impact of ongoing environmental pollution on public health, the study confirmed the complete shift from acute to serious chronic diseases in 2016[16]. This pattern is difficult to treat and identify, as it involves a transformation from simple autoimmune diseases to more complex types. This reflects the long-term cumulative effect of direct exposure. These findings are supported by recent studies in 2022 and 2023 [30],[31] in Middle Eastern countries that have shown chronic exposure to heavy metals, such as lead and cadmium, is linked to impaired immune response and increased susceptibility to chronic skin diseases, which are prevalent due to the cumulative effect of environmental pollution by 2022[32].

Although a formal meta-analysis was not feasible because of the methodological heterogeneity of the included studies and data sources, the structured synthesis consistently demonstrated an increasing trend in environmental pollution and its associated adverse effects on human and animal health throughout the review period. The convergence of evidence from international reports, governmental databases, and peer-reviewed studies strengthens the reliability of the observed trends and supports the conclusion that environmental degradation represents a growing challenge to health security in Iraq. Therefore, any weakness in health monitoring exacerbates environmental pollution. Therefore, current findings indicate that environmental pollution in Iraq in general, and in the south in particular, poses a significant and clear health risk. It also represents a long-term, cumulative threat to future generations and the proliferation of diseases. Therefore, there is an urgent need to develop, prepare and update environmental health and veterinary monitoring systems in an integrated manner, and to activate their direct role in national health policies to reduce the future impacts of environmental pollution in southern Iraq and especially in Wasit Governorate.

4.1. Descriptive Statistical Analysis

Owing to the heterogeneity of the included studies with respect to study design, outcome measures, and reporting methods, formal meta-analysis was not considered appropriate. Instead, descriptive statistical synthesis and trend analysis were performed to summarize temporal changes in environmental pollution indicators and associated health outcomes across the reviewed literature.

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5. Conclusion

The results of the current study, which focused on analysis within the One Health framework, showed that environmental pollution in Iraq in general, and in Wasit Governorate in particular, is a significant and escalating risk factor that threatens health, food, and environmental security. Comparative indicators of air pollution levels, especially of particulate matter (PM_{2.5} and PM₁₀), as well as concentrations of heavy metals and chemical pollution in water and soil, showed levels higher than the international standards recommended by global organizations and centers such as the WHO. This is associated with the observed rates of skin diseases and immune system problems in humans, and a similar direct pathological impact on animals as well. Furthermore, the study, through its current findings, confirmed the crucial role of animals as a vital and early indicator of environmental degradation, due to the rapid onset of pathological changes in them compared to humans during the studied time periods (2015–2024). This study also reinforces the importance of harmonizing and integrating data from veterinary health to monitor environmental changes and their impact on the cumulative incidence of health pollutants, which constitutes a sustainable health burden. The community. Therefore, the current study recommends the importance of unifying policies and protocols and activating the "One Health" approach, shared by the human, veterinary, and environmental health sectors, to strengthen regulatory systems and relevant legislation for monitoring pollution sources, and to ensure the reduction of future risks and the achievement of sustainable, pollution-free health development in Wasit Governorate.

Conflicts of Interest

The authors declare no competing interests in this research and publication.

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