Review

Ecology and health: Role of education in solving environmental problems

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Abstract

Objective: Environmental changes significantly affect the growth of morbidity, including respiratory and cardiovascular diseases, and worsen the physical development of children and adolescents and the mental state of the population. The article emphasizes the importance of a sustainable approach to environmental issues and environmental education for future generations.

Methods: An analytical review of scientific literature on the impact of environmental factors on public health and the role of environmental education was conducted. Data from Google Scholar, Scopus, Web of Science and Pubmed were used. The analysis included a comparative method, identification of key patterns and an assessment of approaches to the formation of environmental literacy.

Results: The literature review analyzed 145 articles, of which 79 were included in the final review. The studies covered the topics of the impact of environmental factors on public health and the role of environmental education in reducing the impact of environmental problems. The studies showed that environmental degradation, including air and water pollution, climate change and anthropogenic factors, have a significant impact on human health, including the development of respiratory and cardiovascular diseases, as well as mental disorders.

Conclusion: Ecology has a significant impact on human health, causing respiratory diseases, cardiovascular diseases and other diseases. This is especially true for developing countries such as Kyrgyzstan, where pollution and lack of environmental measures worsen the quality of life. It is important to implement sustainable environmental solutions and develop environmental education. An integrated approach will help reduce risks and improve the quality of life, and awareness of the importance of nature conservation will become the basis for future generations.

Key words: Environment, environmental factors, health, morbidity, climate change, environmental situation, education

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Introduction

In recent decades, environmental issues have become an integral part of the global challenges faced by humanity. Pollution of air, water, soil, climate change, loss of biodiversity and depletion of natural resources have a detrimental effect on ecosystems, human health and the sustainable development of the entire society. These processes are closely linked, creating a vicious circle where environmental degradation directly affects human health, including morbidity, life expectancy and quality of life in general. At the same time, awareness of this is interconnected with the need for not only scientific but also educational efforts.

Education in the field of ecology is becoming the most important tool for the formation of a conscious environmental culture among different layers of the population. It is not limited to the transfer of knowledge about the current state of the environment, but includes the education of values that motivate a responsible attitude towards nature and health.

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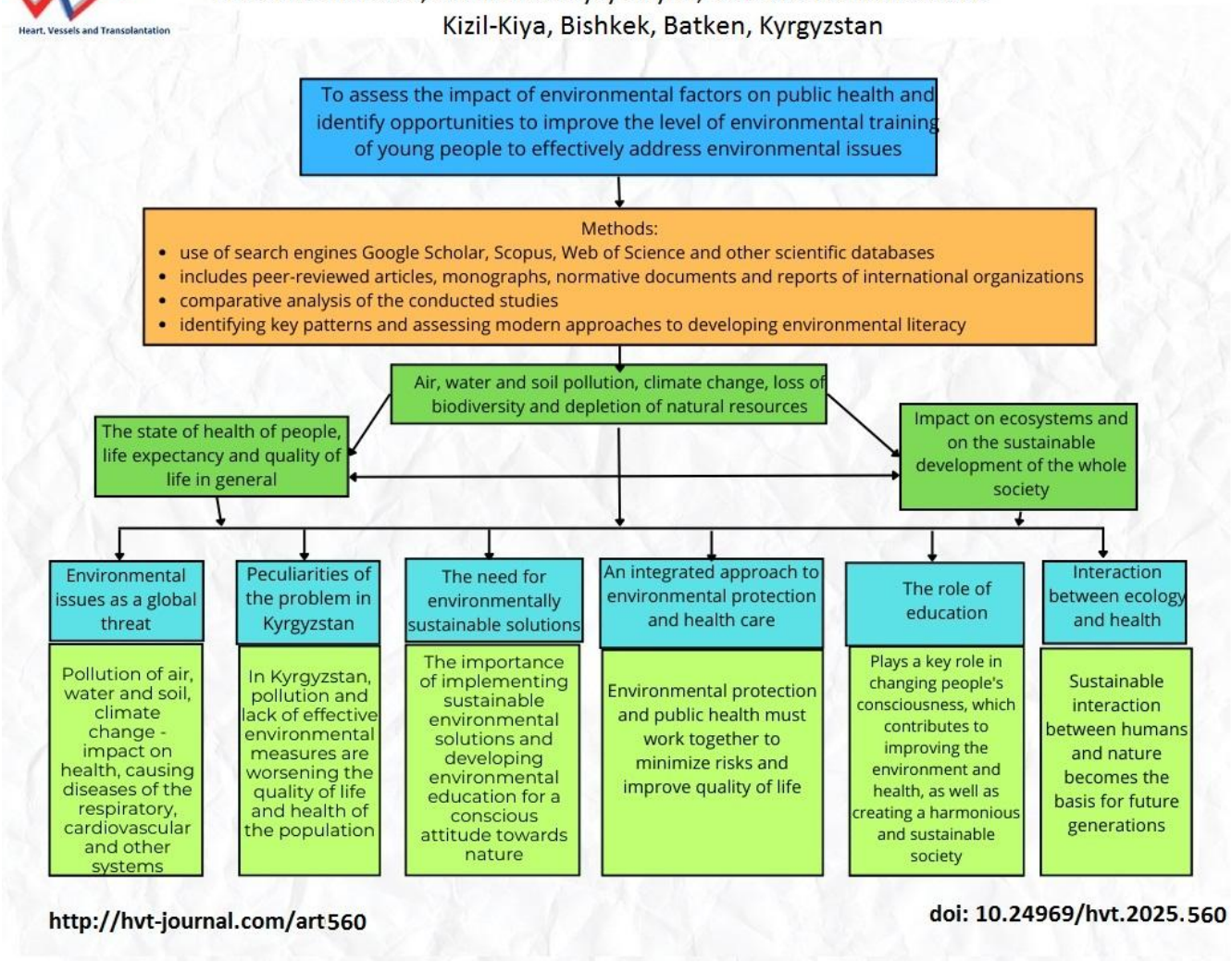

The training of specialists, ecologists, as well as the broad informing of the population about the possible consequences of environmental problems helps not only to overcome current difficulties, but also to prevent the emergence of new threats.

Environmental education has the ability not only to change people's attitudes towards the environment, but also to offer solutions to environmental crises, which in turn contributes to improving public health. No less important is the role of education in stimulating scientific research and introducing innovative environmental practices that can directly affect the reduction of pollution, improvement of water and air quality, and the creation of more climate-resilient communities.

Our aim was to assess the impact of environmental factors on public health and to identify opportunities to improve the level of environmental training of young people to effectively solve environmental problems.

Methods

The article examines key environmental factors such as air, water, and soil pollution, as well as climate change and loss of biodiversity. It presents recent research data and offers recommendations to minimize negative impacts on health.

An analytical review of scientific literature devoted to the influence of environmental factors on public health, as well as the role of environmental education in solving environmental problems, was conducted. The analysis

In the process of selecting sources, peer-reviewed articles, monographs, regulatory documents and reports of international organizations were taken into account. To systematize the information, a comparative analysis of existing studies, identification of key patterns and assessment of modern approaches to the formation of environmental literacy were used. Particular attention is paid to the impact of educational programs on increasing the environmental responsibility of young people and society as a whole.

Results and discussion

To conduct a literature review, 145 articles from scientific databases such as Google Scholar, Scopus, Web of Science and PUBMED were analyzed, of which 79 articles were included in the review. The topics of the included articles directly related to the impact of environmental factors on public health or the study of the role of environmental education in reducing the impact of environmental problems, which were carried out on the basis of long-term observations or were systematic reviews.

Articles that did not meet these criteria were excluded from the analysis, including those that did not present data on the relationship between environmental education and health improvements, or that only addressed short-term effects.

In the process of systematization of information, comparative analysis was used, which made it possible to identify key patterns and evaluate modern approaches to the formation of environmental literacy among the population.

Environmental problems

In the 21st century, the impact of ecology on health is becoming global, covering both developed and developing countries (1). Preservation and restoration of ecology play a key role in global development, especially in the context of modern climate change. Extreme weather events and intensive human socio-economic activity have a multi-level impact on the sustainability of ecosystems, which emphasizes the need for a more conscious approach to environmental issues.

In modern society, more and more attention is paid not only to the preservation of nature, but also to strengthening the health and sustainability of ecosystems, since anthropogenic activity is becoming one of the main causes of disturbances in the ecological balance (2, 3). This, in turn, increases the negative impact on the natural environment and global biodiversity.

However, effective measures to protect and restore ecosystems require significant resources, including financial, social and technological ones. They can only be provided with the support of sustainable economic development and large-scale public participation (4- 6). At the same time, the use of such resources has a direct and indirect impact on the standard of living of the population, health and quality of the environment (7-9).

The interaction of man and the environment has long been the subject of numerous studies conducted by scientists around the world. The impact of human activity on nature is often negative: pollution of water resources, air and soil is one of the main environmental problems of our time. In addition, changes in ecosystems cause problems with food safety, melting of glaciers and icebergs, extinction of animals and damage to plants (10, 11).

Although the Industrial Revolution was a significant step forward in terms of scientific and technological progress, it also had serious environmental consequences. Production processes and technological developments are accompanied by the emission of large quantities of pollutants into the atmosphere, which harms both the environment and human health.

Environmental changes such as deteriorating air quality, declining biodiversity and global warming are exacerbating existing health risks and increasing the burden on health systems.

Air pollution is a major public health problem. A significant number of epidemiological studies have found a correlation between air quality and a wide range of adverse health effects. This highlights the significant role of air pollution in the burden of disease in the general population, ranging from subclinical effects to premature death. Assessing the health risks associated with air quality can play a key role at the individual and global levels of health promotion and disease prevention (8, 12, 13). Since exposure to air pollution, chemicals and socioeconomic factors is closely associated with the development, progression and exacerbation of respiratory diseases (14, 15).

Environmental issues and health

According to the World Health Organization (WHO) report, cardiovascular, respiratory and neonatal diseases remain the leading causes of death worldwide.

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death, accounting for 6% of all deaths in 2000, and lower respiratory tract infection was the fourth leading cause of death (16, 17).

When combined, data on all lung diseases, including COPD, respiratory infections, lung cancer and tuberculosis, make them one of the leading causes of death on the planet. This situation highlights the significant threat to public health posed by deteriorating air quality and rising levels of environmental pollution.

The Lancet Commission on Pollution and Health notes that in 2015, environmental pollution was responsible for approximately 9 million premature deaths (18-20). This figure makes pollution one of the most serious health risks in the world, accounting for approximately one in six deaths worldwide. According to the WHO, 4.2 million people die each year due to ambient air pollution and 3.8 million due to indoor air pollution, mainly due to exposure to smoke from cook stoves and fuels (21).

Long-term effects of air pollution include chronic asthma, lung problems, cardiovascular disease, and increased mortality from cardiovascular disease. According to a Swedish study, diabetes is also likely to develop with long-term exposure to air pollution. In addition, air pollution can cause various serious diseases in children, such as respiratory, cardiovascular, mental and perinatal disorders, which may lead to child mortality or chronic diseases in adulthood. (8, 22-25).

Epidemiological evidence suggests that environmental risk factors are not only the main contributors to non-communicable diseases, especially cardiovascular diseases, but they also contribute to metabolic and mental diseases, including hypertension, heart failure, myocardial infarction, diabetes, arrhythmia, stroke, neurodegeneration, depression and anxiety disorders, and cancer (26- 30).

By 2050, premature mortality attributable to air pollution could double, making air pollution one of the most serious threats to health. In addition, secondary pollutants such as ozone can also cause respiratory diseases, heart disease, and affect reproductive health, premature birth, and cognitive impairment (13, 15, 31-33).

Air pollution and climate change are closely interrelated. Climate is the other side of the same problem that is worsening the condition of our planet. Pollutants such as black carbon, methane, tropospheric ozone and aerosols affect the amount of sunlight reaching the Earth's surface. This causes the planet's temperature to rise, causing glaciers and icebergs to melt (34).

Global warming, accompanied by rising temperatures and more extreme weather events, has a wide-ranging impact on human health. It increases the risk of heat stroke, increases mortality during periods of abnormal heat, contributes to the spread of infectious diseases, and increases anxiety and mental disorders associated with the environmental situation (35).

Climate change directly affects the dynamics of morbidity and the spread of infections, including local and imported ones, since climatic conditions and weather events significantly affect the duration, frequency and intensity of outbreaks of infectious diseases around the world (8).

Parasitic and viral diseases transmitted by insects are becoming more common due to warming, as it reduces the sensitivity of pathogens to climate and shortens their incubation period. In addition, the shift in the geographical habitats of infection carriers changes the epidemiological picture. Such changes, such as warming water, contribute to an increase in the incidence of water-borne infections. In recent years, Europe has seen an accelerated spread of diseases such as malaria, cholera, poliomyelitis and tick-borne encephalitis (36-38).

The spread of epidemics is associated with natural disasters caused by climate change. For example, disruption of water supply and food shortages increase the risks of new infections that affect public health and the healthcare system as a whole.

Mental health risks associated with climate change include higher levels of stress, stress-related disorders, anxiety, despair, depression, and suicidal ideation (39-42).

In developing countries, air pollution is becoming a serious problem due to overpopulation, uncontrolled urbanization, and increasing industrialization. This leads to deterioration of air quality, especially in the context of social inequality and lack of information on sustainable environmental management. The use of fuels such as wood and solid fuels for household use due to low income exposes people to indoor air pollution. Three billion people worldwide are estimated to rely on these energy sources for heating and cooking. In developing countries, women in households tend to

be at the highest risk of illness due to long-term exposure to indoor air pollution (43-46).

Air pollutants can trigger inflammation and oxidative stress, which negatively impact endothelial function and alter blood composition. It is important to emphasize that the link between air pollution and cardiovascular disease highlights the need for air quality control and emission reduction measures to improve human health (8).

Central nervous system dysfunctions, including cognitive impairment, have been observed in adults and children after long-term exposure to air pollutants.

Psychological disorders, autism, retinopathy, poor fetal growth, and low birth weight have been associated with long-term exposure to air pollution. Although the exact cause of neurodegenerative diseases such as Alzheimer's and Parkinson's is still unknown, it is suspected that long-term exposure to pollutants may play a significant role (47-49).

Soil pollution is a major and growing threat to human health. Soil can be contaminated with heavy metals, organic chemicals such as pesticides, biological pathogens, and micro/nanoplastic particles, which cause oxidative stress, which is considered a common initiating event for multiple non-communicable diseases (26, 27, 50-57).

Chemical contaminants in soils can increase the risk of cancer, endothelial dysfunction, atherosclerosis, apoptosis, obesity and other cardiometabolic complications (58), as well as neurodegenerative disorders (50). An estimated 25 million agricultural workers suffer from pesticide poisoning each year (39). Pesticides used in agriculture are associated with an increased risk of several chronic diseases such as diabetes, cancer and asthma, as well as various short-term problems (e.g. dizziness, nausea, skin and eye irritation, headaches) (59).

Pesticide exposure has also been linked to the development of coronary heart disease complications such as acute myocardial infarction, arrhythmia and heart failure (60). Pesticides, industrial and pharmaceutical chemicals, and toxic metals have been linked to a range of reproductive problems such as increased incidence of reproductive diseases in later life, including endometriosis, breast cancer, cervical cancer, uterine cancer, and testicular cancer (18, 61, 62).

The environmental situation in Kyrgyzstan also remains one of the pressing issues affecting public health. Despite the rich nature and relatively low level of industrial pollution compared to neighboring countries, a number of environmental factors create serious risks to human health.

The main source of air pollution in Kyrgyzstan is vehicle exhaust fumes, especially in large cities such as Bishkek and Osh. Bishkek, the capital of Kyrgyzstan, regularly experiences high levels of air pollution. In January 2020, the city topped the list of the most polluted cities in the world according to AirVisual, with PM2.5 concentrations reaching 279.6 μg/m^3, well above WHO recommended limits. In addition, the main sources of pollution are exhaust fumes from a large number of cars and densely built-up areas that impede natural ventilation of the city. In winter, the situation is aggravated by the use of coal for heating, which leads to high levels of harmful substances in the atmosphere, including fine particles. Problems with solid waste management remain relevant. Landfills, such as the one in Bishkek, are overflowing, leading to soil and air pollution (63-65).

The country faces an acute problem of solid waste disposal. Many landfills do not comply with environmental standards, which leads to soil and groundwater pollution. The lack of effective waste processing and disposal systems worsens the situation.

Between 2010 and 2019, 12-13% of deaths in Kyrgyzstan were related to air pollution, highlighting the seriousness of the environmental problem in the country (66, 67).

Radioactive waste left over from uranium mining during the Soviet era is particularly dangerous. These sites pose a potential threat to the environment and public health.

Despite the abundance of water resources, access to clean drinking water remains a problem for a significant part of the population. The main sources of pollution of rivers and lakes are industrial and agricultural runoff, insufficient wastewater treatment, and waste discharges into water bodies. According to 2018 data, every sixth resident of Kyrgyzstan did not have access to safe drinking water, which leads to the spread of water-related diseases.

According to the Kyrgyz Ministry of Health, the prevalence of cardiovascular and respiratory diseases remains consistently high. In areas with a high concentration of industrial waste (for example, near

mining enterprises), there is an increase in cancer (65, 68).

Poor quality of drinking water and a weak water purification system in some regions lead to an increase in intestinal infections, especially in rural areas.

Resolving environmental challenges and health

In 2024, the Zhogorku Kenesh (Parliament) of the Kyrgyz Republic discussed current issues in the field of ecology, climate and environmental protection. The Green Initiative platform was initiated to develop and implement environmentally sustainable initiatives in the country.

Today, environmental pollution has acquired the status of a global problem requiring coordinated international actions and strategies. Environmental stress has a direct impact on human health, affecting not only their physical condition, but also their mental well-being and social aspects of life. Therefore, awareness of the importance of sustainable human interaction with nature and the introduction of environmentally friendly technologies is becoming one of the key tasks of modern society.

Minimizing environmental damage not only preserves the health of current and future generations, but also significantly reduces global risks. This requires urgent and coordinated action at the international level. Key solutions include eliminating sources of pollution, developing environmentally friendly technologies, and raising awareness of the negative health effects of pollution.

In modern conditions, environmental protection requires a comprehensive approach, including educational, scientific and management initiatives. These measures are aimed at harmonizing the interaction between man and nature, which not only contributes to the preservation of ecosystems, but also creates the basis for improving the general well-being and health of future generations.

Environmental education of youth and health

In the context of the deteriorating environmental situation, it is important not only to take measures to reduce harmful emissions and rationally use natural resources, but also to form environmental awareness in the younger generation.

One of the key areas in this process is the training of qualified personnel capable of conducting high-quality ecology lessons in general education institutions. Environmental education should become an integral part of the school curriculum, helping children and adolescents to understand the relationship between the state of the environment and health, develop a responsible attitude towards nature and develop skills of environmentally literate behavior (69-71).

Environmental education of students is an important task of modern society, which directly affects its future. It should become an integral part of the worldview of the new generation, the basis of their activities. An environmentally literate person is able to reduce environmental risks and use natural resources rationally. Knowledge in the field of environmental protection helps students assess environmental conditions and minimize their negative impact on human health.

Environmental training is aimed at developing environmental awareness and behavior in young people based on compliance with the norms of interaction with nature and environmental protection activities. Environmental behavior includes respect for the environment and participation in solving environmental problems. However, in the environmental education system of the Kyrgyz Republic there is a deficit of scientific and methodological support, which is due to shortcomings in the organization of education. This hinders the effective training of specialists and the implementation of environmental education.

State policy on environmental protection and rational use of natural resources plays an important role in sustainable development. There are two approaches to the implementation of environmental education: one focuses on the integration of ecology into the educational process through special courses and new methods, the second - on the formation of the core of eco-culture, expanding the boundaries of environmental awareness. Modern methods of environmental monitoring and information technology create favorable conditions for modeling environmental education.

The educational program on ecology helps students to master the basic concepts of ecology, identify unfavorable environmental factors and develop measures to minimize them. It is important that the educational process includes innovative teaching methods that contribute to the formation of a new environmental consciousness. Environmental culture should be not only part of educational, but also educational activities, which contributes to the awareness of a person of his responsibility for nature and its impact on the health of society.

Directions for future research

Based on the analysis conducted, a more in-depth study is planned in the future, aimed at studying the influence of the level of environmental literacy and environmental culture of young people on psychosocial aspects, such as the level of stress, anxiety, depression, as well as on the health of the population as a whole.

The study will conduct a comparative analysis of the health of people who have undergone environmental education and those who have not had such experience.

Conclusions

The impact of ecology on human health in the 21st century is becoming one of the main global problems. Air, water and soil pollution, as well as climate change, have a serious impact on human health, causing respiratory diseases, cardiovascular diseases and other chronic diseases. This problem is especially acute in developing countries, including Kyrgyzstan, where pollution and the lack of effective environmental measures affect the quality of life and health of the population. It is important to implement environmentally sustainable solutions and develop environmental education to form a conscious attitude towards nature. An integrated approach to environmental protection and healthcare will help minimize risks and improve the quality of life. Awareness of the importance of sustainable human interaction with nature becomes the basis for future generations.

The role of education in solving environmental problems and improving health is multifaceted and extremely important. Transformation of consciousness at the individual and public level can not only improve the environmental situation, but also affect the quality of life of each person, contributing to the creation of a sustainable and harmonious society in which ecology and health go hand in hand.

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