

# Determinants of Response to Risk Factors Affecting Health Status

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A – research concept and design, B – data collection, C – data analysis and interpretation, D – article writing, E – critical review of the article, F – final approval of the article

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## ABSTRACT

*Determinants of Response to Risk Factors Affecting Health Status*

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This article aims to identify the main determinants of the response to risk factors that affect health status. We designed a model to define these determinants. The research methodology involves using a function modeling method with graphic language. As a result, the determinants of the response to risk factors affecting health status were identified. The scientific novelty of the results obtained lies in the introduction of a new methodological approach to presenting the key determinants of the response to risk factors affecting health status. The practical value of the results can be utilized to protect, prevent, and create a safe environment for health. The study is limited by not considering all possible determinants. Further research is needed to expand our analysis of responses to risk factors.

**Keywords:** risk, factors, determinants, health, safety

## STRESZCZENIE

*Determinanty reakcji na czynniki ryzyka wpływające na stan zdrowia*

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Niniejszy artykuł ma na celu zidentyfikowanie głównych determinantów reakcji na czynniki ryzyka wpływające na stan zdrowia. Zaprojektowany przez autorów model definiuje te determinanty. Metodologia badań polega na wykorzystaniu modelowania funkcjonalnego połączonego z językiem graficznym. W rezultacie zidentyfikowano wiodące determinanty reakcji na czynniki ryzyka wpływające na stan zdrowia. Nowatorstwo naukowe uzyskanych wyników polega na wprowadzeniu nowego podejścia metodologicznego do prezentacji kluczowych determinant reakcji na czynniki ryzyka wpływające na stan zdrowia. Wartość praktyczna wyników może być wykorzystana do zapobiegania ryzykom oraz tworzenia i ochrony bezpiecznego środowiska dla zdrowia. Badanie jest ograniczone przez nieuwzględnienie wszystkich istniejących determinant. Niezbędne są dalsze badania, aby rozszerzyć analizę reakcji na czynniki ryzyka.

**Słowa kluczowe:** ryzyko, czynniki, determinanty, zdrowie, bezpieczeństwo

## Introduction

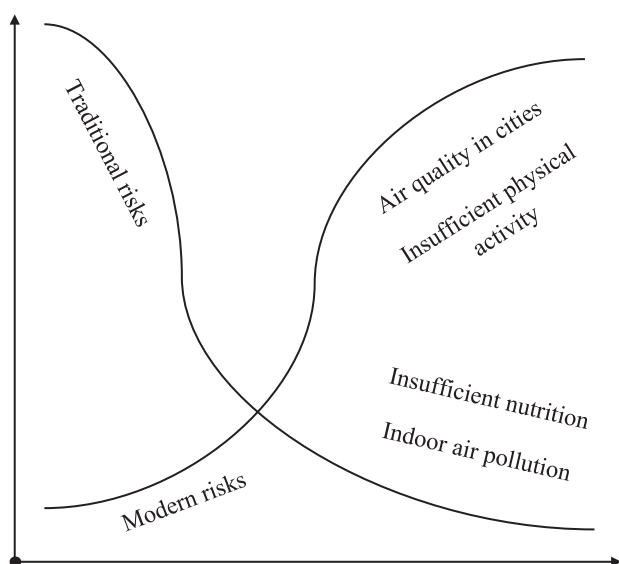
Describing illnesses and injuries, as well as risk factors contributing to these conditions, is vital for health-care planning and decision-making. Data on population health status and the prevalence of risks are often fragmented and sometimes contradictory. To synthesize this information and allow comparison of

the relative importance of risk factors across different populations worldwide, a conceptual framework must be used. While most scientific and medical resources focus on treatment, understanding health risks is crucial for disease and injury prevention. Often, a specific disease or injury results from the influence of two or more risk factors, meaning that several interventions can target each of these factors.

Moreover, most risk factors are associated with the development of several diseases; thus, targeting these factors can reduce the underlying causes of those 3 diseases. For example, reducing smoking will lower mortality and decrease the incidence of lung cancer, heart disease, stroke, chronic respiratory diseases, and others. Quantifying the influence of risk factors on disease occurrence allows for an informed choice of the most effective interventions aimed at improving health globally.

The impact of modern risks varies based on the level of socio-economic development. For instance, urban air pollution poses a higher health risk factor in middle-income countries than in high-income countries, due to the latter's significant progress in controlling this risk factor through health policy development. The rise in the impact of newly emerging risks is inevitable; however, their propensity can be mitigated by public health measures. Implementing effective tobacco control policies in low- and middle-income countries can build on the success of the industry in high-income countries. By adopting such policies early, low- and middle-income countries could avoid the high incidence of tobacco-related illnesses now prevalent in high-income countries. This serves as the foundation and prologue for further research and updates to the article.

The transformation of risk factors in the time dimension is depicted in Figure 1.



**Figure 1.** Transformation of risk factors in the time dimension

The article aims to identify the main determinants of the response to risk factors affecting health. The structure of the article includes a literature review, a description of the methodology, presentation of the main results and their discussion, formulation of conclusions, and further research directions.

## Literature review

The literature indicates that contemporary work safety conditions are currently perceived negatively.[1,2] Approximately 30% of European employees work in unsanitary and unhygienic conditions. The injury incident rate per 1,000 employed persons in the first half of 2022 was 1.89, totaling 27,900 incidents, according to initial data from Statistics Poland.[3,4] One in every four employees working in unfavorable sanitary and hygienic conditions in Europe is female. Poor working conditions hazardous to women's health can lead to health issues in future generations, posing a threat to various societal aspects, including national security.[5,6]

As highlighted in the literature,[5,7] over half of the global population still cooks over an open fire or in traditional ovens using firewood, manure, coal, or agricultural waste. In poorly ventilated conditions, the use of solid fuels means that people, especially women and children, are exposed to significant levels of indoor smoke and the associated high health risks.

As noted in the scientific and practical literature, potential health risks include lethal outcomes from exposure to extreme temperatures and natural disasters, communicable diseases, increased foodborne and waterborne infections, exposure to photochemical air pollutants, and conflict. Climate change will have the greatest impact on health in societies with limited resources, weak technological development, and fragile infrastructure.[8,9] As only a few of the many potential effects of climate change can be fully quantified, the consequences of increasingly frequent and severe natural disasters are not considered in this article.

Analyzing the literature,[10,11] with the aim of forming a model to define the main determinants of the response to risk factors affecting health status, we found several gaps that prompted our study. We have further determined that a number of issues with the analysis of reactions to risk factors affecting health status still remain relevant (Table 1).

**Table 1.** Main gaps resulting from the literature review in our study

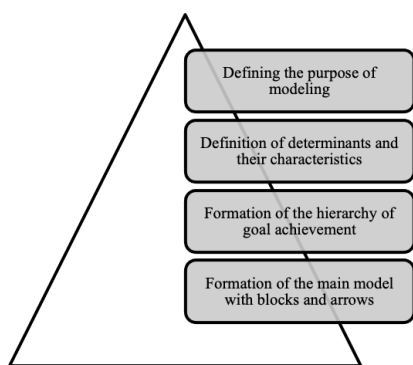
Gaps	Characteristics
New Approach	Lack of methodological approach to proposed improvement measures
Modeling	Lack of effective models with a clear approach
Contemporary Issues	Obsolete and not taking into account modern risk factors

### Methods

As part of our research, we seek to identify and present the key determinants of response to risk factors affecting health. This can be achieved using one of the methods of the IDEF family.

The method suitable for providing an overview of the key determinants emphasizes inputs, outputs, mechanisms, and means, and details the vertical and horizontal relationships between the determinants of response to risk factors affecting health status.

The structure of the application of the IDEF0 method in the framework of our study is shown in Figure 2.



**Figure 2.** The structure of the application of the IDEF0 method in the framework of our study

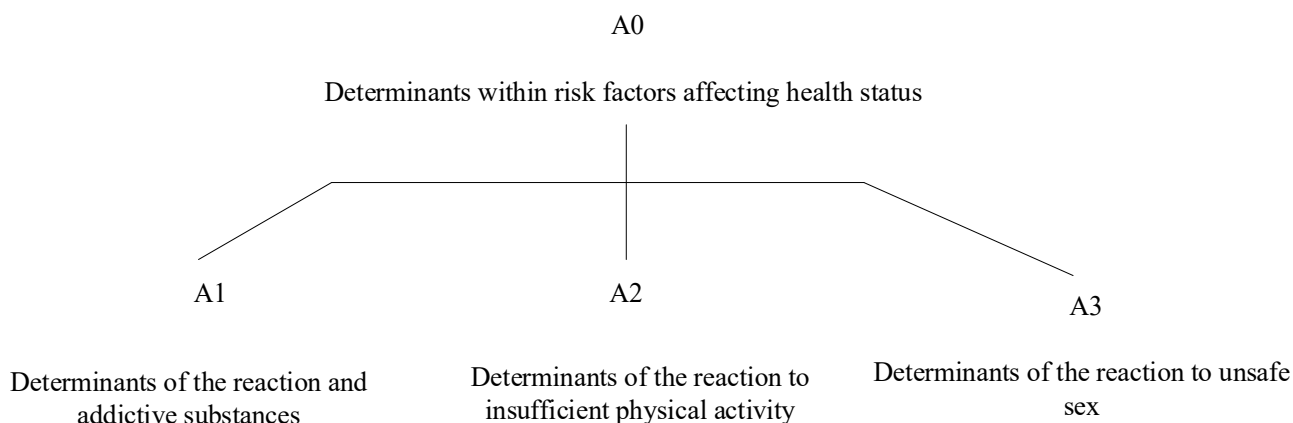
The IDEF0 method offers significant advantages in the context of our study. Its simplicity in understanding and visual representation of the model's key stages

through functional blocks, enhanced by vertical and horizontal relationships depicted as arrows, makes it possible to comprehend the functional and investigative links between the key elements of the model. Another advantage of the methodology is its flexibility, allowing for local adjustments to established models without altering the model's fundamental structure or its key goal and purpose.

### Results

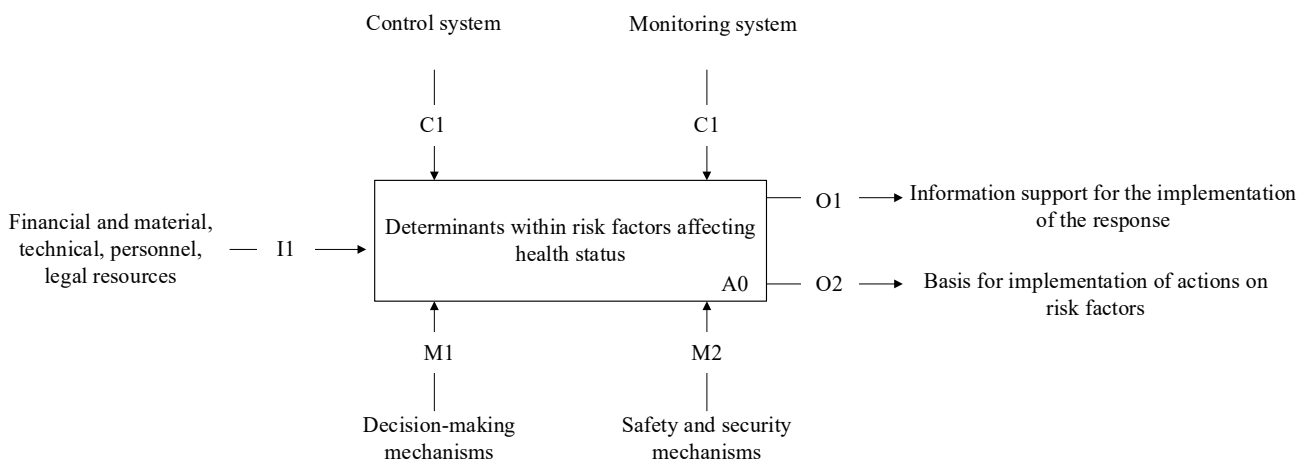
Risk determinants and characteristics vary significantly depending on age. Certain risk factors predominantly affect children, including low body weight, inadequate nutrition (with the exception of iron deficiency), unsafe drinking water, indoor air pollution from the use of solid fuels in households, and climate change. Only a few risk factors impact the health of adolescents; however, risk-related behaviors in adolescence significantly influence their health later in life. In adults, the impact of risk factors varies with age. Young adults bear a considerable burden of disease resulting from substance abuse, unsafe sex, lack of contraception, iron deficiency, and child sexual abuse. In contrast, the elderly are more affected by risk factors leading to chronic diseases such as cardiovascular and cancer diseases.

Let us illustrate the hierarchy of determinants for group A using the graphical modeling language (Figure 3).



**Figure 3.** Hierarchy of determinants of group A in the framework of the graphical modeling language

Next, it is necessary to add the context to the definition of the group A determinants, as presented in the diagram form in Figure 4.



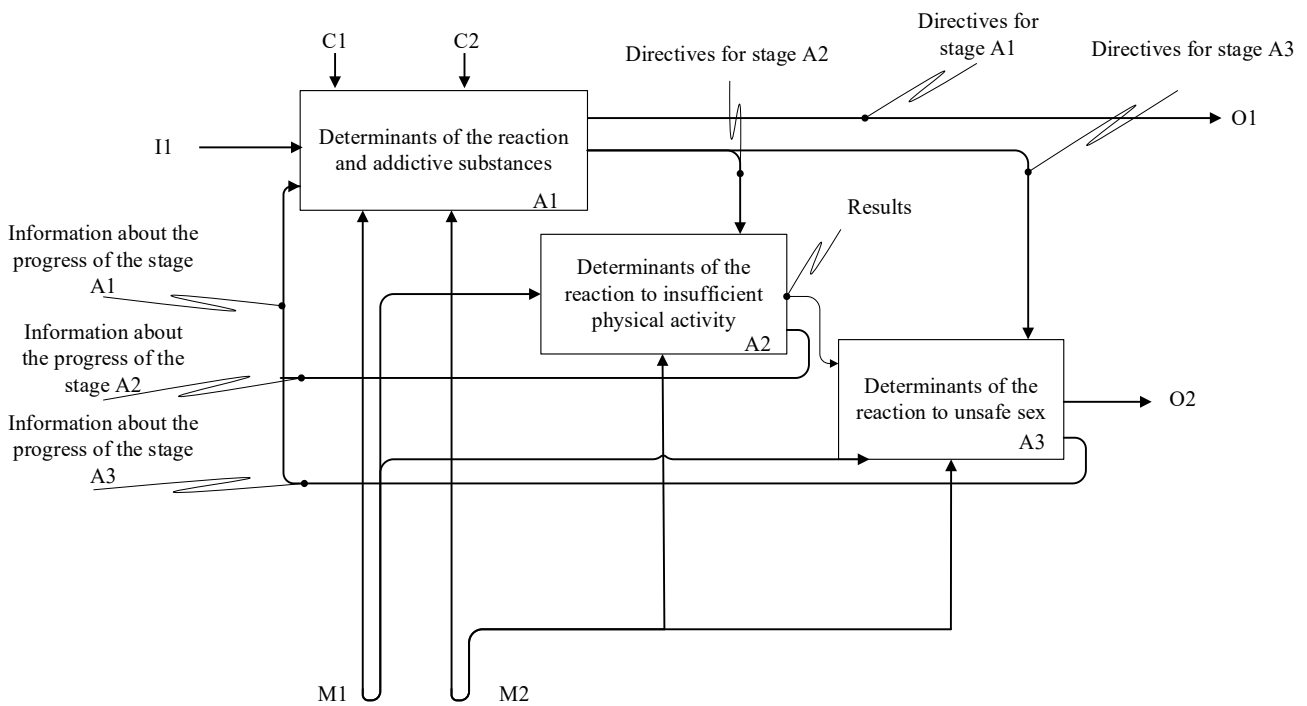
**Figure 4.** Context diagram of group A determinants

A1. Determinants of the reaction to addictive substances. Smoking significantly increases the risk of death from lung cancer and other cancers, heart disease, stroke, chronic respiratory diseases, and other pathologies. The presence of tobacco smoke in the environment and smoking during pregnancy also harm the health of non-smokers. The number of smokers is increasing in many low- and middle-income countries, while it is declining steadily, albeit slowly, in most high-income countries. Alcohol contributes to more than 60 types of disease and injuries, although it may also reduce the risk of coronary heart disease, stroke, and diabetes. There is a wide variation in alcohol consumption patterns in different regions. Consumption levels in some Eastern European countries are approximately 2.5 times higher than the world average of 6.2 liters of pure alcohol per year. Except for a few countries, the lowest levels of alcohol consumption are found in Africa and the Eastern Mediterranean. Alcohol has a positive effect on the cardiovascular system in the elderly in regions where alcohol is consumed in low to moderate doses on a regular basis without binge drinking.

A2. Determinants of the reaction to insufficient physical activity. Physical activity reduces the risk of cardiovascular disease, some types of cancer, and type 2 diabetes. It also helps improve the condition of the musculoskeletal system, control weight, and

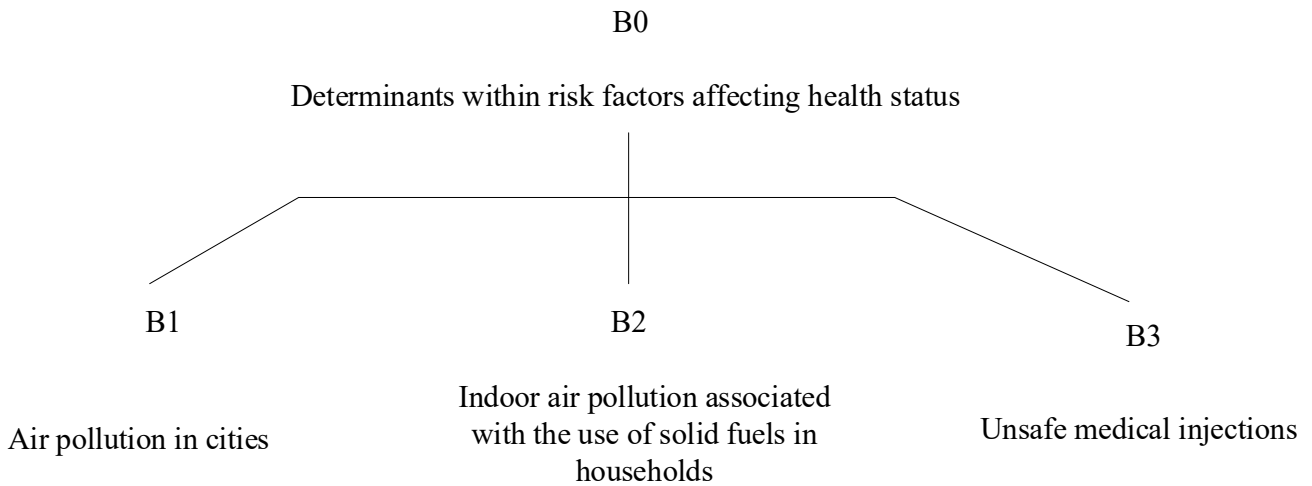
reduce symptoms of depression. Physical activity is manifested in various spheres, including at work, when using transport, when doing household chores, and during rest. In high-income countries, a large proportion of physical activity occurs during leisure time, while in low-income countries, it occurs during working hours, doing household chores, and traveling on public transport. According to various estimates, insufficient physical activity determines about 21-25% of the severity of breast cancer and colon cancer, 27% of the severity of diabetes, and about 30% of the severity of coronary heart disease.[12]

A3. Determinants of the reaction to unsafe sex. People's sexual behavior varies greatly in different countries and regions. In 2004, unsafe sex was estimated to account for more than 99% of HIV infections in Africa, the only region where more women than men are infected with HIV or have acquired immunodeficiency syndrome. In other regions, the percentage of HIV/AIDS deaths attributable to unsafe sex ranges from 50% in low- and middle-income countries in the Western Pacific region to 90% in low- and middle-income countries in the Americas region according to WHO.[13] In virtually all regions outside of Africa, HIV transmission through unsafe sex occurs primarily among commercial sex workers and men who have sex with other men (Figure 5).



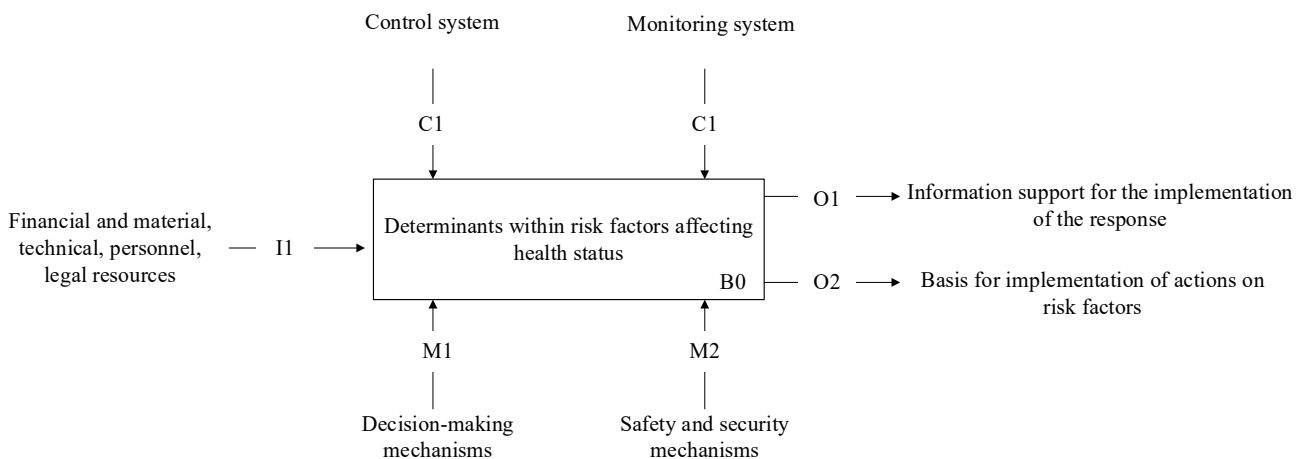
**Figure 5.** The model for defining determinants for group A0

Bearing this in mind, Figure 6 illustrates the hierarchy of determinants for group B using the graphical modeling language.



**Figure 6.** Hierarchy of determinants of group B in the framework of the graphical modeling language

Next, it is necessary to add the context to the definition of the group B determinants, as presented in the diagram form in Figure 7.



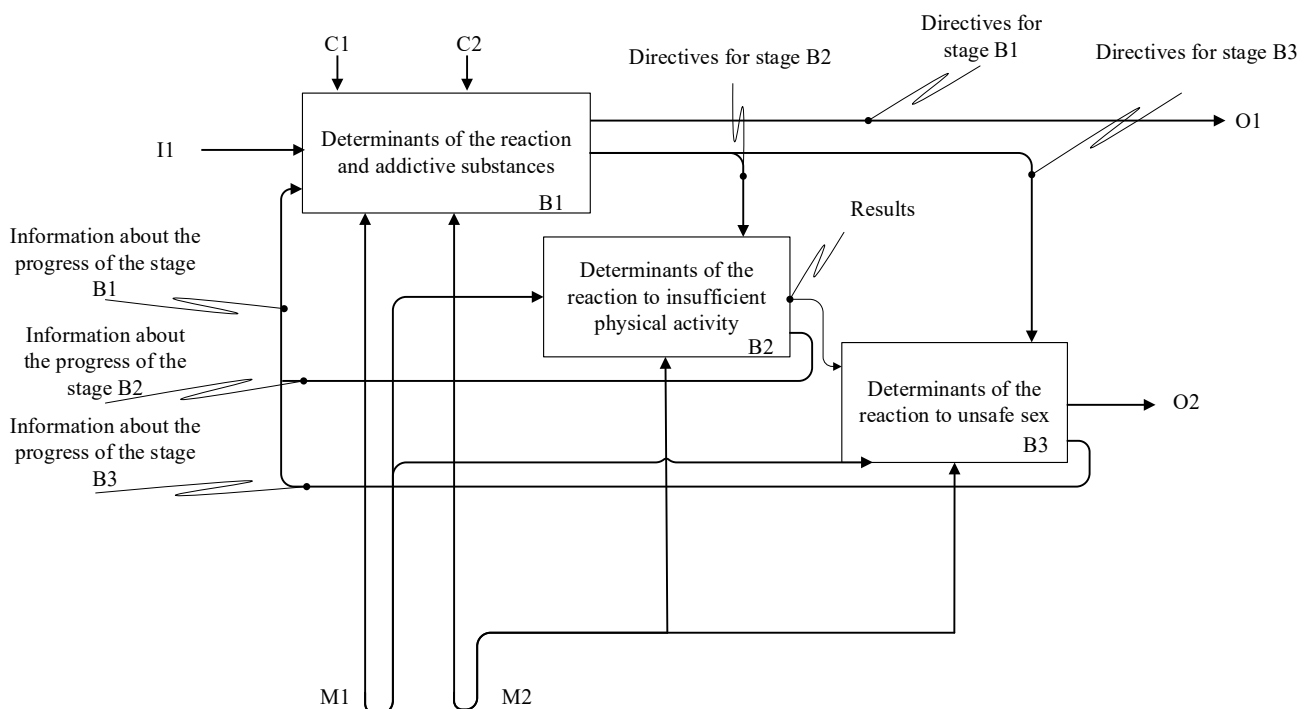
**Figure 7.** Context diagram of group B determinants

B1. Air pollution in cities. Industrial plants, cars, and trucks release complex mixtures of pollutants into the air, many of which are harmful to health. Of these pollutants, fine particulate matter is the most harmful to health. Tiny particulate matter results from the combustion of fuels in both mobile devices such as vehicles and stationary devices such as power plants. Fine particulate matter is associated with a wide range of acute and chronic diseases such as lung cancer and cardiopulmonary disease.

B2. Indoor air pollution is associated with the use of solid fuels in households. More than half of the world's population still cooks over open fires or traditional ovens using wood, manure, coal, or agricultural waste. In

conditions of limited ventilation, the use of solid fuels exposes people, especially women and children, to high levels of indoor smoke exposure and associated high health risks.

B3. Unsafe medical injections. The complex nature of the medical care provision at this stage inevitably carries both risks and benefits. Patient safety is a major global public health issue. Estimates show that in developed countries, one in 10 patients is harmed during inpatient care. The likelihood of harm to health in a hospital is higher in developing countries than in industrialized countries. The risk of nosocomial infection in some developing countries is up to 20 times higher than in developed countries (Figure 8).[14]



**Figure 8.** The model for defining determinants for group B0

There are thousands of other health risks both within and outside the categories discussed in this report. These include risk factors for tuberculosis and malaria (which together account for 4.5% of the global burden of disease), family and environmental risk factors, risk factors for psychiatric disorders and injury, and a wide range of dietary risk factors. Similarly, some important risks associated with exposure to infectious agents or antibiotic resistance are not included in this report. Although genetic predisposition plays a significant role, the article did not attempt to quantify the burden of disease due to genetic causes. In general, the approach and methods used in the article can be used more broadly in order to draw the attention of health policymakers to the potential for preventing health risks.

## Discussion

When discussing the results obtained, it is pertinent to compare them with similar findings to highlight their novelty and uniqueness.

For example, a certain group of scientists [15,16] reported that people at work are exposed to numerous risk factors, which can lead to injuries, cancer, hearing loss, diseases of the respiratory and musculoskeletal systems, cardiovascular and reproductive systems, neurological disorders, skin diseases, and mental disorders. In their report, risk factors are assessed selectively due to the lack of global data.

Other researchers [17,18] aim to cover as many risk factors affecting health as possible. There are thousands of other health risks both within and outside the categories covered in this article. These include risk factors for the development of tuberculosis and malaria (accounting for a total of 4.5% of the global burden of disease), family environment risk factors, environmental conditions, risk factors causing mental disorders and injuries, as well as a wide range of nutritional risk factors. Similarly, some significant risks related to exposure to infectious disease agents or antibiotic resistance are not included in this report. Although genetic predisposition plays a crucial role, the article did not attempt to quantify the disease severity due to genetic causes.

However, there are studies [19,20] that narrow down risk factors to only social determinants. Society is constantly at risk. In trying to protect himself, a person introduces new means of protection, thereby generating new types of risks and scales of distribution. The current stage of the European economy's development is characterized by a significant number of social risks, products of high rates of social and technological modernization. Work safety occupies a special place among these risks. One of the main human rights in the social and work spheres is the right to safe

working conditions and full compensation for damages resulting from failures to ensure them. Yet, it is in the field of work safety where the manifestation of social risks is intensifying.[21-24]

As regards our research results, they exhibit both similarities and differences with other studies. The similarity lies in our agreement with several theoretical aspects of the problem of risk factors affecting health status. Our study also underscores the thesis of how problematic health protection is and how many risks affect it.

The scientific novelty of our results lies in introduction of a new methodological approach to presenting the key determinants of the response to risk factors affecting health status.

## Conclusions

Many diseases result from the interaction of multiple risk factors. By reducing the impact of specific risk factors associated with a particular disease, it is possible to influence the disease development. The cumulative impact of multiple risk factors often results in lower mortality rates and disease severity compared to the individual impact of each risk factor.

Global health risks are evolving due to changes in consumption patterns and the increasing elderly population, resulting from successful efforts against infectious diseases and declining birth rates. Developing countries face a dual health challenge with the rise of infectious diseases and maternal and child health risks, traditionally impacting the impoverished, along with the recent addition of non-communicable diseases. Severely impoverished countries still contend with significant health challenges from malnutrition, unsafe sexual practices, contaminated water, inadequate sanitation and hygiene, iron deficiency, and indoor air pollution caused by solid fuels. Risk factors such as high blood pressure, high cholesterol levels, obesity, and lack of physical activity contribute to the overall severity of diseases.

Several cost-effective interventions are established, and risk prevention strategies can be expanded to additional countries. The essential scientific and economic information, factual data, and research needed to make policy decisions that can greatly enhance global health are already accessible. The determinants influencing the response to risk factors impacting health status were identified. The results obtained have practical value that can be utilized to prevent, safeguard, and establish a secure health environment. The study is restricted by not taking into account all potential determinants. Additional research is required to broaden our previous analysis of responses to risk factors.

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The authors declare no conflict of interest.

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