THE INFLUENCE OF THE STANDARD OF LIVING ON BREAST CANCER MORBIDITY AND MORTALITY IN EUROPE IN THE PERIOD BETWEEN 2017 AND 2019

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Abstract

This paper explores the hypothesis that there is a connection between the standard of living (expressed by the Human Development Index) and the standardised rates of breast cancer incidence and mortality in the female population of Europe. The examination whether the standard of living has an impact on breast cancer incidence and mortality is based on the use of bivariate correlation, as the simplest form of quantitative analysis of two variables which seeks to determine the empirical relationship between them. The second part of the analysis involves the determination of linear relationships using simple linear regression analysis models testing the average impact of the Human Development Index on the standardised breast cancer incidence and mortality rates. The analysis takes into account the importance of yet another socioeconomic factor – response to screening, which can have a major impact on breast cancer mortality.

Key words: breast cancer, index of social development, factors, incidence, mortality.

УТИЦАЈ ЖИВОТНОГ СТАНДАРДА НА МОРБИДИТЕТ И МОРТАЛИТЕТ ОД КАРЦИНОМА ДОЈКЕ У ЕВРОПИ У ПЕРИОДУ ИЗМЕЂУ 2017. И 2019. ГОДИНЕ

Антрект

Овај рад анализира хипотезу о повезаности животног стандарда (премо индекса HDI) и стандардизованих стопа инциденције и морталитета од карцинома дојке у женској популацији Европе. Испитивање постојања утицаја животног

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The rapid increase in chronic degenerative diseases is one of the major health challenges of global development in this century. Cancer is the leading cause of death worldwide, responsible for nearly 10 million deaths in 2020, or nearly one in six deaths globally (WHO, 2022). The most common types of cancer are breast cancer, lung cancer, colon cancer, rectal cancer, and prostate cancer. Breast cancer is listed as a cause of death that could be avoided if timely diagnosis and adequate treatment are provided (OECD & European Commission, 2022). The most common risk factors that have been the subject of scholarly research over a considerable period of time include the quality of healthcare and lifestyle (smoking, insufficient physical activity, poor diet, stress, alcoholism), as well as poor prevention (no access to screening, not responding to screening, insufficient information about health and specifically about diseases). Furthermore, public health and the global economy are inextricably linked. Due to this, different levels of investment in health care, approaches to optimal treatment, stages of the disease at the moment of diagnosis, and levels of healthcare organisation on the national level are reflected in the different mortality and morbidity rates across countries. According to the data provided by the American Cancer Society (ACS) and the International Agency for Research on Cancer (IARC) in 2020, breast cancer is the leading cause of neoplasms in the female population in almost all parts of the world (IARC, 2022). As far as the overall new cancer burden among women is concerned, the standardised incidence rates show that the countries of the world can be roughly divided into economically developed ones, with high incidence rates, and other countries, with significantly lower values. The trend of high incidence rates is explained by a better organisation of preventive examinations, and a better quality of diagnostics, but also by the effects of demographic aging, which leads to an increased number of women at risk of this disease (IARC, 2022)

It has been estimated that there were 684,996 deaths worldwide among women diagnosed with breast cancer in 2020. The clustering of the
countries of the world according to the number of prevalence cases and breast cancer mortality shows some regularity related to the level of economic development (IARC, 2022). The Cancer Atlas (Jemal et al., 2019) confirms the connection between the degree of socioeconomic inequality (shown through the HDI\(^1\)) and different types of cancer (although a more detailed analysis at country level has not been done). The study indicates that increased HDI values are accompanied with a transformation of healthcare and clinical services, which leads to an increased prevalence. In countries marked by a high socioeconomic development, cancer is the leading cause of premature death, after cardiovascular diseases, because it is a disease “linked to socioeconomic transitions” (Jemal, et al., 2019, pp. 44). Breast, lung, colorectal, prostate and stomach cancer are predominant diseases in these countries. On the other hand, countries with low HDI values are going through social and economic changes, and it can be expected, according to the forecasts of the international organisations ACS and IARC, that cancer death rates in these countries will double by 2040 (ACS, 2019).

The main goal of the paper is to test the hypothesis on the connection between the standard of living (shown by the HDI) and breast cancer incidence and mortality rates in the female population of Europe. Focusing on European countries, which are demographically, socially, culturally, historically and ethnically much closer to each other, with a prevailingly high level of social development (measured by the HDI), could yield more precise information about the degree to which breast cancer incidence and mortality trends are linked with the level of the standard of living. The purpose of the analysis is to test whether the level of social development can still be considered (and to what extent) a determinant in breast cancer incidence and mortality in Europe. Can we say that there is a certain level of social development above which the standard of living becomes irrelevant? The importance of responsiveness to screening, which also belongs to the group of socioeconomic factors, will be taken into consideration as an additional factor that can have a major impact on breast cancer mortality. One of the reasons for focusing this research on European countries is the greater reliability and availability of data, as well as a greater degree of equality between women and men, especially in terms of access to healthcare and prevention.

**METHODOLOGY**

This research involves an analysis of the data on the standardised breast cancer incidence and mortality rates, based on the database maintained by the Statistical Office of the European Union (EUROSTAT), and the Human Development Index (HDI), calculated by the Office of the

\(^1\) HDI stands for the Human Development Index.
Human Development Report, of the United Nations Development Program (UNDP). The analysis presented in this paper addresses the average values of the indicators for the 2017–2019 period. Out of fifty-one European countries, thirty-two, for which all the necessary data was available, are included in the analysis. The countries that have been left out are mostly those of Central and Eastern Europe.

The Human Development Index (HDI) is used as an indicator of the level of the standard of living, as an assessment of the country’s progress through three main dimensions of social development: healthcare, education, and the economic state of the nation. The summary health indicator is the value of life expectancy at birth. Education is measured by the (average and total) years of schooling for those aged 25 and older, whereas economic power is calculated based on the gross national income per capita (adjusted to the purchasing power parity). According to the HDI values, countries are classified into three categories as highly developed (very high index =>0.800, high 0.700–0.799), developing (medium 0.550–0.699), and underdeveloped (low <= 0.549). According to the HDI, which is either very high or high in Europe, all European countries belong to the category of developed countries of the world.

The examination of whether breast cancer incidence and mortality are related to the standard of living is based on the use of bivariate correlation, as the simplest form of the quantitative analysis of two variables for the purposes of determining the empirical relationship between them, and testing simple hypotheses about the relationship. This type of analysis was used to test the hypothesis that breast cancer incidence and mortality rates depended on the population’s standard of living. The Pearson correlation coefficient was used in the analysis, assuming the normality of distribution.

The second step in establishing linear relationships was the application of simple linear regression analysis models, which test the average impact of the Human Development Index on the standardised mortality rate and the standardised incidence rate. The analysis was performed using the least squares deviation method (LSD) on logarithmic data with a significance level (α) of 5%. Data analysis and visualisation were done in the RStudio programme, in the R programming language.

**RESULTS**

The scatter diagram shows that there is no statistically significant relationship between the variations in the incidence rate and the standard of living index (Diagram 1.a). The Pearson correlation coefficient did not confirmed the hypothesis that the Human Development Index is associated with the standardised incidence rate. The values indicate a very weak positive monotonic relationship between these variables (R=0.31, p>0.05). The scatter diagram between the Human Development Index and the standardised mortality rate (Diagram 1.b) also indicates a weak, but
negative correlation ($R = -0.26, p > 0.10$). The inverse nature of the correlation means that the decreasing mortality rate corresponds to an increased standard of living in this trend. The scatter diagrams show a large dispersion of data around a straight line, which means that their interdependence is weak and virtually non-existent. In either case, the Pearson coefficients showed there is no statistically significant monotonic relationship between the variables at the 5% significance level.

Figure 1. Correlation diagrams, Human Development Index and standardised breast cancer incidence rates (a) and Human Development Index and standardised breast cancer mortality rates (b) among women, European countries, 2017–2019

*Note.* The value of the Pearson correlation ($R$) ranges from -1 to +1. The value of the coefficient determines the strength of the correlation and the sign determines the direction of the correlation.

*Source:* Prepared by the author.
It was of particular importance for the analysis to determine the degree of impact of the standard of living, as a predictor variable, on the level of variation in the breast cancer incidence and mortality rates, i.e. to analyse the degree to which the standard of living explained variation in the incidence and mortality variables. Answers were provided by examining the presence and significance of linear correlation using simple linear regression analysis models. The simple linear regression models were derived from logarithmic data for all three variables. From the first linear regression model (Diagram 2.a), wherein the dependent variable is breast cancer incidence and the independent variable is the HDI, we learn through the least squares method that only $6\%^2$ of the variation in incidence can be predicted and explained by the standard of living. The standard of living does not have a statistically significant positive impact on incidence, as demonstrated by determining the statistical significance of the standardised beta coefficient ($\beta=0.301, p>0.1$). In the second model (Diagram 2.b), wherein the dependent variable is breast cancer mortality and the independent variable is the HDI, it can be observed that only $3\%$ of the variation in mortality is explained by the standard of living, while the rest is explained by the influence of other factors. This means that there are other more important variables, apart from the standard of living, that influence the trend of breast cancer incidence and mortality. Although the value of the standardised beta coefficient is negative ($\beta=-0.252, p>0.1$), indicating a negative impact of the standard of living on breast cancer mortality, the p-value of the test is greater than 0.1, which indicates the absence of statistical significance between the variables.

The results of the correlation and linear regression analyses do not allow for the conclusion that there is a correlation without statistical significance between the standard of living and the number of new cases and deaths from breast cancer. It can be concluded that there is a very weak correlation between the standard of living and breast cancer incidence, which move in the same direction, and the variation in different directions of the standard of living and breast cancer mortality. Finally, the regression analysis suggests that the number of new cases and deaths cannot be explained by the level of the standard of living in a particular country. The comparative data for European countries (Table 1) used in the analysis suggests significant deviations that clarify the results of the statistical method indicating the correlation between these variables. For example, in the countries of Central and Eastern Europe, most of which have the lowest living standards in Europe, there are countries that are not marked by low incidence rates and high mortality rates. For example, the Republic of Serbia has the lowest values of the standard of living among the se-

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2Through adjusted R-squared
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Figure 2. Simple linear regression models of the Human Development Index and standardised breast cancer incidence rates (a), standardised breast cancer mortality rates (b) among women in selected European countries, 2019–2020

Source: Prepared by the authors
lected countries, while it average incidence rates are in the same range as in Western European countries for the given time period. On the other hand, unlike the Republic of Serbia, Slovenia has a high standardised mortality rate, while it is among the top 15 European countries in terms of the standard of living. The example of Lithuania shows that both the values of the standard of living and the standardised mortality rates can be low – in this particular case, even below those of Switzerland, which is second in Europe in terms of the standard of living.

Table 1. A comparative overview of the average HDI values, standardised incidence and mortality rates for selected European countries, 2017–2019

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
<th>Standardised rate</th>
<th>HDI Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central and Eastern</td>
<td>Austria</td>
<td>31,8</td>
<td>108,1</td>
</tr>
<tr>
<td>Europe</td>
<td></td>
<td></td>
<td>108,1</td>
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<tr>
<td>Central and Eastern</td>
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<td>31,8</td>
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<td>HDI Index</td>
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<tr>
<td>Europe</td>
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<td></td>
<td>31,8</td>
</tr>
</tbody>
</table>

Source: UNDP Human Development Index, standardised incidence and mortality rates EUROSTAT

Prevention Examinations

The available literature often highlights the importance of preventative examinations and the mortality rates from various forms of cancer. Research has shown that women of a lower socioeconomic status attend
screening programmes less frequently, and that they often ignore symptoms, and are therefore more likely to be diagnosed with the disease at an advanced stage (Ceronja, 2010). Education, as one of the direct determinants of socioeconomic status, is as an important factor behind differences in medical examination attendance. Among the countries of the European Union, in Bulgaria, Cyprus, Greece, Poland and Lithuania, there is a pronounced difference between women with a higher level of education, who undergo X-ray examinations of the breasts more frequently, and those with a lower level of education (Eurostat, 2022b). The fact that the population is insufficiently informed is the result of the poor functioning of the national screening programme and the healthcare system in general, which should be an important source of information. The geographical distance from health services is a type of economic inequality, which also affects screening attendance. In Romania and Bulgaria, there is a significant difference between women who live in cities and those who live in rural areas, and the number of the former who attend preventive examinations is 15% higher than the number of their counterparts from the latter group (Eurostat, 2022b).

The percentage of the population covered by national screening programmes is the greatest in Northern European countries, which means that its effect on breast cancer incidence and mortality rates is also greater. Covering of 75% or more of the target population of women is an indicator of the successful implementation of the screening programme. According to the latest available data for the 2017–2020 period (Eurostat, 2022a), the Netherlands, Denmark, Ireland, Finland, Norway, Slovenia, Malta and Great Britain reported a coverage of more than 70%. Less than half of the target population was covered by screening programmes in countries that had joined the European Union last, and generally in those countries of Europe that had lower values of the HDI (Serbia, Bulgaria, Latvia, Hungary, Slovakia). Unresponsiveness to screening programmes is usually interpreted as the effect of an insufficient involvement of local communities, and of low investment in prevention, namely in the activities aimed at improving women’s health. Usually, unresponsiveness is seen as a consequence of the poor functioning of the healthcare system. One of the conclusions of the World Health Organisation (WHO) is that national mammographic breast screening programmes are not an optimal solution for countries with limited economic resources, because the healthcare systems of many European countries cannot ensure the testing of a large number of healthy women, and cannot establish quick and accurate diagnosis, and provide therapy quickly enough for positive cases of breast cancer. For these countries, the WHO recommends the so-called early diagnosis programme, which is based on the rapid identification of cancer in patients who already have the symptoms of the disease. This idea arose after a study conducted in Ukraine, which demonstrated that
the disease was diagnosed at an advanced stage in one out of four breast cancer cases in this country (WHO, 2021).

Preventive measures include keeping statistics, i.e. keeping registries of cancer patients. This analysis includes countries with a very high and high standard of living, and it is surprising that some of them do not have a cancer registry with national coverage. It is assumed that a small part of the breast cancer incidence and mortality that was below the expected level in our analysis could be explained by partial registration.

In this analysis, the Republic of Serbia stands out for the unusually high standardised mortality rates. Although there is a registry at the national level, it is right to say that the high rates have to do with relatively poor cancer surveillance and insufficiently effective programmes for the early detection of breast cancer. Between 2017 and 2021, only 8.4% of the women in Serbia responded to the national annual breast cancer screening (Eurostat 2022a).

The study titled *Global Availability of Cancer Registry Data* investigates whether there is a correlation between the gross national income and the existence of a population-based cancer registry (Siddiqui & Zafar, 2018). The analysis found that the gross national income is directly related to the existence of a registry, through the values of the average health expenditure per capita. Countries with different standards of living spend a similar percentage of their gross domestic product on healthcare, but have a different average rate of healthcare spending per capita. High-income countries spend about 3,224 US dollars per capita on healthcare, while spending on healthcare in low-income countries amounts to only 39 US dollars per capita. The research shows that the countries with the lowest income do not have nationwide registries, which is the reason it is impossible to assess the cancer-related situation, and which makes it difficult for the governments of those countries to direct resources to fight cancer (Siddiqui & Zafar, 2018).

**DISCUSSION AND CONCLUSION**

Access to education and employment, which influence health insurance and income levels, are identified as positive consequences, while the modern lifestyle (stress, smoking, physical inactivity, alcoholism) is highlighted as the negative consequence of the modernisation of society. Significant differences in breast cancer mortality rates among European countries are a consequence of improved patient survival rates thanks to an early diagnosis and better organisation of health services in the western parts of the continent. It is also possible to observe differences in survival rates among countries with similar medical standards, and these may be associated with the structure and funding of the healthcare system. Differences in treatment may also have an impact, as some countries
favour chemotherapy over surgery or vice versa. In some countries, access to specialist medical care is complicated, which may be a reason for establishing the diagnosis at an advanced stage.

The hypothesis that an increased HDI leads to increased breast cancer incidence and decreased mortality is well-aligned with the data at the global level. European countries have high values of HDI, regardless of the differences in the population’s standard of living, and the aforementioned hypothesis is not plausible in this case. It seems that, upon reaching a certain level of social development, the importance of socioeconomic determinants in cancer mortality changes. According to the data, the variations in the relationship between breast cancer incidence and mortality are the smallest in the countries of Northern and Western Europe. On the other hand, the greatest variations are observed in the regions of Central and Eastern Europe. In countries that were under socialist rule for a great part of the 20th century, the values are the highest – especially the mortality rates, and the reasons for this are late diagnosis and the treatment of diseases in the terminal stage. The organisation of preventive examinations and the response to these are the major challenges for that group of countries, because it seems that a small share of women either respond to national screening programmes aimed at an early detection of breast cancer or they decide to initiate examinations independently, due to insufficient trust in the health system and poor awareness of the need to take care of their own health. Research has shown that the attendance of screening programmes is lower among women of a lower socioeconomic status, and that national policy-makers should focus on special actions targeting those vulnerable categories in order to reduce socioeconomic inequalities in health outcomes.

The main limitations of this research that could challenge the reliability of our conclusions are related to the quality of the available data, especially in some countries, and the potential shortcomings of HDI as an indicator of the standard of living. According to critics, the HDI measures the average achievements of countries in some aspects, and can only provide a broad framework for some of the key issues of social development. Social development is assessed using indicators that are more common in developed economies, whereas the factors of poverty, and gender or ethnic inequality are not taken into account (Jahan, 2002). Just like no single indicator can cover all of the diverse aspects of countries’ development, the HDI cannot fully capture the complexity of the indicators of progress and the quality of life. Therefore, its significance in relation to breast cancer mortality is not easy to explain.
REFERENCES


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THE INFLUENCE OF THE STANDARD OF LIVING ON BREAST CANCER MORBIDITY AND MORTALITY IN EUROPE IN THE PERIOD OF 2017 AND 2019 YEARS

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Abstract

Breast cancer is 2020 recognized as the most common cancer among women worldwide. When it comes to the burden of women with breast cancer, the standardized incidence rates show that countries around the world can be roughly divided into economically developed countries with high incidence rates and countries with significantly lower values. The trend of high incidence rates is associated with better organization of preventive screening, faster diagnosis, and the effects of demographic aging that lead to a higher number of women in risk of this disease. Grouping countries according to morbidity and prevalence cases reveals certain patterns that depend on economic development. The most developed countries have declining values of mortality rates, while other countries stagnate or even register an increase of these values. According to the previous analysis, we concluded that between the standard of living and the standardized incidence rates there is a weak positive monotonic correlation without statistical significance. Comparative analysis of countries in Europe confirms a negative monotonic correlation, also without statistical significance. In these countries, high and very high levels of standard of living, there is no mutual linear causality between mortality rates and high incidence rates.

Keywords: breast cancer, standard of living, morbidity, mortality.