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The Impact of Socioeconomic Factors on Cancer Survival Rate

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ABSTRACT

Background: The socioeconomic status as a major determinant of health status has a considerable impact on the cancer survival rate. The present study aimed to investigate the impact of socioeconomic factors on the 5-year survival rate for the most common cancer types in 56 countries.

Methods: In this ecological study, 5-year survival data for gastric cancer, colon cancer, lung cancer, breast cancer, cervical cancer, ovarian cancer, prostate cancer, and leukemia during the period of 2005-2009 and socioeconomic factors including gross domestic product (GDP), life expectancy, literacy rate, urbanization and healthcare expenditure were extracted from the CONCORD-2 study and the World Bank database, respectively. Multivariable regression analysis was used to estimate the model with the ordinary least-squares (OLS) method using Stata 14 software.

Results: The GDP coefficient for breast cancer, cervical cancer, and leukemia was positive and significant. No correlation was identified between gastric, colon, lung, ovarian, and prostate cancers with GDP. Gastric, colon, breast, and prostate cancers had a positive and significant correlation with life expectancy, while no significant correlation was found between lung cancer, cervical cancer, ovarian cancer, and leukemia with life expectancy. There was no correlation between cancer survival rate and literacy rate, or urbanization. There was only a positive correlation between prostate cancer with healthcare expenditure. Furthermore, there was no statistically significant relationship between gastric and ovarian cancers with socioeconomic variables. Finally, GDP and life expectancy had the most significant impact on cancer survival rates.

Conclusion: Different countries can play a key role in increasing cancer survival rates by implementing policies to improve economic and social factors.

Keywords: Socioeconomic Factors, Cancer, Survival Rate

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INTRODUCTION:

Cancer, as a chronic disease, is one of the leading causes of mortality and disability worldwide (1, 2). Based on the officially published statistics, 42 million people are diagnosed with cancer around the world, while this number is expected to increase by 15 million until 2020 (3). The global burden of cancer has also been rising due to aging and population growth as well as high-risk behaviors and is considered as one of the main challenges for the health systems in different countries (4). Due to advances in therapeutic methods and also technological breakthroughs in the field of medical equipment, patients survive for a long time after the initial diagnosis of their disease (5). The survival rate is one of the most critical indicators which helps health policy makers and physicians in providing accurate diagnoses and treatment methods by giving an estimate for disease prognosis (6). According to numerous studies and scientific evidence, socioeconomic factors as one of the determinants of health status, have a significant impact on cancer survival rate. So, people with lower socioeconomic status have a lower survival rate (7, 8). A comparative study has been conducted in the United States, Wales, England, Denmark, Netherlands, Finland, France, Germany, Italy, Spain, and Sweden. They showed that the United States and France, with the highest cancer survival rate, allocated the largest share of their gross domestic product (GDP) to health. Thus, there is a possible correlation between financial inputs to the health system and its proportional outcomes (9). In a cohort study conducted in Portugal on patients aged 15 to 84 years, men with colorectal cancer had a 5 to 10 years lower cancer survival rate rather than women (8). Another study in Denmark that focused on the direct impact of education, the amount of income and the type of homeownership on the cancer survival rate, concluded that individuals with higher levels of education, higher income, and personal homeownership had higher levels of survival rate (10). Based on another study in Finland, patients of a higher social class status had a higher survival rate for the 10 most prevalent cancers in that country (11). The result of a study conducted among European countries also suggested a positive role for health system funds in increasing cancer survival rates (5). Findings from another study on breast cancer patients living in England and Wales showed that deprived women who had a lower life expectancy, lost a considerable amount of their lives after initial cancer diagnosis and had a lower survival rate compared to women living in less deprived areas. Hence, the deprivation factor was identified as an important component of life expectancy (7), and life expectancy is a socioeconomic factor that influences the cancer survival rate.

In the ecological studies, although it is not possible to find out the specific condition for each patient separately due to the nature of the study based on the past documentation, they can probably show the possible relationship between socioeconomic factors and cancer survival rate (8). It should be noted that ecological studies are the first step in initiating epidemiological research, and also in measuring socioeconomic factors through different methods and based on various variables. The current ecological study aimed to investigate the impact of socioeconomic factors including GDP, life expectancy, literacy rate, urbanization, and healthcare expenditure on the 5-year survival rate for eight most common cancers including gastric cancer, colon cancer, lung cancer, breast cancer, cervical cancer, ovarian cancer, prostate cancer, and leukemia.

METHODS:

This is an ecological study aimed to investigate the impact of socioeconomic factors on the 5-year survival rate for the common cancers. In this study, the impact of socioeconomic factors including GDP, life expectancy, literacy rate, urbanization, and healthcare expenditure on the 5-year survival rate for eight most common cancers including gastric cancer, colon

cancer, lung cancer, breast cancer, cervical cancer, ovarian cancer, prostate cancer, and leukemia have been investigated according to the following model:

SUR=F (GDP, LE, LR, UR, HE)

Where "SUR" represent the cancer 5-year survival rate (Dependent variable), "GDP" represent the gross domestic product, "LE" represent the life expectancy, "LR" represent the literacy rate, "UR" represent the urbanization, and finally "HE" represent the healthcare expenditure (Independent variables).

Data Sources:

In this study, the 5-year survival rate for the included cancers were collected and extracted from the Global surveillance of cancer survival study (CONCORD-2) conducted by Claudia Allemani et al. (12) and available data of cancer registry systems in the studied countries between the years 1995 and 2009. It is necessary to mention that due to the lack of complete data on the 5-year cancer survival rate for a number of countries, a total of 56 countries were selected and entered the study. Eventually, data concerning GDP, life expectancy, literacy rate, urbanization, and healthcare expenditure as socioeconomic factors were extracted from the World Bank database (13).

Data Analyzing Method:

Single variable and multivariable regression analysis were used to investigate the correlation between cancer survival rate and socioeconomic factors, by which eight regression models created with the OLS to estimate the models. Each model was related to a separate type of cancer. Significance levels of 5% and 10% were used in all analyses. Data analysis was performed using Stata software version 14.

RESULTS:

Table 1 shows the statistical description of study variables and cancers. As illustrated, between socioeconomic variables, GDP and healthcare expenditure had the highest and the lowest average, respectively. The average survival rates for gastric cancer, colon cancer, lung cancer, breast cancer, cervical cancer, ovarian cancer, prostate cancer, and leukemia were 25.33, 55.18, 14.04, 78.72, 61.41, 38.30, 78.17 and 41.43, respectively (additional information can be deduced from **Table 1**).

The Breusch-Pagan heteroskedasticity test was performed using the "hettest" command. Results showed that the null hypothesis based on homoscedasticity was rejected. Afterward, the "robust" command was used to resolve the heteroskedasticity issue.

The results of the single variable and multivariable regression analyses are shown in **Tables 2** and **Table 3**, respectively. According to the results of single-variable regression analysis, gastric cancer, colon cancer, breast cancer, prostate cancer, and leukemia were significantly associated with all independent variables. Gastric cancer, considered as a single variable, had a significant correlation only with the level of literacy and life expectancy. Whereas, cervical cancer was associated with variables such as GDP, life expectancy, and literacy rate. Finally, there was no relationship observed between ovarian cancer with study variables as a single variable (additional information can be deduced from **Table 2**).

According to the results of the multivariable regression analysis, the GDP coefficients for breast cancer, cervical cancer, and leukemia were positive and significant, meaning that one unit increase in the GDP will increase the cancer survival rate by 0.00019290, 0.00038330 and 0.00057780, respectively. The survival rate of gastric, colon, lung, ovarian, and prostate cancers had no relationship with GDP.

The survival rate of gastric, colon, breast, and prostate cancers had a positive and significant correlation with life expectancy at a level of 5%. In other words, by increasing one unit in life expectancy, the mentioned cancer survival rates will increase by 1.25, 1.54, 1.10, and 1.86, respectively. No significant correlation was found between lung cancer, cervical cancer, ovarian cancer,

Table 1. The statistical description of study variables (N=56)

Effect	Variables	Observations	Average	Standard Deviation	Minimum	Maximum
Socioeconomic Factors	GDP Per Capita	56	21469.88	17903.24	707.00	66775.39
	LE	56	75.66	4.53	64.56	81.92
	LR	56	54.93	46.04	1	99.8
	UR	56	70.61	16.98	15.18	97.44
	HE	56	7.10	2.39	2.36	15.13
	Cancers	**Observations**	**Average**	**Standard Deviation**	**Minimum**	**Maximum**
5-Year Survival Rate	Gastric	56	25.33	9.56	3	57.9
	Colon	56	55.18	9.81	28.1	69.4
	Lung	56	14.04	5.89	2.2	37.2
	Breast	56	78.72	8.92	43.1	90.6
	Cervical	56	61.41	10.91	10.3	86.7
	Ovarian	56	38.30	9.26	8	82.7
	Prostate	56	78.17	16.30	27.4	100
	Leukemia	56	41.43	18.51	6	90

GDP: Gross Domestic Product; LE: Life Expectancy; LR: Literacy Rate; UR: Urbanization; HE: Health Expenditures

and leukemia with life expectancy. The relationship between cancer survival rates with literacy rate and urbanization was not statistically meaningful. A significantly positive relationship was found between prostate cancer and healthcare expenditure. Thus, by each unit increase in healthcare expenditure, the survival rate of prostate cancer would increase by 1.83. There was no significant correlation between healthcare expenditure with the rest of the studied cancers. There was no significant statistical relationship between gastric and ovarian cancer survival rates with the independent variables. Overall, among socioeconomic factors considered in the current study, GDP and life expectancy had the most significant impact on cancer survival rates. (additional information can be deduced from **Table 3**).

DISCUSSION

Cancer is one of the most important health issues in the world and accounts for a significant share of countries' limited resources and health facilities (14, 15). The present ecological study aimed to investigate the impact of socioeconomic factors including GDP, life expectancy, literacy rate, urbanization, and healthcare expenditure on the 5-year survival rate for the most common cancers

Table 2. Results of single-variable regression analysis (N=56)

Variable	Gastric	Colon	Lung	Breast	Cervical	Ovarian	Prostate	Leukemia
	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
GDP Per Capita	$1*10^{-3}$	$3*10^{-3}$	$6*10^{-5}$	$3*10^{-3}$	$2*10^{-3}$	$4*10^{-5}$	$4*10^{-3}$	$5*10^{-3}$
LE	0.82*	1.56*	0.34	1.25*	0.87*	0.15	2.1*	1.79*
LR	-0.05*	-0.11*	-0.03	-0.07*	-0.05*	-0.01	-0.13*	-0.12*
UR	0.05*	0.19*	0	0.14*	0.05	-0.08	0.27*	0.29*
HE	0.92*	1.96*	0.29	1.48*	0.3	-0.02	3.58*	3.22*
Variable	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation
GDP Per Capita	$7*10^{-4}$	$5*10^{-4}$	$4*10^{-5}$	$5*10^{-4}$	$7*10^{-4}$	$7*10^{-5}$	$1*10^{-1}$	$1*10^{-3}$
LE	0.26	0.2	0.17	0.2	0.3	0.02	0.39	0.49
LR	0.02	0.02	0.016	0.02	0.03	0.02	0.04	0.05
UR	0.07	0.07	0.04	0.06	0.08	0.07	0.12	0.14
HE	0.52	0.48	0.33	0.46	0.61	0.52	0.78	0.95

GDP: Gross Domestic Product; LE: Life Expectancy; LR: Literacy Rate; UR: Urbanization; HE: Health Expenditures

including gastric cancer, colon cancer, lung cancer, breast cancer, cervical cancer, ovarian cancer, prostate cancer, and leukemia. Single variable and multivariable regression analysis were used to assess the relationship between cancer survival rate and socioeconomic factors. Thus, the models were established by using eight regression models and applying the OLS.

The results of this study indicated the positive impact of GDP on increasing cancer survival rates. The GDP coefficients for breast cancer, cervical cancer, and leukemias were positive and significant, in a way that one unit increase in GDP will increase the cancer survival rate by 0.00019290, 0.00038330 and 0.00057780, respectively. Quaglia et al. identified the GDP variable as the main determinant of cancer survival rate in elderly patients living in 16 European countries (16). In another study in high-income countries, there was also a strong and significant relationship between GDP and decreasing in cancer mortality rate (17). It seems that countries with a higher GDP and, subsequently, better public welfare and health system indices have higher cancer survival rates. By allocating funds for health services, these countries have advanced cancer early detection techniques and a better treatment process. These techniques are not affordable for the government or people in countries with low GDP. Therefore, people become

Table 3: Results of multivariable regression analysis (N=56)

Variable	Gastric	Colon	Lung	Breast	Cervical	Ovarian	Prostate	Leukemia
	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
GDP Per Capita	$1*10^{-3}$	$3*10^{-3}$	$6*10^{-5}$	$3*10^{-3}$	$2*10^{-3}$	$4*10^{-5}$	$4*10^{-3}$	$5*10^{-3}$
LE	0.82*	1.56*	0.34	1.25*	0.87*	0.15	2.1*	1.79*
LR	-0.05*	-0.11*	-0.03	-0.07*	-0.05*	-0.01	-0.13*	-0.12*
UR	0.05*	0.19*	0	0.14*	0.05	-0.08	0.27*	0.29*
HE	0.92*	1.96*	0.29	1.48*	0.3	-0.02	3.58*	3.22*
Constant	31.38	23.67	20	23.65	32.37	32.13	46.4	55.6
Variable	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation	Standard Deviation
GDP Per Capita	$7*10^{-4}$	$5*10^{-4}$	$4*10^{-5}$	$5*10^{-4}$	$7*10^{-4}$	$7*10^{-5}$	$1*10^{-1}$	$1*10^{-3}$
LE	0.26	0.2	0.17	0.2	0.3	0.02	0.39	0.49
LR	0.02	0.02	0.016	0.02	0.03	0.02	0.04	0.05
UR	0.07	0.07	0.04	0.06	0.08	0.07	0.12	0.14
HE	0.52	0.48	0.33	0.46	0.61	0.52	0.78	0.95
Constant	57.94**	-52.07*	-20.17	0.13	16.86	10.72	-65	12.93
Adjusted R2	0.11	0.52	0.05	0.42	0.27	0.01	0.33	0.25
F Statistics	2.43	13.01	1.62	9.05	5.22	1.13	6.54	4.84
Root MSE	8.99	6.78	5.73	6.78	9.27	9.21	13.29	15.93

GDP: Gross Domestic Product; LE: Life Expectancy; LR: Literacy Rate; UR: Urbanization; HE: Health Expenditures
**P<0.05; **P<0.1*

aware of their disease when there is a far lower possibility of treatment and hence, low survival probability for the affected patients.

According to our results, gastric, colon, breast, and prostate cancers had positive and significant correlations with life expectancy. In a study entitled "Life expectancy and cancer survival rate in the EUROCARE-3 cancer registry areas", Micheli et al. found that there is a significantly strong relationship between the 5-year survival rate for all of the cancer types and life expectancy (18). A study conducted among women with breast cancer also showed that patients with lower life expectancy

had lost much of their lives after the primary diagnosis of cancer and subsequently had lower survival rates (7). The results of another study showed that people with higher life expectancy also have a higher survival rate (19). These studies are consistent with the present study. The positive relationship between cancer survival rate and life expectancy suggests that people with low life expectancy generally live in more deprived areas and have a lower socioeconomic status. Hence, the total sum of these factors causes a higher cancer mortality rate among these groups.

Baeradeh et al. indicated no relationship between the literacy rate and the survival rate of patients with gastric cancer (20), which was in line with a study conducted in Chile (21). Even though several studies have demonstrated a relationship between literacy rate and cancer survival rate (6, 8, 10, 11, 22-24), we detected no significant relationship between these factors. Overall, considering the different results reported by previous studies, it seems that there is a need for doing more researches to clarify the impact of literacy rate on cancer survival rate.

An analytical research paper titled "Survival rate of patients with gastric cancer and its effective factors" found that there is no meaningful relationship between residence (urbanization or living in rural areas) and the 5-year survival rate of patients with gastric cancer (20). Another study performed in the United States clearly showed the difference between people living in urban and rural areas regarding the cancer survival rate. They showed that people in urban areas were more likely to survive while living in rural areas had reduced survival rate by 10%. In this study, cancer incidence in rural areas was also reported lower rather than the urban areas (25). In the study of Wales, it was concluded that the survival probability of people living in the countryside was 35% lower than those who had better access to healthcare facilities in urban areas (26). The result of another study conducted in the United States and Wales is not consistent with the present study either. Therefore, in this study, we could not reach a meaningful relationship between cancer survival rate and the urbanization variable. It is possible that due to less diagnostic and screening capacities in rural areas and difficult access to healthcare and health facilities, cancer will be detected in more advanced stages, and the patient will receive less care. All the factors mentioned above reduce the survival rate of cancer patients in countryside areas. It should be noted that some patients living in rural areas undergo treatment process by moving to cities, so that they will have better access to health services and will have a better chance of survival. This may explain why the results from different studies report less survival rate for the people living in suburban areas.

A study conducted among European countries highlighted the role of healthcare expenditure in increasing the cancer survival rate (5). In a similar study, among the healthcare expenditure indicators, the number of CT scan devices had a significant relationship with the cancer survival rate (16). The results of another study also showed a strong and significant relationship between healthcare expenditure and cancer survival rate (17). In line with these findings, the result of this study suggests that there is a positive and significant relationship between the survival rate for prostate cancer and healthcare expenditure. Accordingly, it can be concluded that increasing the number of financial resources entering the health system will probably improve the health outcomes in various fields.

Typically, in ecological studies, results should not be generalized at the individual level, because the study units are communities. Besides, variation in the social and cultural conditions of each country can play a key role in this regard. There may also be other factors that affect the cancer survival rate. Hence, it is better to generalize the results of the current study more carefully.

Despite these limitations, in this study, the impact of different socioeconomic factors on the most common cancers survival rate was investigated. Single studies were compared together in a comprehensive view to see all variables near each other and to reach a logical conclusion. For future researches, doing more specialized studies on each cancer in each country and finding the hidden reasons for the results of the current study are suggested. The findings derived from different researches can be applied by policy-makers in large-scale policies to make better decisions based on scientific evidence (evidence-based policymaking).

CONCLUSION

Overall, according to the results of this study and other studies in this field, countries with higher GDP, life expectancy, literacy rate, urbanization rate, and also higher allocated budget to the health system have a higher cancer survival rate. Therefore, policies to improve socioeconomic factors can affect this index positively.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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