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REVIEW ARTICLE

Epidemiology of the Incidence and Mortality of Pancreas Cancer and its Relationship with the Human Development Index (HDI) in the World: An Ecological Study in 2018

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Abstract: ***Objective*:** Pancreatic cancer is one of the leading causes of mortality in developed countries and a lethal malignant neoplasm worldwide. This study aims to evaluate the epidemiology of pancreatic cancer incidence and mortality and its relationship with HDI.

Methods*:** This is a descriptive cross-sectional study that is based on cancer incidence data and cancer mortality rates derived from the ***GLOBOCAN in 2018.

The incidence and mortality rates of Pancreas as well as Pancreas cancer distribution maps were derived for world countries. *The data* analysis was conducted using a correlation test, and regression tests were used to evaluate the correlation of the incidence and mortality of Pancreas with HDI. The statistical analysis was carried out by Stata-14, and a significance level of 0.05 was considered.

Results: The highest incidence of pancreatic cancer was reported in Asia with 214499 (46.7%) cases and the lowest incidence was related to Oceania with 4529 cases (0.99%). The results showed a positive and significant correlation between incidence ($r = 0.764$, $P < 0.0001$) and mortality ($r = 0.771$, $P < 0.0001$) of pancreatic cancer and the HDI index. The results of ANOVA revealed that the highest mean incidence was related to the very high HDI ($P < 0.0001$) and the highest mortality was connected to the very high human development ($P < 0.0001$). The results exhibited that incidence was positively and significantly correlated with GNI ($r = 0.497$, $P < 0.0001$), MYS ($r = 0.746$, $P < 0.0001$), LEB ($r = 0.676$, < 0.0001) and EYS ($r = 0.738$, $P < 0.0001$). Also, a significant positive correlation was found between mortality and GNI ($r = 0.507$, $P < 0.0001$), MYS ($r = 0.745$, $P < 0.0001$), LEB ($r = 0.679$, < 0.0001), and EYS ($r = 0.748$, $P < 0.0001$).

***Conclusion*:** Given the higher incidence and mortality of pancreatic cancer in countries with HDI, it is necessary to pay a greater attention to risk factors and appropriate planning to reduce these factors and minimize the impact and mortality rate of this disease.

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1. INTRODUCTION

Today, non-communicable diseases (NCD) are the leading cause of mortality worldwide, particularly car accidents and cancers, leading to a decline in life expectancy of countries in the 21st century [1]. The incidence of cancer is rising in the world, and it is projected to double in 2030 with the current growing trend of disease [2, 3]. In recent years, cancer control has come to fore as a public health issue. Worldwide, pancreatic cancer is the seventh major cause of death. According to the Dally Index (DALY), the burden of disease caused by this cancer is particularly significant [4]. Given the aggressive nature of the disease, it is a significant health concern around the world. This is also the fifth terminal cancer in industrialized countries that accounts for about 4% of cancer deaths among men and women around the world. In the United States, pancreatic cancer accounts for about 2.7% of total cancer cases [2, 5].

The principal risk factors for pancreatic cancer are increased life expectancy, changes in fertility, and demographic structure, which are connected with socio-economic development. The cancer statistics vary in countries with different economic systems [6]. However, the overall trend of pancreatic cancer incidence and death can be observed in all parts of the world and diverse socioeconomic development levels. Smoking, type-2 diabetes, and obesity have been reported as risk factors for pancreatic cancer in developing countries [7].

Pancreatic cancer is closely associated with the level of industrialization in societies so that most deaths caused by this cancer have been reported in developed countries. The high mortality rate of this cancer elevated its rank as the fourth leading cause of death to the second in the United States in 2017. According to GOLOBOCAN estimates, in 2012, a million new cases of cancer and 500,000 deaths occur in Central and South America (CSA) annually [4, 6, 7].

Some reasons for ineffective treatment of pancreatic cancer are lack of appropriate diagnostic testing or screening, lack of proper response to chemotherapy or radiation therapy, and invasive adenocarcinoma of pancreatitis [4]. The survival of patients with pancreatic cancer is very low, so only 4% of patients survive for more than five years. Given the high mortality rate of pancreatic cancer, its mortality rate is approximately equal to its incidence[8].

Given the global pattern and timing of pancreatic cancer in recent years, raising public awareness about this disease is essential for planning and managing financial and human resources for its prevention. Each country needs to come to a conclusion by compar-

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ing its figures with that of other countries. Moreover, there is still a huge controversy surrounding the impact of financial and social status on the risk factors of the disease [4].

The purpose of this study is to assess the impact of socioeconomic development (based on HDI) on the global trend of incidence and mortality of pancreatic cancer in the world based on World Bank data in 2018. In this study, we seek to study critical characteristics of cancer transmission in the world by examining the relationship between its incidence rate and HDI, which consists of life expectancy, education, and gross national income.

2. METHODS

Given the limited quality and coverage of cancer data worldwide, particularly in low- and middle-income countries, caution must be exercised when interpreting these estimates. IARC's approach involves both evaluating, compiling, and using data from the Agency's collaborators in these estimates and working alongside national staff to improve local data quality, registry coverage, and analytical capacity. The apparent need for investment in population-based cancer registration in low- and middle-income countries has triggered the launch of Global Initiative for Cancer Registry Development (GICR), coordinated by IARC. The goal of GICR is to boost cancer control by improving the coverage, quality, and adoption of population-based cancer registration data worldwide. A summary of steps taken to generate the current set of cancer incidence, mortality, and prevalence estimates is shown below. The estimation methods are country-specific, and the quality of national estimates depends on the coverage, accuracy, timeliness of the recorded incidence and mortality data of each country.

2.1. Incidence

The methods recruited to estimate the sex- and age-specific incidence rates of cancer in a specific country fall into the following broad categories in the order of importance: 1. Observed national incidence rates projected for 2018 (45 states). 2. The most recently observed incidence rates (national or regional) applied to the population in 2018 (50 states). 3. Rates estimated from national mortality data by modeling and using mortality-to-incidence ratios derived from cancer registries in each country (14 states). 4. Rates estimated from national mortality estimates by modeling and using mortality-to-incidence ratios derived from cancer registries in neighboring countries (37 states). 5. Age- and sex-specific national incidence rates for all types of cancers obtained by averaging overall rates from neighboring countries. These rates were then categorized to calculate the national incidence for specific sites using available cancer-specific relative frequency data (7 states). 6. Rates estimated as the average of those obtained from selected neighboring countries (32 states).

2.2. Mortality

The methods used to estimate the sex- and age-specific mortality rates of cancer in a specific country fall into the following broad categories in the order of importance: 1.Observed national mortality rates projected for 2018 (81 states). 2. The most recently observed national mortality rates applied to the population in 2018 (20 states).3. Rates estimated from the corresponding national incidence estimates by modeling and using incidence-to-mortality ratios derived from cancer registries in neighboring countries (81 states).4. Rates estimated an average of those from selected neighboring countries (3 states) [9, 10].

2.3. HDI

HDI is a compound index that comprises three dimensions: life expectancy, education, and access to essential sources for a proper and sensible life. The groups and regions with remarkable progress in all HDI components have developed more rapidly in comparison with low or moderate HDI countries. As shown by this index, the world is unequal because national averages conceal most of different experiences in human life. There are growing inequalities in northern and southern countries. Income inequality has risen both domestically and internationally [11-13].

3. RESULTS

Based on the results obtained from the cancer registry in 2018, there were 18078957 recorded cases of cancers in both sexes, of which 48918 cases (2.68% of all cancers) were related to pancreatic cancer. Also, there were 9555027 cancer-related deaths in 2018, of which 432,242 cases (85.4%) were related to pancreatic cancer.

The highest incidence of pancreatic cancer belonged to Asia with 214499 cases (46.7%), and the lowest incidence to Oceania with 4529 cases (99.9%). The highest mortality was also observed in the Asia with 200681 cases (46.4%), and the lowest in Oceania with 4002 cases (93.03%) (Fig. **1**).

Table **1** shows the incidence and mortality rate of pancreatic cancer in each continent. As listed in the table, the highest incidence of pancreatic cancer in the world was reported in Hungary (10.8 per 100,000), Uruguay (10.7 per 100,000), and Republic of Moldova (10.5 per 100,000). The highest rates of pancreatic cancer mortality were also reported in Uruguay (9.9 per 100,000), Hungary (4.9 per 100,000), and Malta (8.7 per 100,000) (Table **1**, Fig. **2**).

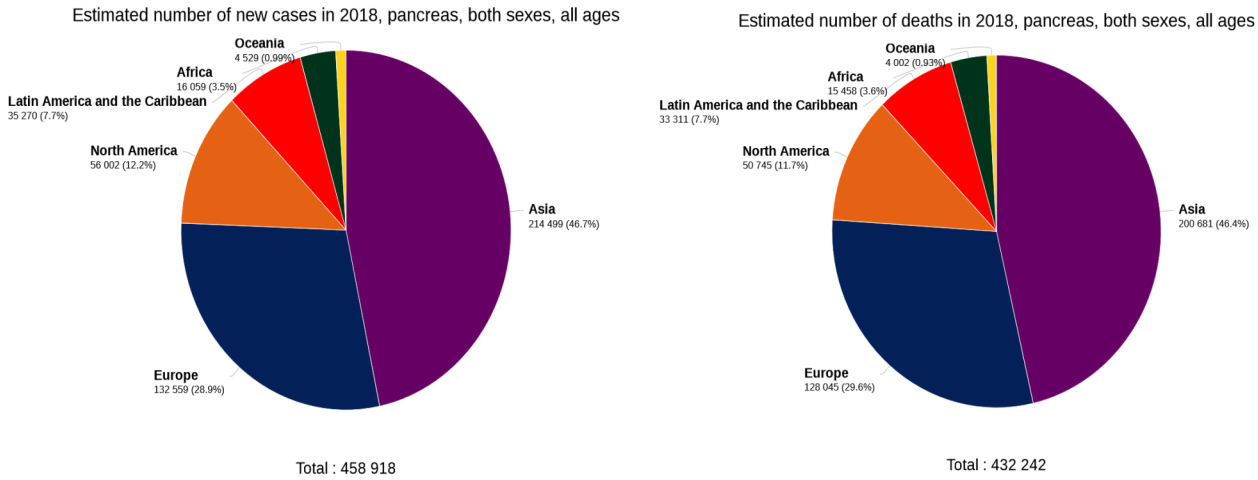


Fig. (1). Incidence and mortality of pancreas cancer by continents (2018) ***[Source: GLOBOCAN 2018].*** (*A higher resolution / colour version of this figure is available in the electronic copy of the article*).

Table 1. Table 1. Estimated age-standardized incidence and mortality rates for pancreatic cancer in World in 2018 ***[Source: GLOBOCAN 2018].***

Mortality			Incidence			Other countries
Cum. Risk	**ASR**	**Crud Rate**	**Cum. Risk**	**ASR**	**Crud Rate**	
						Africa
0.27	2.3	2.2	0.28	2.4	2.2	Algeria
0.13	1.1	0.46	0.15	1.2	0.5	Angola
0.4	2.9	1.5	0.41	3.1	1.5	Benin
0.09	1	0.69	0.09	1	0.69	Botswana
0.21	1.8	0.72	0.21	1.8	0.74	Burkina Faso
0.17	1.5	0.63	0.16	1.4	0.63	Burundi
0.55	5.3	4.5	0.56	5.4	4.5	Cabo Verde
0.33	2.7	1.2	0.33	2.7	1.3	Cameroon
0.21	1.8	0.93	0.21	1.8	0.95	Central African Republic
0.22	1.8	0.68	0.22	1.8	0.73	Chad
0	0	0	0	0	0	Comoros
0.3	2.5	1.1	0.3	2.5	1.2	Congo, Democratic Republic of
0.19	1.6	0.87	0.19	1.7	0.91	Congo, Republic of
0.3	2.5	1.2	0.3	2.5	1.2	Côte d'Ivoire
0.07	0.64	0.51	0.07	0.64	0.51	Djibouti
0.43	3.6	2.9	0.43	3.7	2.9	Egypt
0.29	2.1	0.91	0.29	2.1	0.91	Equatorial Guinea
0.1	0.92	0.48	0.1	0.94	0.5	Eritrea
0.08	0.72	0.42	0.1	0.92	0.52	Ethiopia
0.6	4.8	8	0.75	5.9	9.6	France, La Réunion
0.19	1.6	1.1	0.19	1.6	1.1	Gabon
0.06	0.52	0.23	0.06	0.52	0.23	The Gambia
0.21	2.1	1.1	0.23	2.1	1.1	Ghana
0.04	0.32	0.18	0.04	0.35	0.21	Guinea
0.21	1.4	0.73	0.21	1.4	0.73	Guinea-Bissau
0.37	3.2	1.4	0.38	3.2	1.4	Kenya
0.08	0.72	0.49	0.08	0.72	0.53	Lesotho
0.16	1.3	0.7	0.16	1.4	0.72	Liberia
0.44	4.1	3	0.47	4.3	3.3	Libya
0.06	0.53	0.29	0.06	0.52	0.29	Madagascar
0.07	0.42	0.2	0.06	0.4	0.2	Malawi
0.39	3.3	1.3	0.39	3.3	1.3	Mali
0.2	1.5	0.86	0.2	1.5	0.88	Mauritania
0.41	3.6	5.6	0.45	3.7	5.8	Mauritius

(Table 1) Contd....

Mortality			Incidence			Other countries
Cum. Risk	**ASR**	**Crud Rate**	**Cum. Risk**	**ASR**	**Crud Rate**	
0.23	1.9	2	0.27	2.2	2.3	Morocco
0.07	0.58	0.3	0.07	0.56	0.31	Mozambique
0.16	1.2	0.7	0.17	1.3	0.73	Namibia
0.18	1.4	0.62	0.18	1.4	0.63	Niger
0.28	2.3	0.97	0.28	2.3	1	Nigeria
0.41	3.3	1.7	0.41	3.3	1.7	Rwanda
0	0	0	0	0	0	Sao Tome and Principe
0.23	2	0.93	0.23	2	0.94	Senegal
0.2	1.5	0.74	0.2	1.5	0.75	Sierra Leone
0.18	1.5	0.69	0.18	1.6	0.72	Somalia
0.47	4.3	3.5	0.47	4.3	3.6	South Africa
0.21	1.9	0.98	0.21	1.9	0.99	South Sudan
0.11	1	0.62	0.11	1	0.61	Sudan
0.09	0.77	0.43	0.08	0.7	0.43	Swaziland
0.06	0.55	0.26	0.06	0.55	0.26	Tanzania, United Republic of
0.12	0.97	0.49	0.13	0.99	0.51	Togo
0.3	2.5	3	0.31	2.6	3	Tunisia
0.28	2.4	0.85	0.28	2.4	0.91	Uganda
0.07	0.66	0.25	0.07	0.67	0.26	Zambia
0.4	3.2	1.4	0.41	3.2	1.4	Zimbabwe

Asia

0.16	1.4	0.6	0.16	1.4	0.6	Afghanistan
1	8.5	14	1	8.9	14.6	Armenia
0.31	2.6	2.8	0.31	2.7	2.9	Azerbaijan
0.52	3.5	1.9	0.52	3.6	1.9	Bahrain
0.11	0.99	0.83	0.12	1	0.84	Bangladesh
0.53	3.2	2.2	0.53	3.2	2.2	Bhutan
0.57	4.8	4.1	0.65	5.4	4.8	Brunei
0.14	1.1	0.78	0.13	1.1	0.8	Cambodia
0.56	4.9	7.8	0.6	5.2	8.2	China
0.43	3.8	1.9	0.43	3.8	1.9	Gaza Strip and West Bank
0.38	3	5.6	0.38	3.1	5.8	Georgia
0.1	0.82	0.78	0.1	0.85	0.8	India
0.23	2	1.8	0.23	2.1	1.9	Indonesia
0.32	2.9	2.6	0.34	3.1	2.8	Iran, Islamic Republic of
0.31	2.5	1.3	0.31	2.5	1.3	Iraq

(Table 1) Contd....

Mortality			Incidence			Other countries
Cum. Risk	**ASR**	**Crud Rate**	**Cum. Risk**	**ASR**	**Crud Rate**	
0.91	7.8	12.7	0.86	7.6	12.1	Israel
0.86	7.8	29.4	1.1	9.7	33.9	Japan
0.43	3.7	2.3	0.43	3.7	2.4	Jordan
0.73	5.7	6.1	0.73	5.8	6.2	Kazakhstan
0.5	4.2	5.8	0.52	4.1	5.7	Korea, Democratic Republic of
0.69	6.1	12.9	0.86	7.2	14.4	Korea, Republic of
0.44	3.7	1.8	0.46	3.8	1.9	Kuwait
0.57	4.4	3.5	0.56	4.5	3.6	Kyrgyzstan
0.16	1.2	0.8	0.16	1.2	0.82	Lao People's Democratic Republic
0.45	3.7	4.3	0.45	3.7	4.3	Lebanon
0.33	3	2.9	0.35	3.2	3	Malaysia
0.08	1.1	0.9	0.08	1.1	0.9	Maldives
0.53	3.9	2.9	0.6	4.6	3.5	Mongolia
0.17	1.4	1.3	0.18	1.5	1.4	Myanmar
0.23	1.8	1.5	0.24	2	1.7	Nepal
0.36	3	1.5	0.36	3	1.6	Oman
0.08	0.71	0.5	0.09	0.74	0.53	Pakistan
0.41	3.8	2.9	0.42	3.8	2.9	Philippines
0.28	2.7	0.82	0.28	2.7	0.82	Qatar
0.25	2.1	1.5	0.27	2.2	1.6	Saudi Arabia
0.77	6.7	12.9	0.85	7.6	14.8	Singapore
0.06	0.56	0.74	0.07	0.62	0.82	Sri Lanka
0.39	3.3	2.3	0.39	3.3	2.3	Syrian Arab Republic
0.22	1.8	1.1	0.23	1.9	1.2	Tajikistan
0.23	2	3.2	0.24	2	3.3	Thailand
0.18	1.5	0.83	0.18	1.5	0.83	Timor-Leste
0.79	6.6	7.8	0.79	6.7	7.9	Turkey
0.34	2.6	2	0.32	2.6	2	Turkmenistan
0.53	4.4	1.4	0.54	4.4	1.4	United Arab Emirates
0.33	2.5	2	0.33	2.7	2.2	Uzbekistan
0.1	0.82	0.93	0.11	0.88	1	Viet Nam
0.24	2.1	0.96	0.24	2.1	0.97	Yemen

(Table 1) Contd....

Mortality			Incidence			Other countries
Cum. Risk	ASR	Crud Rate	Cum. Risk	ASR	Crud Rate	
Europe						
0.51	4.1	7.6	0.55	4.5	8.1	Albania
0.95	8.1	21.3	1	8.7	21.6	Austria
0.81	6.5	12.4	0.9	7.2	13.4	Belarus
0.75	6.6	17	1.1	8.7	19.2	Belgium
0.71	6.3	14.1	1	8	15.9	Bosnia and Herzegovina
0.92	7.6	17.7	1	8.4	18.9	Bulgaria
0.83	7.1	18.4	0.95	8	19.8	Croatia
0.73	6.2	11.3	0.71	5.9	9.9	Cyprus
1	8.3	20	1.1	9	20.8	Czech Republic
0.92	7.7	19.6	0.98	7.8	18.3	Denmark
0.95	7.9	20.2	1.1	9.2	22	Estonia
0.95	8.1	22.5	0.93	7.9	21.6	Finland
0.88	7.7	20.4	1.1	8.9	21.4	France
0.91	7.8	23.3	0.99	8.3	23.2	Germany
0.74	6.5	18.2	0.85	7.3	19.5	Greece
1.1	9.4	21.4	1.3	10.8	24	Hungary
0.93	8.4	17.2	0.85	5.7	10.1	Iceland
0.62	5.5	10.9	0.68	5.9	11.3	Ireland
0.75	6.6	21.4	0.87	7.5	22.9	Italy
0.94	7.8	19.7	1.3	10.3	24.1	Latvia
0.88	7.2	17.2	0.91	7.6	18	Lithuania
0.75	6.8	14.4	0.88	7.8	16.4	Luxembourg
1	8.7	19.9	0.98	8.3	19.2	Malta
0.69	5.2	10.2	0.73	5.6	10.6	Montenegro
0.87	7.4	16.8	0.79	6.7	14.6	Norway
0.83	6.9	15	0.85	7.1	15.2	Poland
0.62	5.4	15.5	0.64	5.6	15.7	Portugal
1.1	8.5	13.2	1.3	10.5	16.2	Republic of Moldova
0.85	6.9	15	0.91	7.4	15.9	Romania
0.91	7.4	13.9	0.88	7.2	13.4	Russian Federation
0.97	7.9	16.8	1.1	8.8	17.2	Serbia
0.96	7.9	15.8	1.2	9.6	19	Slovakia
0.89	7.6	19.7	0.98	8.2	20.3	Slovenia
0.7	5.9	15.7	0.79	6.6	16.7	Spain
0.91	7.7	20.5	0.91	7.7	20	Sweden

(Table 1) Contd....

Mortality			Incidence			Other countries
Cum. Risk	**ASR**	**Crud Rate**	**Cum. Risk**	**ASR**	**Crud Rate**	
0.77	6.6	16.7	0.86	7.2	17.3	Switzerland
0.82	7	17.5	0.82	7	17.2	The Netherlands
0.84	6.9	12.4	0.94	7.8	13.7	The former Yugoslav Republic of Macedonia
0.87	6.9	13.5	0.93	7.3	14.2	Ukraine
069	6.0	15.1	0.82	7.1	17.1	United Kingdom

North America

0.67	5.9	13.9	0.77	6.4	13.9	Canada
0.76	6.6	13.9	0.92	7.7	15.6	United States of America

South America

0.8	6.9	10.5	0.85	7.3	10.9	Argentina
0.26	2.2	3	0.2	2.1	3	Bahamas
0.81	6.4	12.9	0.81	6.4	12.9	Barbados
0.25	2.9	1.8	0.25	2.9	1.8	Belize
0.32	2.7	2.7	0.32	2.7	2.7	Bolivia, Plurinational State of
0.49	4.4	5.6	0.52	4.7	6	Brazil
0.62	5.4	8.7	0.65	5.6	9	Chile
0.42	3.7	4.3	0.45	4	4.7	Colombia
0.45	4.1	5.9	0.44	4	5.7	Costa Rica
0.44	3.8	7.9	0.48	4.1	8.3	Cuba
0.47	4.1	4.3	0.49	4.3	4.5	Dominican Republic
0.33	3	3.2	0.34	3.2	3.4	Ecuador
0.33	3.2	3.8	0.34	3.2	3.9	El Salvador
0.78	6.3	16	0.67	6.1	13.8	France, Guadeloupe
0.68	6.3	18.2	0.79	7	18.7	France, Martinique
0.65	5.4	4.5	0.93	8	6.6	French Guyana
0.25	2.2	1.6	0.25	2.2	1.6	Guatemala
0.3	2.9	2.6	0.29	2.8	2.4	Guyana
0.31	3.1	2.3	0.38	3.6	2.6	Haiti
0.58	4.6	3.3	0.56	4.9	3.5	Honduras
0.34	3.1	4.3	0.37	3.2	4.5	Jamaica
0.39	3.3	3.4	0.43	3.6	3.7	Mexico
0.42	3.5	3	0.44	3.6	3.1	Nicaragua
0.34	3	3.6	0.38	3.2	3.8	Panama
0.52	4.8	4.5	0.55	5.1	4.7	Paraguay
0.45	4.1	4.4	0.49	4.4	4.8	Peru

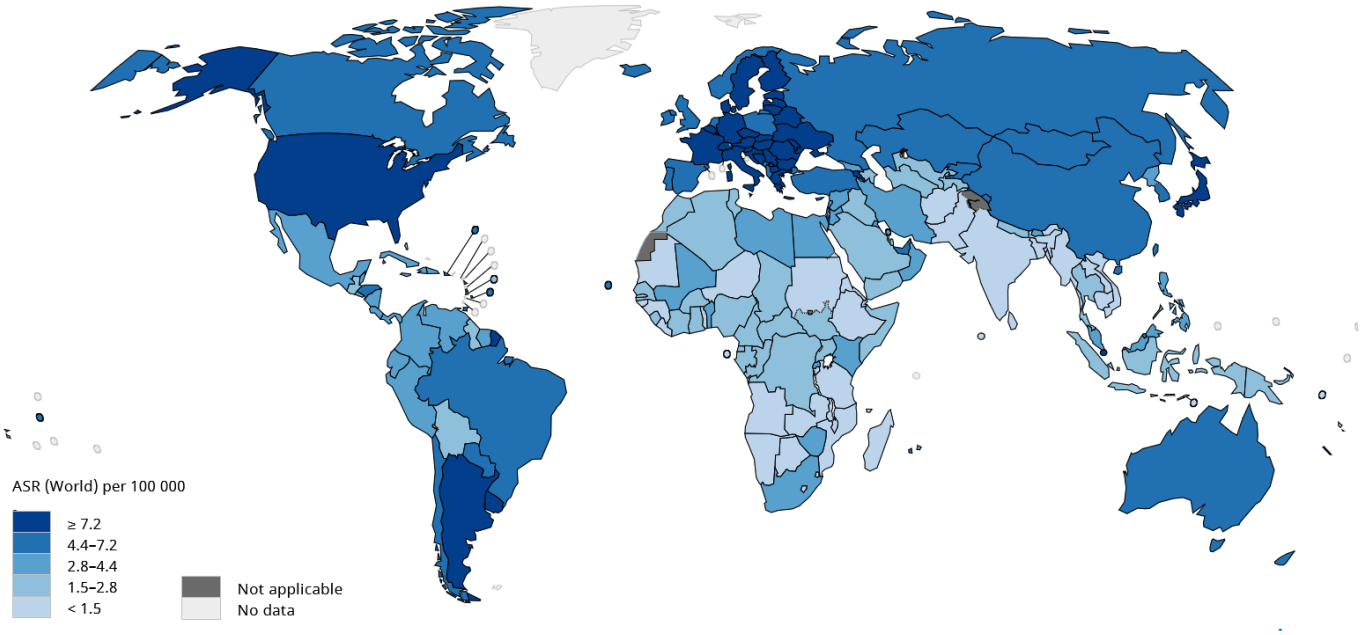
(Table 1) Contd....

Mortality			Incidence			Other countries
Cum. Risk	ASR	Crud Rate	Cum. Risk	ASR	Crud Rate	
0.52	4.4	9	0.53	4.5	9.1	Puerto Rico
0.25	2.8	4.5	0.25	2.8	4.5	Saint Lucia
0.48	4	4.4	0.52	4.4	4.6	Suriname
0.58	5.3	7.9	0.58	5.3	7.9	Trinidad and Tobago
1.2	9.9	19.4	1.2	10.7	20.7	Uruguay
4.6	4.0	4.1	0.48	4.2	4.3	Venezuela, Bolivarian Republic of

Oceania

0.66	5.9	12.8	0.79	6.9	14.5	Australia
0.31	2.6	2.5	0.31	2.6	2.5	Fiji
0.68	6.1	8.9	0.87	8.6	12.5	France, New Caledonia
0.6	4.8	5.6	0.6	4.8	5.6	French Polynesia
0.52	4.8	6.6	0.64	5.3	7.2	Guam
0.68	6	12.8	0.75	6.8	14.7	New Zealand
0.23	1.9	1.2	0.24	2	1.3	Papua New Guinea
0.12	2.1	2	0.91	7	6.1	Samoa
0.24	1.3	0.64	0.12	0.64	0.32	Solomon Islands
0.14	0.57	0.35	0.14	0.57	0.35	Vanuatu

a) Incidence rate



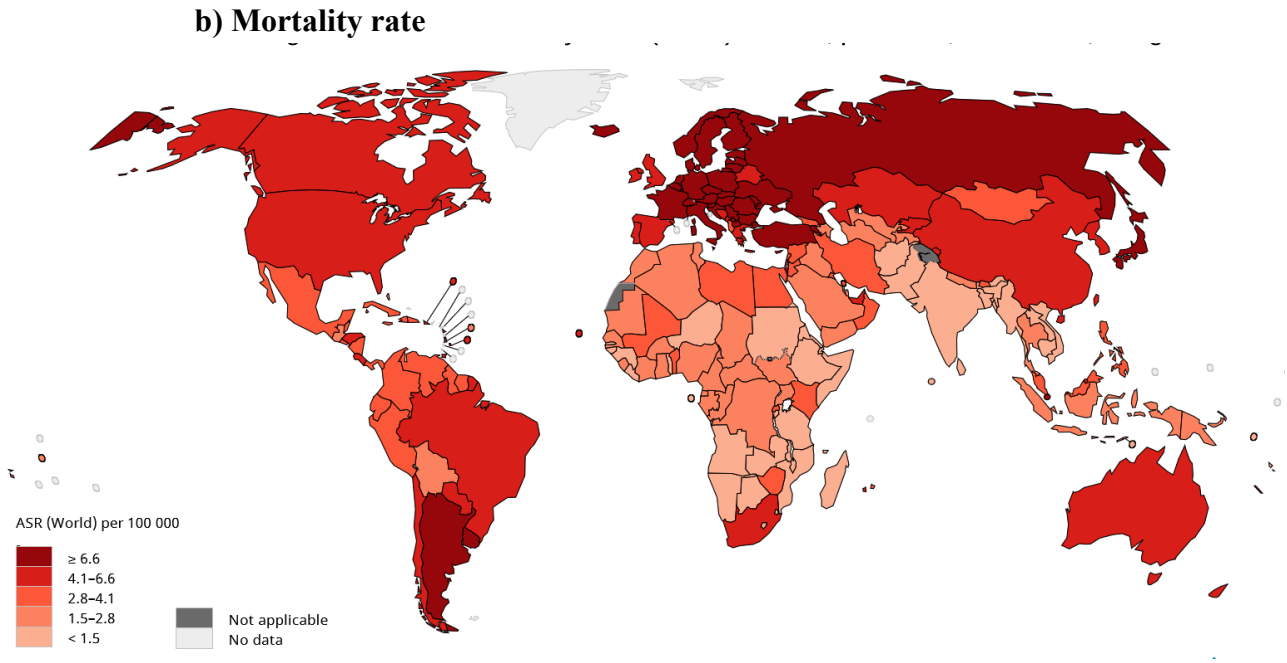


Fig. (2). Estimated age-standardized incidence and mortality rates of pancreatic cancer in the World in 2018 ***[Source: GLOBOCAN 2018].*** (*A higher resolution / colour version of this figure is available in the electronic copy of the article*).

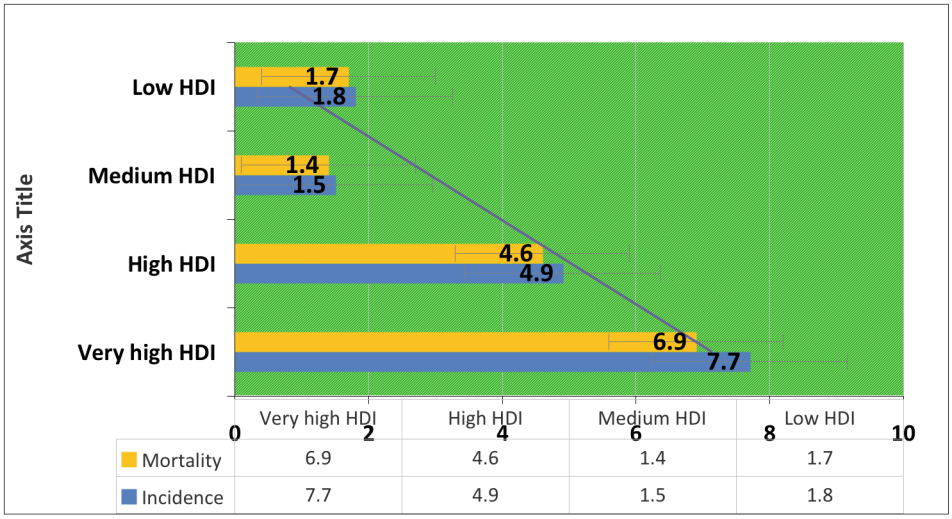
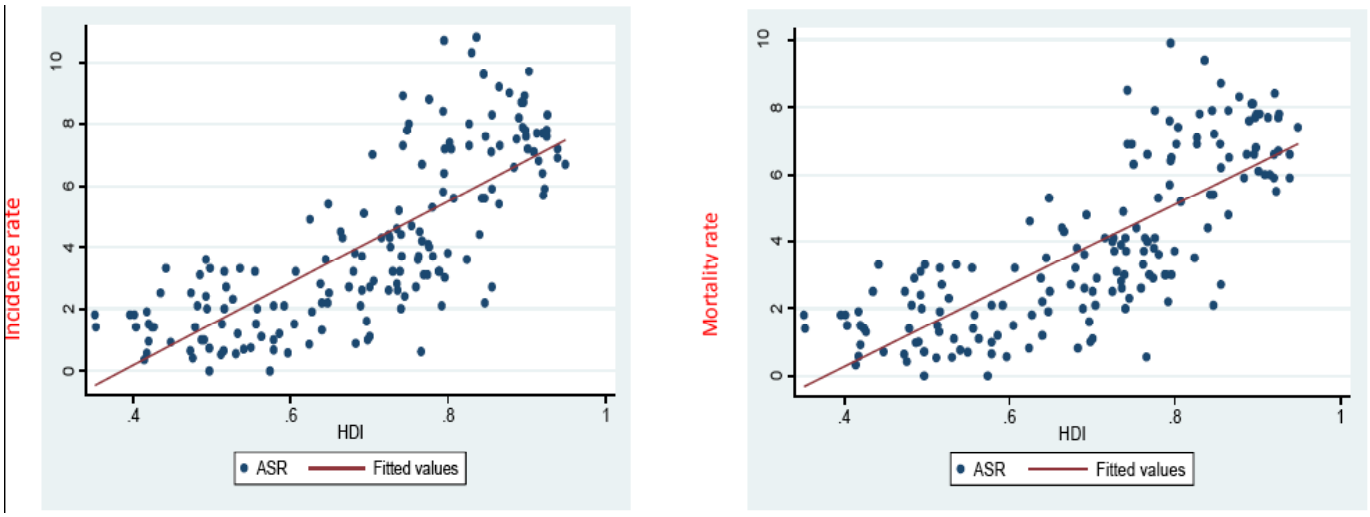


Fig. (3). Distribution of incidence and mortality rates for pancreatic cancer by HDI. (*A higher resolution / colour version of this figure is available in the electronic copy of the article*).

Table 2. Pancreatic cancer incidence and mortality in different HDI Regions in 2018.

Mortality Rate		Incidence Rate		HDI
ASR	CR	ASR	CR	
6.5	14.8	7.1	15.4	Very high human development
4.1	5.9	4.4	6.2	High human development
2.2	1.7	2.3	1.8	Medium human development
1.6	0.7	1.6	0.8	Low human development
P<0.0001	P<0.0001	P<0.0001	P<0.0001	P-value(F-test)



R Sq. linear=0.764, P<0.0001 **R Sq. linear=0.771, P<0.0001**

Fig. (4). Correlation between the HDI, incidence and mortality rates of pancreatic cancer in World in 2018. (*A higher resolution / colour version of this figure is available in the electronic copy of the article*).

Table 3. Pearson correlation between HDI components and the dependent variable

ASMR*		ASIR*		HDI components
P-value	r	P-value	r	
P<0.0001	0.507	P<0.0001	0.497	Gross national income per 1000 capita
P<0.0001	0.745	P<0.0001	0.746	Mean years of schooling
P<0.0001	0.679	P<0.0001	0.676	Life expectancy at birth
P<0.0001	0.748	P<0.0001	0.738	Expected years of schooling

Based on cancer statistics in 2018, the highest incidence (7.7 per 1000000) and mortality (6.9 per 100,000) of pancreatic cancer were reported in very high HDI regions (Fig. **3**).

The results of variance analysis showed that the highest mean incidence (7.1% per 100,000) belonged to very high human development, and there was a statistically significant difference between the incidence rate and growth (P <0.0001). The highest mortality rate (6.5% in 100,000) belonged to very high human development, and there was a significant difference between mortality and developmental index (P <0.0001) (Table **2**).

The results showed that the incidence (r = 0.764, P <0.0001) and mortality (r = 0.0771, P <0.0001) rates of pancreatic cancer were positively and significantly correlated with the HDI index (Fig. **4**).

According to the results, incidence was positively and significantly correlated with GNI (r = 0.497, P <0.0001), MYS (r = 0.746, P <0.0001), LEB (r = 0.676, <0.0001) and EYS (r = 0.738, P <0.0001. Moreover, the results exhibited that incidence was positively and significantly correlated ith GNI (r = 0.507, P <0.0001), MYS (r = 0.745, P <0.0001), LEB (r = 0.679, <0.0001) and EYS (r = 0.748, P <0.0001) (Table **3**).

4. DISCUSSION

Pancreatic cancer is a rare yet lethal cancer. The incidence of this cancer is higher in men than in women, but the mortality rate is equal in both genders, which may be due to the low survival rate in these patients [4]. According to our results, the highest incidence of pancreatic cancer in Europe belonged to Hungary (10.8 per 100,000). Other countries with a high incidence rate are Uruguay (10.7 per 100,000) and Republic of Moldova (10.5 per 100,000). The highest rates of pancreatic cancer were reported in Uruguay (9.9 per 100,000), Hungary (4.9 per 100,000), and Malta (8.7 per 100,000), respectively. Generally, the highest pancreatic cancer incidence has been reported in Asia (46.7%). Other regions include Europe (28%), North America (12.29%), Latin America (7.79%), Africa (3.59%), and Oceania (0.99%), with the lowest incidence belonging to Oceania. Differences in the incidence of cancer in these areas can be attributed to disparity in the economic situation of people. In countries with higher HDI and GPD, the incidence and mortality rate of pancreatic cancer is higher [14].

The death rate of cancer in the United States, Britain, Australia, and Japan is in the range of 6 to 8 per 100,000 for men and 4 to 6 per100,000 for women. However, the number of pancreatic cancer deaths in these countries is growing steadily after a sharp increase in recent decades. In some Asian countries, like South Korea and Singapore, the death rate is still high, and in China, the mortality rate is rising [15, 16].

According to a 207 study by Wong et al. on global data about pancreatic cancer in 2012, countries with higher levels of HDI and GPD had a greater incidence and death rate. The results of this study are aligned with our research findings [4]. These studies reveal that cancer is still a serious global issue for healthcare communities and more extensive studies are required to understand the link between economic development and pancreatic cancer.

Socio-economic changes have exerted profound effects on the shape and scale of this cancer. In countries with low or medium incomes, the risk of cancers is on the rise. Cancer-induced infections account for about 26% of all cancers in low-income countries.

Infectious cancers reported in these countries have paved the way for the growth of cancers in advanced societies, such as Europe and North America. This type of cancer is also referred to as urban lifestyle cancers. Smoking, type-2 diabetes, and obesity are considered as risk factors for pancreatic cancer in developing countries [7, 17]. Pancreatic cancer is associated with the industrialization of societies, so that the highest rates of cancer-related deaths are reported in developing countries [4].

The results also showed that HDI was positively correlated with PC incidence ($r = 0.764$, $P < 0.0001$) and PC death ($r = 0.0771$, $P < 0.0001$) in 2018. As suggested by our findings, the high incidence of pancreatic cancer in countries with higher HDI may be due to advanced diagnostic and timely screening. The underlying causes of high mortality rate in developing countries are aging populations and increased life expectancy in these countries. The main factors contributing to the high incidence of pancreatic cancer in most countries are population aging, lifestyle and demographic changes. Early prevention strategies for pancreatic cancer such as stopping smoking and controlling weight loss can provide deeper insights into the causes of cancers. Despite the reported correlation between the above factors, caution should be practiced in the interpretation of such studies because, in addition to the epidemiological risk factors of pancreatic cancer, inherent constraints of ecological studies should also be taken into account. In sum, the incidence and mortality rate of pancreatic cancer has increased in many countries. In this regard, new treatments, follow-ups and counseling for patients with pancreatic cancer, especially in less developed countries, can be effective in reducing costs and improving the health system of these countries by the provision of early preventive measures and appropriate control measures [4, 18, 19].

CONCLUSION

According to the results of this study, pancreatic cancer is a disease closely linked to industrial life. In countries with higher HDI, the cancer incidence and mortality rate of this cancer is higher, indicating the importance of paying more attention and implementing appropriate planning for reducing risk factors as an effective measure to control the incidence and mortality of the disease.

CONSENT FOR PUBLICATION

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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