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## Original Research

# Global incidence and mortality rates in pancreatic cancer and the association with the Human Development Index: decomposition approach



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## ABSTRACT

**Objectives:** Pancreatic cancer has a lower morbidity yet higher case fatality rates (CFRs) compared with other gastrointestinal cancers. The effects of socio-economic components on pancreatic cancer rates have been acknowledged; however, the effects of the Human Development Index (HDI) inequality are not. In this study, we aimed to determine the contribution of important socio-economic components on pancreatic cancer rates using a decomposition approach.

**Study design:** Global ecological study.

**Methods:** Incidence and mortality rates of pancreatic cancer were obtained for 172 countries from GLOBOCAN and the United Nations Development Program. The World Bank database was also used to obtain the HDI and its gradient for 169 countries. Inequality in pancreatic cancer age-specific incidence and mortality rates was calculated according to the HDI using the concentration index (CI). We decomposed the CI to determine main contributors of the inequality.

**Results:** The CI for incidence and mortality of pancreatic cancer in both genders according to the HDI was 0.26 (95% confidence interval: 0.21–0.30) and 0.25 (95% confidence interval: 0.21–0.30), respectively, which indicated more concentrated inequality in advantaged countries. About 80% of the inequality sources were predicted by socio-economic component in both rates of pancreatic cancer. The main contributors to inequality were the mean years of schooling, life expectancy at birth, expected years of schooling, and urbanization.

**Conclusion:** Global inequalities exist in pancreatic cancer incidence and mortality rates according to the HDI; in addition, inequality was more concentrated in countries with higher score of HDI.

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## Introduction

Pancreatic cancer is one of the most common malignant tumors worldwide. This cancer is the 12th most common malignancy, while due to its high fatality rate, categorized as the seventh leading cause of cancer mortality.<sup>1</sup> According to GLOBOCAN 2012, pancreatic cancer accounts for nearly 4.0% of all cancer deaths; annually it was estimated that 338,000 people were diagnosed with pancreatic cancer and 331,000 people died of it.<sup>2</sup>

In 2012, pancreatic cancer incidence and mortality rates were highest in Northern America and Western Europe, and were lowest in Middle Africa and South-Central Asia.<sup>3</sup> Although the etiology of the disease is still insufficiently known, evidence shows that people with the known risk factors such as smoking habits, high body mass index, diabetes mellitus, high-fat diet, and inactive lifestyle are more prone to it.<sup>4–6</sup> In addition, some other traits, such as gender, play a substantial role so that the disease has occurred almost 48% more in Chinese men.<sup>7</sup>

Several studies have shown that some factors, such as differences in life expectancy, education level, income level, and access to healthcare, can cause disparities in incidence and mortality among countries.<sup>8,9</sup> As a core socio-economic determinant of health, the Human Development Index (HDI) is composed of four components including mean years of schooling, expected years of schooling, life expectancy, and gross national income (GNI).<sup>10</sup> The HDI is considered as the gold standard for international comparisons of development.

Information on social epidemiologic aspect such as inequalities related to incidence and mortality of any type of cancer is necessary for health planning and hypothesis generation for further research. Some studies have assessed the relationship between the HDI and some types of cancer;<sup>8–11</sup> therefore, this study was conducted to determine the association between the incidence and mortality of pancreatic cancer with socio-economic development.

## Methods

This ecological study was performed on the relationship of the age-specific incidence and mortality rate (ASR) of pancreatic

cancer with the HDI. The HDI has several main components, including life expectancy at birth, mean years of schooling, and GNI per capita, and also some ancillary indices, including percent of urbanization, and age-standardized obesity (defined as body mass index  $\geq 30$  kg/m<sup>2</sup>) in adults (the weighted average of the age-specific obesity rate among adults aged 20 years and older). ASR is a summary measure of the rates indicating the disease distribution on population levels having a standard age structure and is an integrated part of the global comparisons due to the major effects of age on population distribution of the cancers.

Data of the incidence and mortality rate of pancreatic cancer for the year 2012 were obtained from the global cancer project for 172 countries.<sup>7</sup> The HDI and other indices were obtained for 169 countries from the United Nations Development Program database.<sup>10</sup>

Data analysis was restricted to 169 countries for which both the epidemiologic data from the GLOBOCAN database and the HDI were available. We used the predefined categories of the distribution of the HDI by country: low (HDI < 0.5), medium ( $0.5 \leq \text{HDI} < 0.8$ ), high ( $0.8 \leq \text{HDI} < 0.9$ ), and very high (HDI  $\geq 0.9$ ). Therefore, these countries were categorized into four groups including 1) Very High Human Development (27 countries); 2) High Human Development (37 countries); 3) Medium Human Development (89 countries); and 4) Low Human Development (16 countries). In this study, we used the correlation bivariate method for the assessment of correlation between the incidence and mortality rates of pancreatic cancer with the HDI.

We determined the HDI inequality in the ASR of pancreatic cancer by the concentration index (CI). The value of CI ranged from  $-1$  to  $+1$  while the negative value indicates more concentration of the outcome in poor populations and the positive value indicates vice-versa.

We decomposed the CI to determine the main contributors of inequality in pancreatic cancer. In the first step of the decomposition process, we calculated elasticity for each variable which shows the amount of changes in the dependent variable associated with change in one explanatory variable. Having multiplied the elasticity of each determinant by its CI, we estimated absolute contribution of each determinant to inequality.

Data were analyzed by Stata computer software, version 12 (StataCorp, College Station, TX, USA). Distributive Analysis

**Table 1 – Incidence and mortality rates of pancreatic cancer according to the HDI and components.**

Region	Incidence				Mortality			
	N	Crude rate	ASR (W)	Cumulative risk	N	Crude rate	ASR (W)	Cumulative risk
World	337,872	4.8	4.2	0.47	330,391	4.7	4.0	0.44
More developed regions	187,465	15.0	7.2	0.85	184,429	14.8	6.8	0.79
Less-developed regions	150,407	2.6	2.8	0.31	145,962	2.5	2.7	0.29
Very high HDI	174,344	15.1	7.2	0.85	170,497	14.8	6.8	0.77
High HDI	55,638	5.3	4.6	0.55	56,474	5.4	4.6	0.55
Medium HDI	98,632	2.8	2.7	0.29	94,447	2.7	2.6	0.27
Low HDI	9108	0.7	1.2	0.15	8822	0.7	1.2	0.15

ASR, age-specific rate; HDI, Human Development Index; N, numbers.  
Crude and age-standardized rates per 100,000.  
Cumulative risk [0–74], percent.

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