



An ecological study of the incidence and mortality rates of pancreatic cancer in 2020: exploring gender disparities worldwide

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Abstract

Introduction: Pancreatic cancer is a highly mortal disease that used to be rare but its incidence rate has increased in the last few decades. Despite declining overall cancer incidence and mortality rates in developed countries, pancreatic cancer tends to increase in both incidence and mortality. Previous studies showed a male predominance in pancreatic cancer in patients older than 35. However, considering the sudden rise in incidence in young females, a new survey is crucial to address the current pattern of pancreatic cancer distribution between males and females. Hormonal factors may play a role in the pathogenesis of pancreatic cancer.

Objectives: This study aimed to evaluate the role of gender differences in mortality and incidence of pancreatic cancer in an ecological study based on data extracted from the GLOBOCAN project in 2020.

Patients and Methods: An ecological study was carried out to assess gender disparity in pancreatic cancer incidence and mortality rates. The data used in the study were obtained from the Global Cancer (GLOBOCAN) project of the World Health Organization (WHO) in 2020 (<https://gco.iarc.fr/>).

Results: The pancreatic cancer mortality rate worldwide (2020) was estimated at 466,003 cases, encompassing 246,840 cases (52.96%) among males and 219,163 cases (47.04%) among females. The study found that although there were differences in the mean pancreatic cancer incidence and mortality rates between males and females when measured by indicators such as number, ASR, and crude rate, these differences were not statistically significant.

Conclusion: In conclusion, the pancreatic cancer incidence and mortality rate is increasing worldwide. In spite of the fact that men die from pancreatic cancer at a higher rate than women, there is no statistically significant difference between the two.

Registration: The study protocol was registered on the Research Registry website with the unique identification number (UIN) researchregistry9598.

Keywords: Pancreatic neoplasms, Pancreatic cancer, Sex characteristics, Gender differences, Sexual dichromatism

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Introduction

Pancreatic cancer is the most fatal malignancy with a 5-year survival of less than 2-9%. It is the 14th most common cancer worldwide; while its mortality rate stands at the 7th place among all types of cancer (1). Formerly, pancreatic malignancies were considered rare, but with the rise in pancreatic cancer incidence in the last few decades, it is now a growing concern. Currently, the worldwide pancreatic cancer burden has dramatically increased. With the global population aging as well as the increasing prevalence of obesity, diabetes, smoking,

and alcoholism, the burden of pancreatic malignancies is expected to continue rising in the future (2). Despite declining overall cancer incidence and mortality rates in developed countries, pancreatic cancer incidence and mortality tend to rise (3). The main non-hereditary risk factors for pancreatic cancer are tobacco smoking, diabetes mellitus, obesity, pancreatitis, and alcoholism (4).

There is a significant gap between male and female patients in all cancer types incidence and mortality. Cancer incidence and mortality rates are 19% and 43% higher in men than in women. Gender gaps differ greatly

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■ Implication for health policy/practice/research/medical education

In an ecological study based on the data from the GLOBOCAN project in 2020, we found that there were variations in the average pancreatic cancer incidence and mortality rates between males and females when measured by indicators such as number, age-standardized rate (ASR), and crude rate. However, these differences were not statistically significant.

among countries, reflecting a variety of cultural and environmental factors. Such differences can be explained by hormonal and chromosomal factors, higher risk factor exposure in men, and the gender difference in compliance for prevention and early detection of cancer. While the gender gap is theoretically and epidemiologically obvious in certain types of cancer (e.g., breast cancer, lung cancer), in pancreatic cancer more investigation is needed to find any gender disparity (5).

Previous studies showed a male predominance in pancreatic cancer in patients older than 35. However, considering the sudden rise in incidence in young females, a new survey is crucial to address the current pattern of pancreatic cancer distribution between males and females (6). A cohort study reported a 23%-60% decrease in pancreatic cancer incidence following hormonal replacement therapy in post-menopausal women. It shows the role of sex hormones in pancreatic cancer pathogenesis (7).

A thorough investigation of the previous data may address any gender gap in pancreatic cancer incidence and mortality.

Objectives

This study compares pancreatic cancer global incidence and mortality between men and women based on data extracted from GLOBOCAN project in 2020. The results will help design studies for defining risk factors, pathogenesis, screening, and prognosis of pancreatic cancer.

Methods and Materials

Study design

An ecological study was carried out in 2020 to assess gender disparities in pancreatic cancer incidence and mortality rates. The data used in the study were obtained from the Global Cancer (GLOBOCAN) project of the World Health Organization (WHO) (<https://gco.iarc.fr/>). Incidence & Mortality definition The GLOBOCAN project, an internationally recognized cancer database, has played a key role in establishing precise definitions regarding pancreatic cancer incidence and mortality rates which is available at (<https://gco.iarc.fr/today/data-sources-methods>). The initiative, spearheaded by the prestigious International Agency for Research on Cancer

(IARC), falls under the jurisdiction of the WHO. Notably, the GLOBOCAN project supplies comprehensive estimates of cancer incidence and mortality rates, encompassing 36 different types of cancer across six continents (185 countries) on a global scale.

Age-standardized rates (ASR)

The ASR is a calculated age-specific average rate, with weights derived from a standard population distribution. This rate, commonly expressed per 100,000, serves as a useful indicator in statistical analysis (8).

Crude rate

A crude rate refers to the occurrence of new cases (or deaths) within a designated population over one year. This rate is typically presented as the number of cases per 100 000 individuals at risk (9,10).

Data collection

Data on the estimated occurrence and death rates of pancreatic cancer worldwide in 2020 was extracted from a project known as GLOBOCAN. This particular project offers estimates of cancer occurrence and death rates globally for 36 different types of cancer spanning six continents (185 countries). To conduct the study, data were retrieved from the GLOBOCAN 2020 database, which is an integral component of both the IARC and the WHO. The GLOBOCAN 2020 database, an internet-based platform, furnishes comprehensive cancer statistics worldwide, alongside providing estimations of the occurrence and death rates for 36 different types of cancer and all sites where cancer can manifest. This database can be accessed online via Cancer Today (<https://gco.iarc.fr/today/online-analysis-table>), where users can conveniently generate maps and explore visual representations.

Statistical analysis

SPSS software version 27 was utilized for data analysis. For quantitative data, the findings were presented in the form of mean \pm standard deviation (SD), while qualitative data was reported as a number. The Kolmogorov-Smirnov test was employed to evaluate the normality distribution of the data. Moreover, equality of variance was assessed using Levene's test. To compare the mean of pancreatic cancer incidence and mortality based on different indicators such as number, ASR, and crude rate in both males and females, the independent t-test and Mann-Whitney U test were employed. A *P* value below 0.05 was deemed statistically significant.

Results

In 2020, the worldwide new cases frequency of pancreatic cancer was 495 773 cases, with 262 865 males (53.02%) and 232 908 females (46.98%). Asia had the highest frequency, and Oceania had the lowest. Based on the ASR indicator, Europe's continent was the highest with an ASR of 18.7,

Table 1. Pancreatic cancer global incidence rates by gender on continents (Data source: GLOBOCAN, 2020)

Population	Gender	Number	Uncertainty Interval	Crude Rate	ASR	Cum. Risk
Asia	Male	129 488	[127536-131469]	5.5	4.7	1.50
	Female	104 213	[102435-106022]	4.6	3.3	1.27
	Total	233 701	[231055-236377]	5.0	4.0	1.38
Europe	Male	70 210	[67969.6-72524.3]	19.4	9.4	2.67
	Female	69 906	[67694.5-72189.8]	18.1	6.4	2.04
	Total	140 116	[136953-143352]	18.7	7.8	2.31
Northern America	Male	32 938	[32549.8-33330.8]	18.0	9.3	2.70
	Female	29 705	[29331.9-30082.8]	15.9	6.9	2.10
	Total	62 643	[62106.2-63184.4]	17.0	8.0	2.37
Latin America and the Caribbean	Male	18 477	[16674.1-20474.8]	5.7	5.0	1.55
	Female	18 875	[17145.3-20779.2]	5.7	4.0	1.36
	Total	37 352	[34821.0-40066.9]	5.7	4.5	1.45
Africa	Male	9 239	[6860.0-12443.1]	1.4	2.7	0.79
	Female	7 831	[5658.6-10837.3]	1.2	2.0	0.58
	Total	17 070	[13705.7-21260.1]	1.3	2.3	0.67
Oceania	Male	2 513	[2364.3-2671.1]	11.8	7.3	2.37
	Female	2 378	[2235.1-2530.0]	11.2	6.0	2.03
	Total	4 891	[4682.9-5108.3]	11.5	6.6	2.19
ASR (world) and crude rate per 100 000						

and Africa was the lowest with 2.3. The distribution and frequency of pancreatic cancer by gender in different continents based on indicators, including number, crude rate, ASR, and cumulative risk was summarized in [Table 1](#). The frequency of pancreatic cancer mortality worldwide (2020) was estimated at 466 003 cases, encompassing 246 840 cases (52.96%) among males and 219 163 cases (47.04%) among females. It is noteworthy that Asia exhibited the highest mortality rate, while Oceania had the lowest. Focusing on the ASR indicator, it becomes evident that Europe registered the highest ASR value, whereas Africa recorded the lowest. An extensive analysis of the distribution and frequency of pancreatic cancer by gender across different continents, considering a range of indicators such as the number of cases, crude rate, ASR, and cumulative risk, has been comprehensively summarized in [Table 2](#).

The worldwide distribution of the estimated incidence of pancreatic cancer, as determined by the ASR, is presented in [Figure 1](#). Similarly, the corresponding mortality rate for pancreatic cancer in individuals across the globe is depicted in [Figure 2](#). Notably, in the year 2020, the countries of the Russian Federation, Germany, Uruguay, Argentina, the United States, Turkey, France, the Netherlands, and the Scandinavian region exhibited the highest ASR values for the estimated pancreatic cancer incidence and mortality. On the other hand, Asia and Africa exhibited the lowest ASR values. In some countries, the data was unavailable.

The study found that although there were differences in the mean pancreatic cancer incidence and mortality rates between males and females when measured by indicators such as number, ASR, and crude rate, these differences were not statistically significant ($P > 0.05$; [Table 3](#)).

Discussion

This study compares the worldwide incidence and mortality rate between men and women based on the data from the GLOBOCAN project in 2020. Although men die from pancreatic cancer at a higher rate than women, there is no statistically significant difference between the two groups.

In a similar study of pancreatic cancer statistics in 2018, Rawla et al found a similar trend of gender disparity, with slightly higher incidence and mortality in men than women. As the study predicted, the incidence and mortality have increased in 2020 (11). An investigation into the epidemiology of pancreatic cancer in 2020 mentioned male sex as a potential risk factor for pancreatic cancer; the study found no significant difference in mortality between men and women (12). Lippi et al did not find any statistically significant difference in incidence, prevalence, and mortality rates of pancreatic cancer between the two genders either. However, they noted a higher burden of the disease (measured by the disability-adjusted life year-DALY) in men, which had borderline significance (+4.8%, P value= 0.047) (13).

Smoking, obesity, alcoholism, diabetes, an unhealthy

Table 2. The global pancreatic cancer mortality rate by gender on continents (Data source: GLOBOCAN, 2020)

Population	Gender	Number	Uncertainty Interval	Crude Rate	ASR	Cum. Risk
Asia	Male	123 337	[121246-125464]	5.2	4.5	1.50
	Female	100 697	[98769.4-102662]	4.4	3.1	1.27
	Total	224 034	[221186-226919]	4.8	3.8	1.38
Europe	Male	66 698	[64865.2-68582.5]	18.4	8.8	2.59
	Female	65 436	[63647.4-67274.8]	16.9	5.8	1.93
	Total	132 134	[129563-134756]	17.6	7.2	2.21
Northern America	Male	27 888	[27518.5-28262.4]	15.3	7.6	2.38
	Female	25 389	[25031.7-25751.5]	13.6	5.5	1.87
	Total	53 277	[52764.4-53794.5]	14.4	6.5	2.10
Latin America and the Caribbean	Male	17 897	[17214.6-18606.5]	5.6	4.9	1.53
	Female	18 133	[17439.7-18853.9]	5.5	3.8	1.33
	Total	36 030	[35051.7-37035.6]	5.5	4.3	1.42
Africa	Male	8936	[6369.1-12537.5]	1.3	2.6	0.78
	Female	7613	[5261.1-11016.3]	1.1	1.9	0.57
	Total	16 549	[12892.8-21242.1]	1.2	2.3	0.66
Oceania	Male	2084	[1944.6-2233.4]	9.8	6.0	2.04
	Female	1895	[1762.6-2037.3]	8.9	4.5	1.70
	Total	3979	[3784.8-4183.2]	9.3	5.2	1.86
ASR (world) & Crude rate per 100 000						

diet, a family history of pancreatic cancer, and pancreatitis are known risk factors for pancreatic cancer. Smoking is not only associated with an increased incidence of pancreatic cancer but also with a higher mortality rate. In a survey of the collected data from two decades 1994-2013, a higher incidence and mortality rate was observed in men but the incidence rate among women was growing faster than men. This may be due to increasing risk factor exposure, particularly smoking, in women more than men

(14,15). The investigation performed on worldwide data between 2000 and 2018, shows a greater relative increase in incidence in women, especially women with younger ages (15 to 34 years old) (16). Interestingly, a prediction of pancreatic cancer trends from 2019 to 2039 claims that a steeper increase is expected in the crude rate of incidence, mortality, and DALY in women than in men (17).

Gordon et al performed an analysis of pancreatic cancer global incidence in which pancreatic cancer subtypes were

Table 3. The correlation between gender and pancreatic cancer incidence and mortality based on different indicators on continents

Indicator	Gender	Mean	SD	P-value	95% CI		
					Lower	Upper	
Incidence	Number	Male	43810.83	48369.9	0.820*	-52118.9	62104.5
		Female	38818.0	40029.5			
	ASR (World)	Male	6.40	2.71	0.259**	-1.40	4.67
		Female	4.76	1.95			
	Crude rate	Male	10.30	7.31	0.838**	-8.18	9.88
		Female	9.45	6.71			
Mortality	Number	Male	36956.66	48740.41	0.987*	-56128.14	56987.14
		Female	36527.16	38603.90			
	ASR	Male	5.73	2.23	0.166**	-0.80	4.07
		Female	4.10	1.47			
	Crude rate	Male	9.26	6.53	0.815**	-7.18	8.91
		Female	8.40	5.95			

CI, Confidence Interval; SD, Standard deviation.

*Mann-Whitney, **Independent t-test.

ASR (world) & Crude rate per 100 000.

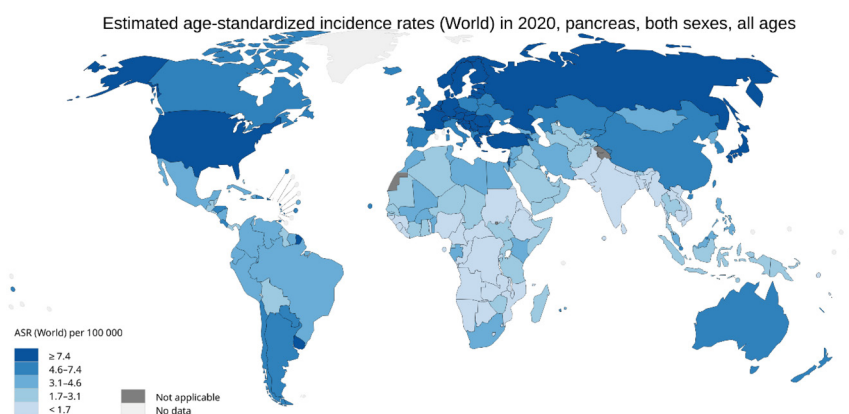


Figure 1. The global pancreatic cancer incidence based on the ASR (per 100000) indicator. Reprinted with permission from IARC/WHO, Copyright (2023). Available from: <https://gco.iarc.fr/>. Accessed May 2023.

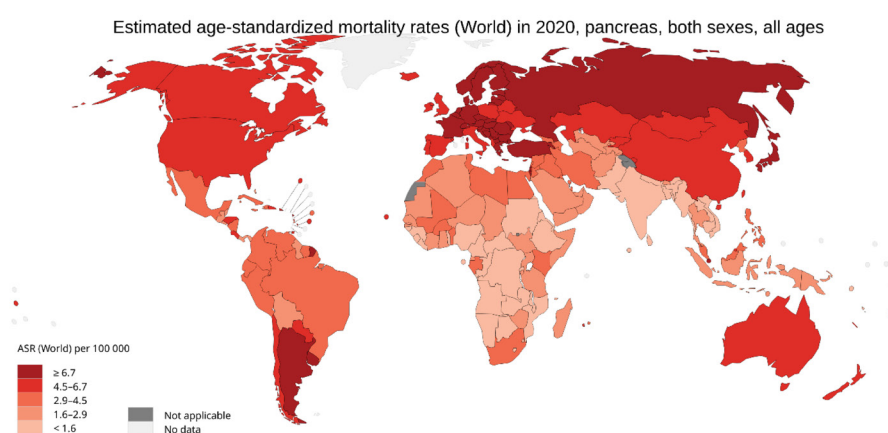


Figure 2. The worldwide pancreatic cancer mortality based on the ASR (per 100,000) indicator. Reprinted with permission from IARC/WHO, Copyright (2023). Available from: <https://gco.iarc.fr/>. Accessed May 2023.

separately observed. The male-to-female ratio was higher in all subtypes except cystic ductal adenocarcinoma, secretory endocrine carcinoma, and solid pseudopapillary adenocarcinoma. The exact histopathologic type of about 70% of the patients has not been mentioned in the documents. One of the limitations we had in our study was that our data was not classified based on disease histopathology (6).

Our study's data were limited to one year (2020). Expanding the target data by considering several years may show different results. Further investigation into the role of gender in pancreatic cancer pathogenesis, incidence, treatment, and surveillance will be illustrative.

Conclusion

In conclusion, the pancreatic cancer incidence and mortality rate is increasing worldwide. Although there is a higher incidence and mortality rate of pancreatic cancer in men compared to women, this difference is not statistically significant.

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Authors' contribution

Conceptualization: Hanieh Molaee and Farshad Gharebakhshi.

Data curation: Anna Ghorbani and Siavash Sangi.

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Writing—review and editing: Ali Asadian, Maryam Aligholizadeh, and Hanieh Molaee.

Conflicts of interest

The authors declare that there is no conflict of interest.

Ethical issue

The research was conducted under the tents of the Declaration of Helsinki. The study has been compiled based on the data from the

GLOBOCAN project of WHO (<https://gco.iarc.fr/>), and its protocol was registered on the Research Registry website with the unique identification number (UIN) researchregistry9598 available at (<https://www.researchregistry.com/browse-the-registry#home/>). The authors have observed ethical issues (including plagiarism, data fabrication, and double publication).

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