Original article

Demographic and Geographic Distribution of Pancreatic Cancer: A Five-Year Retrospective Study at the National Institute of Oncology, Sabratha

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Abstract
Pancreatic cancer is recognized as a highly aggressive disease with a poor overall outlook. Although its occurrence differs across regions, information from Libya and several surrounding countries remains limited. This study describes the demographic characteristics and geographic distribution of patients diagnosed with pancreatic cancer at a major oncology center in Western Libya, aiming to support local health planning. A 5-year retrospective study (2020–2024) was conducted at the National Institute of Oncology-Sabratha. The files of patients with radiological and/or histopathological confirmation of pancreatic cancer were reviewed. Demographic variables and place of residence were evaluated, and basic statistical tests, including chi-square and Fisher's exact tests, were applied. Of the 91 included patients, 52 (57.14%) were male, and 39 (42.86%) were female. The majority of cases occurred in individuals aged 50–69 years. Female patients tended to present at a younger age, though this was not statistically significant. Most patients were from coastal areas, particularly Zawia (25.3%) and Tripoli (19.8%). No significant associations were found between sex and year of admission, age group, or region of origin. This study demonstrates a slight male predominance in pancreatic cancer incidence in Western Libya, aligning with global trends, with a descriptive geographical clustering in industrialized coastal areas. The findings underscore the need for enhanced cancer registry data and targeted public health initiatives. Future research with larger cohorts is recommended to investigate potential environmental, occupational, and lifestyle risk factors contributing to these observed patterns.
Keywords. Pancreatic Cancer, Retrospective Study, Demographic Features, Geographic Distribution.

Introduction
Despite considerable advances in oncology, pancreatic cancer remains one of the most lethal malignancies, characterized by diagnostic challenges and limited treatment efficacy. Globally, it is a leading cause of cancer mortality, ranking among the top twelve most common cancers [1]. According to 2022 estimates, it accounts for approximately 510,992 new cases and 467,409 deaths annually, underscoring its poor prognosis [1]. A central reason for this high mortality is late detection; over 80% of patients present with advanced disease, leaving fewer than 20% eligible for curative surgery [2]. Consequently, the average global five-year survival rate remains dismally low, at only 10-13% [3].
The burden of this disease is not distributed evenly. Profound geographical disparities exist, with the highest established incidence historically documented in developed nations [1, 4]. However, a significant increase in cases within low- and middle-income countries is now evident, a shift driven by the adoption of westernized lifestyles marked by poor diet, rising obesity, and tobacco use [5], a trajectory expected to continue [5].
This pattern points to a fundamental truth about pancreatic cancer. While individual risk is influenced by genetic factors [6–8], the population-wide distribution of the disease is decisively shaped by modifiable lifestyle and environmental exposures [9]. The disease clusters in regions with high rates of smoking [10–12] and obesogenic diets linked to diabetes [13,14]. Chronic pancreatitis, another significant risk factor often linked to alcohol consumption, highlights the role of environmental exposures [15]. In short, robust evidence confirms that lifestyle is the principal architect of global incidence patterns [16,17]. Assessing this risk in specific regions, such as Libya, is challenging due to a lack of robust population-based cancer registries. In such settings, researchers must often rely on hospital-based data from major referral centers, despite the known limitations of this approach [18–20]. These clinical records become a vital, if imperfect, source for understanding local disease trends and informing healthcare planning [21,22]. Yet, moving from global trends to local understanding is critical. In North Africa, and Libya specifically, the epidemiological landscape is under-characterized. The region is undergoing demographic and nutritional transitions that increase non-communicable disease risk, yet comprehensive data on cancer patterns remain scarce [23–25]. Given the limited population-based cancer data, hospital-based analyses provide valuable insight. They help identify local risk factors, including dietary, occupational, or environmental factors, and reveal geographic clustering, generating hypotheses for preventable causes and guiding targeted public health interventions.
This study adopts precisely that localized approach. It analyzes pancreatic cancer presentations at the National Institute of Oncology in Sabratha, a key referral hospital in Western Libya, from 2020 to 2024. The current study aimed to describe the prevalence and geographic distribution of pancreatic cancer cases. Given the well-documented global associations of pancreatic cancer with age and sex, the demographic analysis in this study was confined to these two variables. A specific objective is to investigate whether cases

cluster spatially in industrial municipalities like Sabratha and Zawia. Such a finding could suggest a potential environmental component, possibly related to local industrial activity, and would help prioritize these areas for more detailed environmental health and epidemiological research.

Methods

Study design and setting
This study employed a five-year retrospective design covering the period from January 2020 to December 2024. It was conducted at the National Institute of Oncology in Sabratha, Libya, which functions as a major referral center for cancer patients across western and southern regions of the country. All medical records of patients diagnosed with pancreatic cancer during the study period were reviewed in detail.

Study Population and Eligibility
Patients were included if they had a diagnosis of pancreatic cancer confirmed by histopathology and/or radiological imaging such as CT, MRI, or ultrasound. Those without pathological or radiological confirmation, as well as patients with incomplete medical records, were excluded. After applying these criteria, ninety-one patients were eligible for analysis.

Data Collection
Information was extracted from hospital archives and electronic medical records using a standardized form. Demographic variables such as age, sex, and year of admission were collected, along with geographic data indicating the patient's place of residence, categorized by Libyan regions. Clinical confirmation was based on histopathological reports and radiological findings. To ensure accuracy, data extraction was performed independently by two researchers, and discrepancies were resolved by consensus.

Statistical Analysis
Descriptive statistics were used to summarize demographic and geographic characteristics. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were reported for continuous variables. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test when expected cell counts were small. Odds ratios with 95% confidence intervals were calculated to quantify associations. All statistical analyses were performed using SigmaStat software, and a p-value less than 0.05 was considered statistically significant. Missing data were handled by case-wise deletion, and sensitivity analyses were conducted to confirm the robustness of findings.

Ethical Considerations
The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for medical research involving human subjects. Formal approval was obtained from the Institutional Ethics Committee of the National Institute of Oncology-Sabratha. Patient confidentiality was strictly maintained, and anonymized data were used without the need for individual consent, as authorized by the ethics committee.

Results

The Distribution of Pancreatic Cancer Patients According to Gender
Of the 91 patients with pancreatic cancer were included in this study from 2020 to 2024. Male patients accounted for 52 (57.14%), while females accounted for 39 (42.86%). The yearly distribution of admissions at the Sabratha National Cancer Institute is illustrated (Table 1). Regarding males, the dominant percentage of cases was observed in the year 2023 (36.54%, n=19), followed by the year 2021 (25%, n=13) and the year 2024 (17.30%, n= 9). On the other hand, the highest percentage of cases among females was registered in 2021 (35.90%, n=14), followed by 2023 (28.20%, n=11). A smaller number of cases were reported in 2020 and 2022 for both sexes. We analyzed these data using the chi-square test to determine whether there was an association between gender and the incidence of pancreatic cancer; however, no significant association was observed (p = 0.835).

Table 1. The distribution of male and female pancreatic cancer patients according to years of admission to the National Institute of Oncology-Sabratha

Groups Years of admission	Male pancreatic cancer patients		Female pancreatic cancer patients	
	Frequency	Percent (%)	Frequency	Percent (%)

2020	06	11.54%	04	10.26%
2021	13	25%	14	35.90%
2022	05	9.62%	04	10.26%
2023	19	36.54%	11	28.20%
2024	09	17.30%	06	15.38%
Total	52	100%	39	100%

(x^2 = 1.45, p = 0.835)

The Distribution of Male and Female Pancreatic Cancer Patients According to Age Groups

The mean age of males was 61.35 ± 12.33 years, and that of females was 58.85 ± 14.42 years (Table 2). For male patients, 34.62% (n = 18) of cases were between 60 and 69 years old, while for females, the peak was in the 50-59-year age group (23.08%, n = 9). It is worth noting that a greater proportion of younger patients are found in females in the 30-39-year group (7.69%, n =3) than in males (1.92%, n = 1). The remaining groups include < 30 years (0%, n = 0 males; 2.56%, n = 1 female), 40-49 years (21.15%, n = 11 males; 17.95%, n = 7 females), 70-79 years (15.39%, n = 8 males; 20.51%, n = 8 females), and ≥ 80 years (7.69%, n = 4 males; 5.12%, n = 2 females). Most of the patients were within the age category of 40 to 69 years, while a few were below 30 or above 80 years of age. The age distribution did not significantly differ between males and females as analyzed by Chi square test (p = 0.56). Fisher's exact test was also conducted in two ways: (1) when patients were categorized as < 60 versus ≥ 60 years, no significant association existed between sex and age category (Odds Ratio 1.44, p = 0.41; (2) when each age group was compared individually against all others, no statistically significant difference was observed: < 30 years: OR = 0, p = 0.43; 30–39 years: OR = 0.24, p = 0.31; 40–49 years: OR = 1.23, p = 0.79; 50–59 years: OR = 0.79, p = 0.80; 60–69 years: OR = 1.76, p = 0.26; 70–79 years: OR = 0.70, p = 0.58; ≥ 80 years: OR = 1.54, p = 0.70. Although there was a slightly higher representation of females in the younger age groups, the differences did not reach statistical significance.

Table 2. The distribution of male and female pancreatic cancer patients according to age groups

Groups Age group (Years)	Male pancreatic cancer patients		Female pancreatic cancer patients	
	Frequency	Percent (%)	Frequency	Percent (%)
< 30	0	0%	01	2.56%
30-39	01	1.92%	03	7.69%
40-49	11	21.15%	07	17.96%
50-59	10	19.23%	09	23.08%
60-69	18	34.62%	09	23.08%
70-79	08	15.39%	08	20.51%
≥ 80	4	7.69%	02	5.12%
Total	52	100%	39	100%

x^2 = 4.85, p = 0.56; Fisher's exact test (<60 vs ≥60 years: OR = 1.44, p = 0.41) and individual age group comparisons also showed no significant associations

The Geographical Distribution of Pancreatic Cancer Patients According to the Region

The geographical distribution of cases varied across the studied Libyan regions. Zawia reported the highest number of cases (25.3%, n=23), followed by Tripoli (19.8%, n=18). South Libya and Aljabl Algarbi each accounted for an equal share of cases (13.2%, n=12). The remaining cases were distributed across West Sabratha (11.0%, n=10), Sabratha (9.9%, n=9), Surman (5.5%, n=5), and East Libya (2.2%, n=2). Notable gender differences were observed at the regional level. While Zawia had the highest number of cases for both sexes, female patients showed a higher relative frequency in South Libya (20.5% of all females vs. 7.7% of all males) and Sabratha (15.4% vs. 5.8%). In contrast, male patients had a higher relative frequency in Tripoli (25.0% of all males vs. 12.8% of all females). The distribution of pancreatic cancer cases by region and gender is summarized in (Table 3). However, this observed pattern did not reveal statistically significant differences (p = 0.275).

Table 3. The distribution of pancreatic cancer patients according to the region

Region	Male pancreatic cancer patients	Female pancreatic cancer patients

	Frequency	Percent (%)	Frequency	Percent (%)
Tripoli	13	25%	05	12.82%
Zawia	14	26.93%	09	23.08%
Sabratha	03	5.77%	06	15.39%
Surman	04	7.69%	01	2.56%
South Libya	04	7.69%	08	20.51%
Aljabl Algarbi	06	11.54%	06	15.39%
West Sabratha	07	13.46%	03	7.69%
East Libya	01	1.92%	01	2.56%
Total	52	100%	39	100%

(x^2 = 8.69, p = 0.275)

Discussion

This retrospective study examined patterns of pancreatic cancer cases presenting to the National Institute of Oncology-Sabratha in Western Libya, a key facility for cancer diagnosis and treatment, between 2020 and 2024. Currently, published data from this region are limited. Pancreatic cancer remains among the top ten cancers in Libya, reflecting a substantial burden, as previously reported in Misrata [20]. The national cancer registry recorded 151 new cases in 2020, representing 2.2% of all cancers nationwide [26]. The overall increase in national cancer incidence is, in part, driven by the rising contribution of pancreatic cancer.

As demonstrated in the results, of the original 91 patients diagnosed with pancreatic cancer, 57.14% (n=52) were males and 42.86% (n=39) were females, indicating a slightly higher male incidence (1.3:1). This observed male predominance among hospital-presenting cases is aligned with global trends [27]. This is also in agreement with the profile established by the first Libyan National Cancer Registry (2020), which reported a national male-to-female ratio of 1.25:1 (84 vs. 67 cases) and a higher age-standardized rate for males (4.1 per 100,000) than for females (3.4 per 100,000) [26]. This result also agrees with recent regional data obtained from the Misrata Oncology Centre [20] and other local data from eastern Libya [28,29]. Further, a systematic review of data from 2006 through 2022 estimated the incidence of pancreatic cancer in Libya as 4.6% for males and 2.7% for females [30]. Previous studies have suggested that this difference may be related to differential exposure to smoking, alcohol consumption, and occupational hazards [11,15]. Furthermore, Bosetti *et al.* demonstrated that smoking significantly increases pancreatic cancer risk, a factor traditionally more prevalent among males [31]. The Libyan population is no exception to these risk factors.

An observed pattern in this research is the age distribution of patients, which reflects a younger demographic compared to Western populations. While the global median age for diagnosis typically exceeds 70 years, the majority of cases in this study occurred between 50 and 69, with mean ages of 61.35 and 58.85 for males and females, respectively. This earlier onset aligns with regional data from Benghazi [29]. The peak incidence for men was observed in the 60–69 age group (34.62%), whereas the female peak occurred a decade earlier in the 50–59 bracket (23.08%). This younger burden may be attributed to smoking, a dominant risk factor that can accelerate cancer onset by approximately 10 years [32,33]. Additionally, the rising prevalence of obesity and type 2 diabetes in North Africa has been increasingly associated with an elevated risk and earlier age at diagnosis [12]. Notably, a higher proportion of younger patients were female, particularly in the 30–39 age group (7.69% vs. 1.92% for males). Though not statistically significant, this mirrors the increasing pancreatic cancer incidence in young women observed globally [34]. This trend suggests that specific risk factor exposure, genetic predispositions, or environmental triggers may affect a subset of the female population, potentially involving tumor subtypes like solid pseudopapillary neoplasms [35]. These observations are descriptive and hypothesis-generating, given the small sample size.

Regarding the annual distribution of our data, there was no significant association between sex and year of admission. However, the highest proportions of male admissions occurred in 2023 and 2021 (36.54% and 25.0%, respectively). On the other hand, the percentage of females was 35.90% and 28.20% in 2021 and 2023, respectively. This fluctuation may reflect variables related to the country's conflict, security, and health services, or hospital-based factors rather than actual incidence changes [36]. COVID-19 may have also contributed to this heterogeneity; fewer cases found in 2020 and more in 2021 could be related to diagnostic delays or disruptions in cancer care during the pandemic.

Our study observed geographical variation across Western Libya, with notable clustering in the coastal regions of Zawia (25.3%, n=23) and Tripoli (19.8%, n=18). This distribution is undoubtedly influenced by referral patterns, as the National Institute of Oncology-Sabratha serves as a major oncology center for the region. The low number of cases from eastern Libya is likely attributable to the specialized oncology center in Benghazi serving that region, combined with the considerable geographical distance to Sabratha.

We also observed regional variations in sex distribution, though these were not statistically significant. While the overall series demonstrated male predominance, females outnumbered males in Sabratha and southern Libya, while Aljabl Algarbi showed an equal sex distribution. These descriptive patterns may suggest the influence of local, gender-specific factors such as differential environmental exposures, genetic predispositions, or disparities in healthcare access. As emphasized by Parkin *et al.* [37] and others [38,39],

such hypothesis-generating patterns highlight the importance of regional cancer-registry data, particularly in countries like Libya with limited national cancer surveillance.

This study has several limitations. As a hospital-based study, these findings reflect referral patterns and case distributions rather than population-level incidence rates and are susceptible to referral bias. The relatively small sample size limits the statistical power to detect significant associations. Furthermore, there is an absence of individual-level data on specific risk factors (e.g., smoking intensity, occupation, diet) and the potential for misclassification of geographic origin. While our study cannot establish causality, the convergence of these geographical and demographic patterns underscores the necessity for further research with larger cohorts to explore the potential roles of environmental, genetic, and lifestyle factors in pancreatic cancer distribution across Libya.

Conclusion

In conclusion, pancreatic cancer in Western Libya predominantly affects middle-aged and older adults, with a slight male predominance and a geographical concentration in coastal regions, particularly Zawia and Tripoli. An earlier presentation among some female patients highlights the need for further investigation. These findings emphasize the importance of systematic data collection by the National Cancer Registry and targeted public health initiatives in high-incidence areas. Strengthening early detection pathways, improving regional cancer surveillance, and investigating potential environmental and occupational risk factors are essential to reduce the significant burden of pancreatic cancer in this region.

Conflicts of Interest
The authors declare that they have no conflicts of interest related to this study.

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2024 May;74(3):229–63.
2. Gupta A, Rajput D, Krishnasamy SK, Sharma O, Mishra R, Tandon A, et al. Clinical presentation and outcomes of pancreatic cancer at a tertiary care hospital in the sub-Himalayan region: A retrospective observational study. Cancer Res Stat Treat. 2023;6(1):44–51.
3. Leiphrakpam PD, Chowdhury S, Zhang M, Bajaj V, Dhir M, Are C. Trends in the Global Incidence of Pancreatic Cancer and a Brief Review of its Histologic and Molecular Subtypes. J Gastrointest Cancer. 2025 Dec;56(1).
4. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021 May;71(3):209–49.
5. Li T, Lin C, Wang W. Global, regional, and national burden of pancreatic cancer from 1990 to 2021, its attributable risk factors, and projections to 2050: a systematic analysis of the global burden of disease study 2021. BMC Cancer. 2025 Dec;25(1):189.
6. Klein AP. Genetic susceptibility to pancreatic cancer. Mol Carcinog. 2012 Jan;51(1):14–24.
7. Klein AP. Pancreatic cancer epidemiology: understanding the role of lifestyle and inherited risk factors. Nat Rev Gastroenterol Hepatol. 2021 Jul;18(7):493–502.
8. Zhao ZY, Liu W. Pancreatic Cancer: A Review of Risk Factors, Diagnosis, and Treatment. Technol Cancer Res Treat. 2020;19:1533033820962117.
9. Cai J, Chen H, Lu M, Zhang Y, Lu B, You L, et al. Advances in the epidemiology of pancreatic cancer: Trends, risk factors, screening, and prognosis. Cancer Lett. 2021 Nov 1;520:1–11.
10. Ben QW, Liu J, Sun YW, Wang LF, Zou DW, Yuan YZ. Cigarette Smoking and Mortality in Patients With Pancreatic Cancer: A Systematic Review and Meta-analysis. Pancreas. 2019 Sep;48(8):985–95.
11. Lowenfels AB, Maisonneuve P. Defining the Role of Smoking in Chronic Pancreatitis. Clin Gastroenterol Hepatol. 2011 Mar;9(3):196–7.
12. Pourshams A, Sepanlou SG, Ikuta KS, Bisignano C, Safiri S, Roshandel G, et al. The global, regional, and national burden of pancreatic cancer and its attributable risk factors in 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet Gastroenterol Hepatol. 2019 Dec;4(12):934–47.
13. Carreras-Torres R, Johansson M, Gaborieau V, Haycock PC, Wade KH, Relton CL, et al. The Role of Obesity, Type 2 Diabetes, and Metabolic Factors in Pancreatic Cancer: A Mendelian Randomization Study. J Natl Cancer Inst. 2017 Sep 1;109(9).
14. McGuigan A, Kelly P, Turkington RC, Jones C, Coleman HG, McCain RS. Pancreatic cancer: A review of clinical diagnosis, epidemiology, treatment and outcomes. World J Gastroenterol. 2018 Nov 21;24(43):4846–61.
15. Wang YT, Gou YW, Jin WW, Xiao M, Fang HY. Association between alcohol intake and the risk of pancreatic cancer: a dose-response meta-analysis of cohort studies. BMC Cancer. 2016 Mar 12;16:212.
16. Yadav D, Lowenfels AB. The epidemiology of pancreatitis and pancreatic cancer. Gastroenterology. 2013 Jun;144(6):1252–61.
17. Stoffel EM, Brand RE, Goggins M. Pancreatic Cancer: Changing Epidemiology and New Approaches to Risk Assessment, Early Detection, and Prevention. Gastroenterology. 2023 Apr;164(5):752–65.
18. Corbex M, Bouzbid S, Boffetta P. Features of breast cancer in developing countries, examples from North-Africa. Eur J Cancer. 2014 Jul;50(10):1808–18.

19. Sharma R, Aashima, Nanda M, Fronterre C, Sewagudde P, Ssentongo AE, et al. Mapping Cancer in Africa: A Comprehensive and Comparable Characterization of 34 Cancer Types Using Estimates From GLOBOCAN 2020. Front Public Health. 2022 Apr 25;10:839835.
20. Zarmouh A, Almalti A, Alzedam A, Hamad M, Elmughrabi H, Alnajjar L, et al. Cancer incidence in the middle region of Libya: Data from the cancer epidemiology study in Misurata. Cancer Rep (Hoboken). 2022 Jan;5(1):e1426.
21. de Carvalho JB, Giannichi B, Ferrari G, Tomita LY, Paiva L da S, Adami F, et al. Economic burden of cancer attributable to overweight in the Brazilian Unified Health System. J Cancer Policy. 2022 Sep;33:100346.
22. Jackson A, Virdee PS, Tonner S, Oke JL, Perera R, Riahi K, et al. Validity and timeliness of cancer diagnosis data collected during a prospective cohort study and reported by the English and Welsh cancer registries: a retrospective, comparative analysis. Lancet Oncol. 2024 Nov;25(11):1476–86.
23. Hamdi Y, Abdeljaoued-Tej I, Zatchi AA, Abdelhak S, Boubaker S, Brown JS, et al. Cancer in Africa: The Untold Story. Front Oncol. 2021 Apr 15;11:657651.
24. Kocarnik JM, Compton K, Dean FE, Fu W, Gaw BL, Harvey JD, et al. Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life Years for 29 Cancer Groups From 2010 to 2019: A Systematic Analysis for the Global Burden of Disease Study 2019. JAMA Oncol. 2022 Mar;8(3):420–44.
25. Abdul-Sater Z, Menassa M, El Achi N, Abdul-Khalek RA, Abu-Sittah G, Mukherji D. Strengthening capacity for cancer research in conflict settings: Key informant insights from the middle east. Ecancermedicalscience. 2021;15:1239.
26. National Cancer Control Program, State of Libya. The First Comprehensive Report of the National Cancer Registry: Cancer Incidence in Libya 2020. National Cancer Registry; 2020.
27. Aleksanyan M, Ahmad H, Kakakhel MZJ, Ali MF, Ikram J. Gender-specific trends in incidence and prevalence of pancreatic cancer: A Global Burden of Disease analysis in adults aged 70 and older (1990–2021). J Clin Oncol. 2025 Jun;43(16_suppl):e16410.
28. Bodalal Z, Azzuz R, Bendardaf R. Cancers in Eastern Libya: First results from Benghazi Medical Center. World J Gastroenterol. 2014 May 28;20(20):6293–301.
29. Lehmidi T, Mohamed N, Aishhebi H, Amer A. Trends and Patterns of Pancreatic Cancer Prevalence at Benghazi Medical Center: A Retrospective Analysis (2018–2024). AlQalam J Med Appl Sci. 2025 Sep 30;8(3):1519–28.
30. Atia A, Essam N, Fathi M, Abdullah N, Ahmed R. Cancer Prevalence in Libya: A Systematic Literature Review. Libyan Int J Oncol. 2025;4(1):1–6.
31. Bosetti C, Lucenteforte E, Silverman DT, Petersen G, Bracci PM, Ji BT, et al. Cigarette smoking and pancreatic cancer: An analysis from the International Pancreatic Cancer Case-Control Consortium (PANC4). Ann Oncol. 2012 Jul;23(7):1880–8.
32. Lin RT, Chen YC, Lee WC, Cheng YC, Wu MS, Kuo KN. Risk factors related to age at diagnosis of pancreatic cancer: a retrospective cohort pilot study. BMC Gastroenterol. 2022 May 22;22(1):243.
33. Maisonneuve P, Lowenfels AB. Variation of the age at onset of pancreatic cancer according to tobacco smoking and family history. Int J Epidemiol. 2018 Aug 1;47(4):1357.
34. Abboud Y, Samaan JS, Oh J, Jiang Y, Randhawa N, Lew D, et al. Increasing Pancreatic Cancer Incidence in Young Women in the United States: A Population-Based Time-Trend Analysis, 2001–2018. Gastroenterology. 2023 May;164(6):978–989.e6.
35. Oase KM, Meguid C, Oba A, Al-Musawi MH, Sheridan A, Norris E, et al. Solid Pseudopapillary Neoplasm: A Single Institutional Case Series of a Rare Pancreatic Tumor. J Adv Pract Oncol. 2022 Jul;13(5):497–504.
36. El-Mogassabi A, Kaziri IG. The impact of conflict on cancer care in Libya. J Cancer Policy. 2025 Mar;43:100528.
37. Parkin DM, Bray F, Ferlay J, Jemal A. Cancer in Africa 2012. Cancer Epidemiol Biomarkers Prev. 2014 Jun;23(6):953–66.
38. Bray F, Znaor A, Cueva P, Korir A, Swaminathan R, Ullrich A, et al., editors. Planning and Developing Population-Based Cancer Registration in Low- or Middle-Income Settings. Lyon (FR): International Agency for Research on Cancer; 2014.
39. Bhatia A, Victora CG, Beckfield J, Budukh A, Krieger N. "Registries are not only a tool for data collection, they are for action": Cancer registration and gaps in data for health equity in six population-based registries in India. Int J Cancer. 2021 May 1;148(9):2171–83.