

# Analysis of the incidence of pancreatic cancer under multiple exposures to air pollution and diet

Shu Yi Wang<sup>1</sup>, Jia Fen Chen<sup>1</sup>, Szu Pei Chien<sup>1</sup>, Wan Ting Hsu<sup>1</sup>, She Yu Chiu<sup>2</sup>, Chi Chang Ho<sup>3</sup>, Wei Min Chu<sup>4</sup>, Yu Tse Tsan<sup>4</sup>, Hua Lung Yu<sup>5</sup>, Wen Chao Ho<sup>1</sup>, Pau Chung Chen<sup>6</sup>

<sup>1</sup>Department of Public Health, China Medical University College of Public Health, Taichung, Taiwan

<sup>2</sup>National Health Research Institutes, Taiwan

<sup>3</sup>Institute of Environmental and Occupational Health Sciences, National Taiwan University College of Public Health, Taipei, Taiwan

<sup>4</sup>Taichung Veterans General Hospital, Taiwan

<sup>5</sup>Department of Bioenvironmental Systems Engineering, National Taiwan University, Taiwan

<sup>6</sup>Institute of Environmental and Occupational Health Sciences, National Taiwan University College of Public Health, Taipei, Taiwan; Department of Public Health, National Taiwan University College of Public Health, Taipei, Taiwan; Department of Environmental and Occupational Medicine, National Taiwan University Hospital and National Taiwan University College of Medicine, Taipei, Taiwan; National Institute of Environmental Health Sciences, National Health Research Institutes, Miaoli, Taiwan

## Introduction

According to the Ministry of Health and Welfare statistics, pancreatic cancer is the seventh leading cause of cancer deaths in 2021. In terms of gender, it is the eighth and fifth leading cause of cancer death for men and women respectively. Until now, the cause of pancreatic cancer is unknown. It is only known that smoking, chronic pancreatitis, obesity, long-term diabetes, family history of pancreatic cancer, and a diet of red meats and processed meats will increase the risk of pancreatic cancer. However, the incidence and mortality rates of pancreatic cancer remains high as more and more patients are not exposed to the known risk factors in the past. Many diseases are now known to be associated with air pollution, which affects not only the lungs, but the whole body. Therefore, we would like to explore the correlation between air pollution, diet and pancreatic cancer.

The expansion of industries like manufacturing, petrochemicals, and the use of automobiles have all contributed to economic success and raised living standards in this century. Medical technology has also advanced quickly. Pollution has, however, caused the air quality to rapidly deteriorate as a result of it. Furthermore, the shift from an agrarian to an industrial and commercial society, the rise in dual-income households, an increase in eating out habits, and the predominance of processed foods have all altered dietary patterns in today's society in comparison to earlier ones. Does this dietary adjustment have an impact on the incidence of pancreatic cancer? It's important to investigate if dietary habits and socioeconomic groups' exposure to air pollution affect the prevalence of pancreatic cancer.

## Materials and Methods

A retrospective cohort study was used to analyze the incidence and mortality rates of pancreatic cancer under multiple exposures to air pollution and diet in each county in Taiwan from 2005 to 2018. Mainly using cancer registry data from the National Health Service of the Ministry of Health and Welfare, the cause of death statistics from the Census and Statistics Department of the Ministry of Health and Welfare, air pollution monitoring data in Taiwan, and the Taiwan National Nutrition Health Database. The statistical data of pancreatic cancer incidence and mortality rates were linked to the air pollution monitoring data of Taiwan and the data of Taiwan National Nutritional Health Database for statistical analysis. Additionally, Wilcoxon signed-rank test, Analysis of Variance (ANOVA) and Regression Analysis were used to explore the association between chronic exposure to air pollution and exposure to red meat and processed meat on the development of pancreatic cancer.

## References

### 1. Pancreatic cancer

Pancreatic cancer is known as the "King of Cancers" because its prognosis is so poor once diagnosed. The death rate has been significantly growing in recent years, and it is expected to become the second most frequent malignant tumor by 2030. When pancreatic cancer is discovered, many individuals are already in an advanced stage with distant metastases, which frequently catches both patients and medical teams off surprise.

### 2. Air pollution

Air pollution is a huge and pressing issue today, posing a critical threat to human health. It can cause inflammatory responses and allergic reactions, which can lead to physiological changes and disorders. Numerous studies have discovered links between air pollution and various health disorders, and more diseases are being connected to air pollution as study advances. Allergies, respiratory problems, cardiovascular diseases, gastrointestinal disorders, lung cancer, and other ailments are currently recognized to be linked to air pollution.

### 3. Diet

Diet supplies the basic calories required for human living, but it may also contribute to the onset of some illnesses. Dietary decisions have an impact on a number of disorders, and food metabolism and inflammation are intimately related. Dietary variables can cause inflammation and allergic reactions through immunological responses, which can then start illnesses.

## Results

This study investigated the effects of air pollution and consumption of red meat and processed meat on the incidence and mortality rates of pancreatic cancer respectively. Since pancreatic incidence data was only available for county, we additionally explored multivariate exposure analysis of pancreatic cancer mortality rate and air pollution and food intake.

In the part of pancreatic cancer incidence rate, there is a significant difference in men and women in each county and city. The incidence of pancreatic cancer was 1.72417 (1.47076- 1.97758) in men compared to women, while men had an effect on the incidence rate of pancreatic cancer in NO2 and O3, with NO2 was 0.15016 (0.03123 - 0.26909) and O3 was 0.14585 (0.00645 - 0.28524); women had an effect on the incidence of pancreatic cancer in PM2.5 with a negative correlation -0.0596 (-0.1067 - -0.0124). The effect of red meat and processed meat consumption on the incidence rate of pancreatic cancer was significantly different for men and women in each county. Consumption of red meat and processed meat had a significant effect on the incidence rate of pancreatic cancer of 0.27681 (0.10558 - 0.44804) in men and no significant effect in women. After stratified analysis of counties into four regions (North, Central, South, and East), red meat and processed meat consumption had a significant effect on the incidence rate of pancreatic cancer only in the East 2.14819 (0.17004 - 4.12635) for men, and in the South - 0.35711 (-0.6746 - -0.0396) for women.

Investigating the multiple effects of air pollution and consumption of red meat and processed meat on the incidence rate of pancreatic cancer. Firstly, after controlling for food intake and PM2.5 by Multiple regression analysis, the results showed that the food intake of both men and women was not significant; PM2.5 has a significant effect and is negatively correlated with -0.0288 (-0.05318 - -0.0044) and -0.0522 (-0.07449 - -0.0299) respectively. And then controlling for the values of food intake and O3, the results showed significant effects of food intake for men and women, 0.07162 (0.02079 - 0.12245) and 0.09116 (0.0237 - 0.15861) respectively, while O3 was not significant at all. It can be seen that PM2.5 has a negative correlation on the incidence rate of pancreatic cancer, while O3 has no significant effect. Therefore, this study further investigated the interactions of food intake with PM2.5 and O3, and the result showed that the multiplicative interaction of food intake with PM2.5 and O3 had no significant effect on the incidence rate of pancreatic cancer in both men and women.

## Conclusions

In the part of pancreatic cancer incidence rate, O3 is mostly positively correlated with the incidence rate of pancreatic cancer while PM2.5 is mostly negatively correlated with the incidence rate of pancreatic cancer when exploring a single pollutant. This result is not entirely consistent with the relationship between PM2.5 and O3 as described in the literature. In the part of pancreatic cancer mortality rate, O3 was also mostly positively associated with pancreatic cancer mortality rate, while PM2.5 was almost insignificant in the part of pancreatic cancer mortality rate. However, when considering multiple environmental exposures, it was found that in the interaction of PM2.5, O3, and food intake, related to increasing pancreatic cancer mortality rate in women, but not in men. Further study is in need.