ICEMIT BLACE
The Second International Scientific Conference on Economics, Management and Information Technologies – ICEMIT 2025
CONFERENCE PROCEEDINGS

Health expenditure and gender-specific cancer incidence and mortality: Are there statistically significant differences between country groups?

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Article info

Original scientific paper

DOI:
https://doi.org/10.71159/icemit2511F

Abstract

Cancer is one of the leading causes of death, which emphasises the need for prevention, detection and treatment. This article aims to investigate whether there are statistically significant differences in gender-specific cancer incidence and mortality between countries with low, medium and high health expenditure (as a percentage of GDP). The results for the year 2022 indicate statistically significant differences in cancer incidence and mortality in men between countries with low and medium health expenditure and countries with low and high health expenditure; however, no such differences were found in women.

***Keywords*:** *cancer incidence, cancer mortality, health expenditure*

1. Introduction

Cancer is one of the most common causes of death, which emphasises the need for prevention, detection and treatment. In 2022, 9,625,678 people died of cancer worldwide, of which 56.3% were men and 43.7% women (World Population Review, 2025). Cancer is not only a major challenge for cancer patients (and their families and friends), but also for the healthcare system. Therefore, the relationship between health expenditure and gender-specific cancer incidence and mortality are a hot topic in health economics. Many studies also focus on the relationship between health expenditure and gender-specific incidence-mortality ratios. The aim of this article is to analyse whether there are statistically significant differences in gender-specific cancer incidence and mortality between countries with low, medium and high health expenditure. Studies (Bray et al., 2024; Torre et al., 2016) show that high health expenditure does not necessarily indicate low cancer incidence (i.e., number of newly diagnosed cancer cases) and mortality (i.e., number of cancer deaths), which are influenced by various factors (e.g., demographic, economic, environmental, political, social and technological), but better cancer prevention, detection and treatment.

The rest of this article is organised as follows: Section 2 contains a literature review, Section 3 the methods, Section 4 the results, Section 5 the discussion and Section 6 the conclusion.

2. Literature review

Several studies examine the relationship between health expenditure and total (aggregate) or specific cancer incidence and mortality; recent studies include Ades et al. (2013), Chou et al. (2013), Chahoud et al. (2016), Wang et al. (2020), MacLellan et al. (2024), and Ramadan et al. (2025). Ades et al. (2013) find that the incidence of all cancers and breast cancer is positively correlated and mortality from all cancers is negatively correlated with health expenditure in the European Union. The other measure of health outcomes they analysed, the ratio of cancer mortality to cancer incidence, is negatively correlated with health expenditure for both all cancers and breast cancer. They also find that Western members of the economic association spend more on health, have higher cancer incidence, but lower cancer mortality than Eastern members. Chou et al. (2024), using data from 35 countries worldwide, find a positive relationship between breast cancer incidence and health expenditure and a negative relationship between the ratio of breast cancer mortality to incidence and health expenditure. Chahoud et al. (2016) focus on US states and examine the relationship between health

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expenditure and the mortality-to-incidence ratio for all cancers, breast cancer and colorectal cancer. They find a negative relationship between health expenditure and the mortality-to-incidence ratio for breast cancer. Wang et al. (2020), who analysed prostate cancer incidence, cancer mortality and the ratio of prostate cancer mortality to incidence for 47 countries, found a positive correlation between the first and third indicators of health outcomes and health expenditure. MacLellan et al. (2024) analyse the incidence of 4 major cancers in Canadian provinces. Their regression results show a positive relationship between health expenditure and the incidence of colorectal and prostate cancer. They argue that social spending, which includes various social programmes, is important for population health and find that the relationship between social and health spending is negatively associated with colorectal, breast and prostate cancer. Ramadan et al. (2025) focussed on high-income countries with an older population and examined the evolution of the association between cancer mortality and incidence over time. They divided the observed sample into groups of countries with high and low health expenditure and found that the relationship between mortality and incidence for different types of cancer is lower in the former than in the latter.

Aydın and Aydın (2025) concluded that although both national wealth and health expenditure are positively associated with cervical cancer outcomes in European countries, health expenditure has a much stronger and statistically significant impact than overall wealth. A GLOBOCAN-based analysis by Elmadani et al. (2025) documents substantial regional variations in cancer burden across Europe, driven in part by differences in health investment. Disparities in mortality-to-incidence ratios further highlight the importance of health infrastructure and timely interventions.

Gender-specific evidence also continues to emerge. Cancer incidence and mortality can be gender-specific (see e.g., OECD, 2023; Cook et. al, 2009; Liu, 2016; Jackson et al., 2022; Tosakoon et al., 2024). The OECD (2023, p. 74) states that in OECD countries, cancer incidence and mortality are generally higher in men than in women, but that large country differences in gender gap can be observed, which can be at least partly explained by the greater prevalence of various risk factors such as smoking and alcohol consumption in the male population. Cook et al. (2009) examined gender differences in cancer incidence in the US and found that only five cancers have a higher incidence in women than in men, and that the male-to-female ratio for cancer incidence for specific cancer can reach values up to 29. Liu (2016) states that the gender differences in cancer mortality rates in the world are age- and country-dependent, with higher rates in men than in postmenopausal women. Jackson et al. (2022) focusses on the USA and 21 cancer types and find that for 19 cancer types the incidence is higher in men than in women. Using regressions, they found that the gender-specific differences can be explained not only by risk factors, but also by biological differences between the sexes. Tosakoon et al. (2024), who also analysed the USA, found a higher incidence of cancer in men than in women for 44 of the 49 types of cancer studied, and argue that this result is generally not dependent on ethnicity or race. Additionally, Amini, Sharma, and Jani (2023) found that the gender differences observed in leukaemia outcomes may reflect the influence of social, material, behavioural, and biological factors. Further research from Scotland indicates that factors positively associated with hazard of death tended to be negatively associated with costs, reflecting the importance of survival for long-term costs. Finally, the OECD (2025) reports that increased investment in health systems contributes to improved health outcomes by providing more accessible and higher-quality care.

3. Methods

Cancer incidence and mortality data for the year 2022 were obtained from the World Population Review Webpage, comprising a sample of n = 161 countries. The average cancer incidence was 180.19 cases per 100,000 population (SD = 82.77) and the average cancer mortality was 128.61 deaths per 100,000 population (SD = 94.37).

To analyse whether there are statistically significant differences in gender-specific cancer outcomes between countries, the countries were divided into three categories based on the terciles of their health expenditure: low, medium and high health expenditure countries (measured as a percentage of GDP).

As the distribution of cancer incidence and mortality data was not normal, a non-parametric Kruskal-Wallis test was used to identify statistically significant differences between the three groups.

The statistical analyses were performed with IBM SPSS Statistics 29.

4. Results

A Kruskal-Wallis test was performed to determine whether gender-specific cancer incidence and mortality differ significantly between countries with low, medium and high health expenditure (see Table 1 and Table 2).

Table 1. Mean ranks for cancer incidence and mortality by health expenditure group

Variable	Low expenditures (n=54)	Medium expenditures (n=53)	High expenditures (n=54)
Cancer Incidence (Total)	54.07	87.10	101.94
Cancer Incidence (Male)	53.71	89.32	100.12
Cancer Incidence (Female)	56.40	83.89	102.77
Cancer Mortality (Total)	52.80	92.13	98.28
Cancer Mortality (Male)	59.67	94.82	88.77
Cancer Mortality (Female)	71.39	84.61	87.06

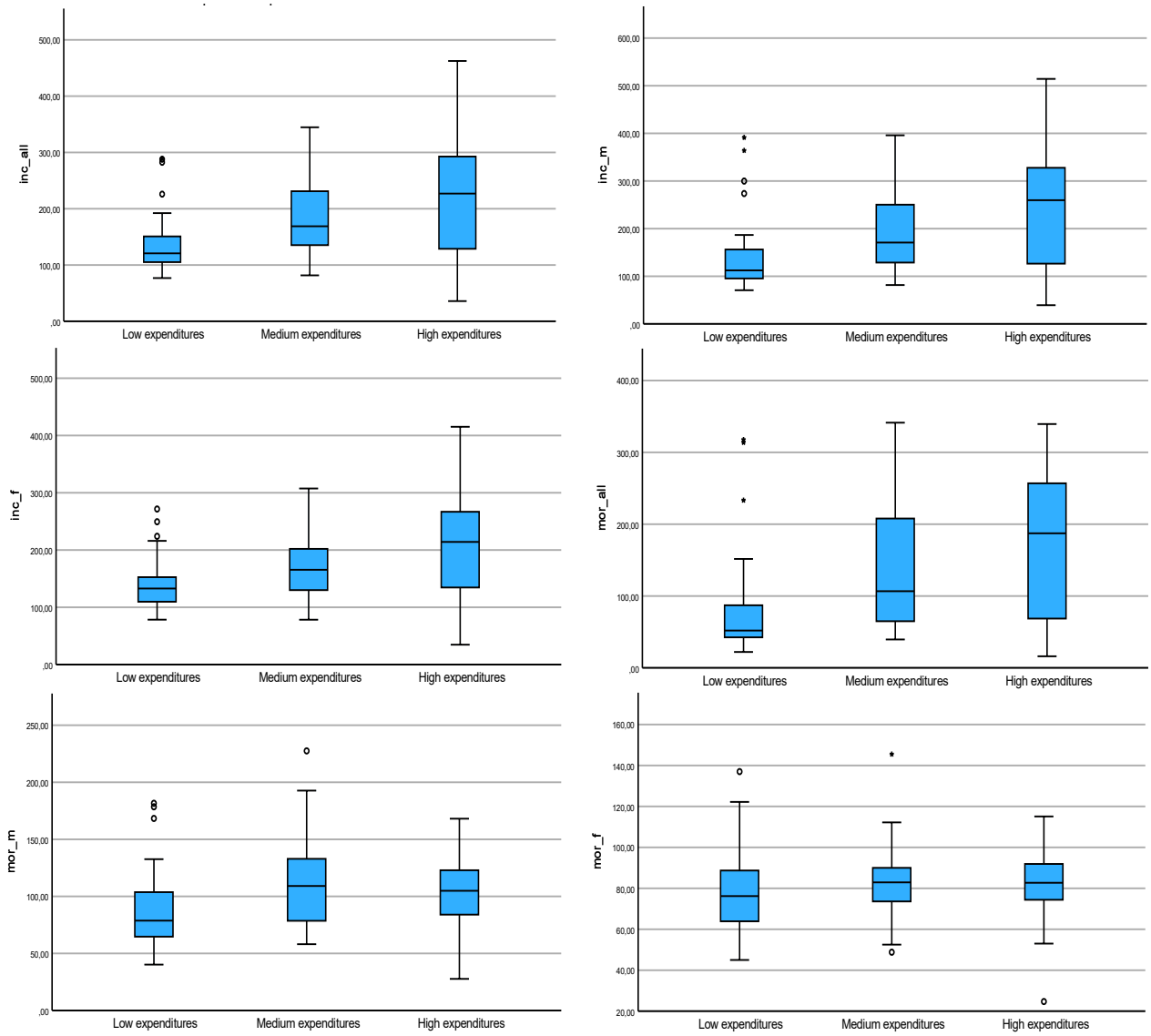
Source: Authors calculations

Table 2. Kruskal-Wallis test results for cancer incidence and mortality

Variable	H	df	p
Cancer Incidence (Total)	29.81	2	< .001
Cancer Incidence (Male)	29.27	2	< .001
Cancer Incidence (Female)	27.01	2	< .001
Cancer Mortality (Total)	30.20	2	< .001
Cancer Mortality (Male)	17.46	2	< .001
Cancer Mortality (Female)	3.53	2	.171

Source: Authors calculations

Figure 1. Boxplots for cancer incidence and mortality by health expenditure group



Source: Authors calculations

A Kruskal-Wallis test showed that there were statistically significant differences between the groups in cancer incidence (total), $\chi 2$ (2, N = 161) = 29.81, p < .001, cancer incidence (male), $\chi 2$ (2, N = 161) = 29.27, p < .001, cancer incidence (female), $\chi 2$ (2, N = 161) = 27.01, p < .001, cancer mortality (total), $\chi 2$ (2, N = 161) = 30.20, p < .001 and cancer mortality (male), $\chi 2$ (2, N = 161) = 17.46, p < .001.

A Kruskal-Wallis tests also showed that there was no significant difference in cancer mortality (female) between the three groups, $\chi 2$ (2, N = 161) = 3.53, p = .171. The mean rank for cancer mortality (female) was 71.39 for the low expenditure group, 84.64 for the medium expenditure group, and 87.06 for the high expenditure group.

For better visual interpretation of the differences in cancer incidence and mortality between the low, medium and high health expenditure groups, boxplots are presented in Figure 1.

Post-hoc analyses with pairwise comparisons and Bonferroni correction were performed to investigate further statistically significant differences between the groups. These analyses helped to identify statistically significant differences in cancer incidence and mortality between the health expenditure country groups.

Table 3. Post hoc pairwise comparisons of groups based on health expenditure

Variable	Groups Compared	p–value (adjusted)[1]
Cancer Incidence (Total)	Low vs. Medium	.001
	Low vs. High	.000
	Medium vs. High	.300
Cancer Incidence (Male)	Low vs. Medium	.000
	Low vs. High	.000
	Medium vs. High	.693
Cancer Incidence (Female)	Low vs. Medium	.007
	Low vs. High	.000
	Medium vs. High	.109
Cancer Mortality (Total)	Low vs. Medium	.000
	Low vs. High	.000
	Medium vs. High	1.000
Cancer Mortality (Male)	Low vs. Medium	.004
	Low vs. High	.000
	Medium vs. High	1.000

[1]Note: Significance values have been adjusted by the Bonferroni correction for multiple tests.
Comparisons involving female cancer mortality are not shown because the overall Kruskal–Wallis test was not statistically significant (p = .171).

Source: Authors calculations

Table 3 contains pairwise post-hoc comparisons of groups (countries with different levels of health expenditure) for variables for which the Kruskal–Wallis test showed statistically significant differences between at least two groups. The post-hoc analyses, conducted using the Dunn test with Bonferroni correction, showed that the countries with low health expenditure differed consistently from the countries with medium or high expenditure in both cancer incidence and cancer mortality (adjusted p < .01). However, the differences between the medium- and high expenditure groups were not statistically significant for any of the variables analysed.

5. Discussion

The results presented show statistically significant differences between groups of countries in terms of cancer incidence and health expenditure, as countries with low health expenditure have a lower cancer incidence than countries with medium and high health expenditure. This result is consistent with the literature (e.g., Ades et al., 2013; Chou et al., 2024; Wang et al., 2020). The finding that cancer mortality is lower in countries with low health expenditure than in countries with medium and high expenditure is inconsistent with the literature. This may be related to the size of the country sample, which is larger than in much of the literature reviewed and includes several less developed economies, and offers at least two explanations for the result. Firstly, it is known that cancer incidence increases with population age (see e.g., White et al., 2014). As less developed countries have a lower health expenditure than more developed countries (Our world in data, n.d.) but younger population (Ritchie et al., 2019), it may well be that cancer incidence and mortality is lower there than in countries with medium and high health expenditure. Second, cancer incidence and mortality can be lower in countries with low health expenditure because cancer is less successfully diagnosed and treated and less frequently reported as a cause of death than in countries with medium and high health expenditure (World population review, 2025; Martinez et al., 2024). There can also be other factors that are positively related to economic development and health expenditure levels, e.g., levels of risk factors such as smoking, alcohol consumption, healthy diet (see e.g., OECD, 2023), which are worth investigating further but are beyond the scope of this research.

The findings of this study have important implications for public health policy internationally. If the aforementioned argument explaining higher cancer mortality in less developed countries is valid, then cancer mortality will increase with the economic development of these countries. This suggest that policy measures promoting affordability, such as expanding insurance coverage and improving access to preventive services, may help reduce avoidable cancer deaths in all studied groups of countries. Improving equitable access to early detection may therefore be an effective strategy for reducing global cancer disparities. However, differences in public health financing, insurance models, and public health infrastructure across countries further contextualise these results. Countries with limited public health expenditure, fragmented insurance systems, or greater socioeconomic inequality often experience more pronounced impacts of financial barriers on cancer outcomes. In contrast, countries with stronger health systems and well-developed preventive care programmes typically report lower mortality from several cancer types. Although this study does not conduct a region-specific subgroup analysis, these cross-country structural differences highlight the importance of considering broader health system characteristics when interpreting the relationship between health expenditure and cancer mortality.

6. Conclusion

This article aimed to analyse whether there are statistically significant differences in gender-specific cancer incidence and mortality between countries with different levels of health expenditure in GDP. Based on data from 2022, we found statistically significant differences between countries with low and medium as well as low and high levels of health expenditure in GDP, but not between countries with medium and high levels of health expenditure in GDP. Interestingly, this only applies to men, but not to women, which emphasises the need to determine the reasons for this. One possible reason for this could be that countries with a higher level of health expenditure in GDP pay more attention to the timely detection and treatment of cancer in men.

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