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Original

An ecological assessment of global thyroid cancer incidence and mortality according to the human development index in 2020

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Abstract

Introduction: Thyroid cancer is a prevalent form of cancer globally, and its occurrence has been on the rise in recent times. The human development index (HDI) is a comprehensive indicator of social and economic progress, which has been linked to both the occurrence and mortality rates of cancer.

Objectives: This study aimed to evaluate the correlation of thyroid cancer incidence and mortality with the HDI.

Materials and Methods: This ecological study was conducted to investigate thyroid cancer incidence and mortality according to the HDI based on extracted data from the GLOBOCAN project in 2020. To illustrate the distribution of thyroid cancer incidence and mortality by HDI in world countries, the scatter plot and variance analysis model were conducted.

Results: Results showed that most thyroid cancer deaths and new cases occurred in women. The distribution of thyroid cancer incidence among the HDI classification regions was statistically significant ($P<0.001$); however, the mortality rate was not significant ($P>0.05$).

Conclusion: We concluded that the incidence of thyroid cancer is influenced by socioeconomic development, with more developed countries having higher incidence rates; however, the mortality rate does not appear to be significantly affected by the HDI.

Keywords: Thyroid neoplasm, Mortality, Incidence, Human development index

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Introduction

Thyroid cancer is a type of malignancy that originates in the thyroid gland, which is located at the base of the neck and plays a crucial role in regulating metabolism through hormone production (1). This cancer can manifest in several forms, with papillary thyroid carcinoma being the most common, followed by follicular, medullary, and anaplastic thyroid cancers (2). Risk factors for developing thyroid cancer include exposure to radiation, certain genetic predispositions, and a history of thyroid disease; while thyroid cancer often has a favorable prognosis, especially in its early stages, its incidence has been rising globally, prompting ongoing research into its causes and effective treatment strategies (3). The incidence and mortality of thyroid cancer have shown significant trends over recent decades, particularly in the United States and globally. In the United States, thyroid cancer incidence has increased substantially, with an average annual increase of 3.6% from 1974 to 2013, primarily driven by papillary thyroid carcinoma, which accounted for the majority of cases diagnosed during this period (4). Despite the rising incidence, mortality rates have remained relatively stable or even decreased in many regions, indicating that while more cases are being diagnosed, advancements in detection and treatment may improve survival outcomes (5,6). Globally, similar patterns are observed, with increasing incidence rates reported across various countries; however, mortality rates tend to show less dramatic changes or declines, particularly in high-income nations (5,7). This disparity highlights the importance of

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Implication for health policy/practice/research/medical education

Thyroid cancer incidence is rising globally, especially in more developed countries, with a higher occurrence in women. This study analyzed the correlation between thyroid cancer rates and the human development index (HDI) using GLOBOCAN 2020 data, finding a significant association between HDI and incidence but not mortality. Results suggest that while thyroid cancer is more common in developed nations, the mortality rate remains relatively unaffected by socioeconomic factors.

ongoing research to understand the factors influencing these trends and to optimize care for patients diagnosed with thyroid cancer.

The human development index (HDI) is a composite statistic used to assess countries' overall development and well-being, incorporating three key dimensions; health, education, and standard of living (8). Specifically, HDI measures life expectancy at birth as an indicator of health, mean years of schooling and expected years of schooling as indicators of education, and gross national income (GNI) per capita adjusted for purchasing power parity as a measure of economic prosperity (9). The HDI index, developed by the United Nations Development Programme (UNDP), provides a comprehensive assessment of human development that extends beyond traditional economic indicators such as gross domestic product (GDP) (10). Countries are ranked on a scale from 0 to 1, with higher values indicating greater levels of human development, which can influence various health outcomes, including those related to cancer incidence and mortality rates (11).

The evaluation of the correlation between thyroid cancer incidence and mortality with HDI can reveal significant insights into how socioeconomic factors influence health outcomes; therefore this study was conducted to explore the relationship between thyroid cancer incidence and mortality rates across various countries with the HDI.

Objectives

This study aimed to investigate the relationship between thyroid cancer incidence and mortality rates across different countries with the HDI index as a measure of socio-economic development. This study provides insights into how variations in HDI impact the prevalence and outcomes of thyroid cancer, thereby highlighting potential disparities in healthcare access, cancer diagnosis, and treatment effectiveness globally. By analyzing these associations, the study seeks to inform public health strategies and resource allocation to improve cancer care in regions with varying levels of human development.

Materials and Methods

Study design

This ecological and observational research was conducted to investigate the correlation between thyroid cancer incidence and mortality with the HDI in 2020, using online data from the World Health Organization (WHO) website (https://gco.iarc.fr/).

Data collection

In this ecological investigation, information regarding the occurrence and fatality of thyroid cancer was compiled from Internet-based resources, particularly the official website of the Global Cancer (GLOBOCAN) project under the supervision of WHO (https://gco.iarc.fr/). For data calculation, two indicators, including age-standardized rate (ASR) and crude rate were used. These indicators are calculated per 100 000 people (12,13).

Human development index

The HDI serves as a concise gauge of the mean attainment in three aspects of human development; longevity and wellness, erudition, and possessing a respectable quality of life. This scale, which ranged from 0 to 1 (a greater number indicates more development), represents a geometric mean of standardized indicators for every one of the three dimensions, consequently evaluating the achievements within each dimension. Life expectancy is assessed by the mean number of years an individual can expect to live from birth, the educational dimension is determined by the average number of years of formal education received, and the standard of living is quantified by the per capita GNI (14).

Statistical analysis

The software version 27 of SPSS was employed to conduct data analysis. To assess the distribution of thyroid cancer occurrence and fatality based on the HDI levels across nations globally, the scatter plot and variance analysis model was employed. The level of significance was deemed to be less than 0.05.

Results

In 2020, around 586 202 of new cases of thyroid cancer were estimated worldwide (23.42% male versus 76.58% female). The distribution of these cases varied across countries with different levels of development, with the highest number of cases reported in the high HDI region and the lowest number of reported cases in the low HDI region. The total number of thyroid cancer deaths was 43,646 cases worldwide, with 36.44% in men and 63.56% in women. Very high HDI countries had the highest frequency of deaths, and those with low HDI had the lowest mortality (Figure 1).

The scatter plot demonstrated the correlation between the thyroid cancer incidence in 2020 and the HDI categories. This figure displays the HDI classification on the x-axis and the incidence on the y-axis. The countries were allocated into four HDI categories (very high, high, medium, and low). The results indicated that countries with very high HDI had the highest frequency

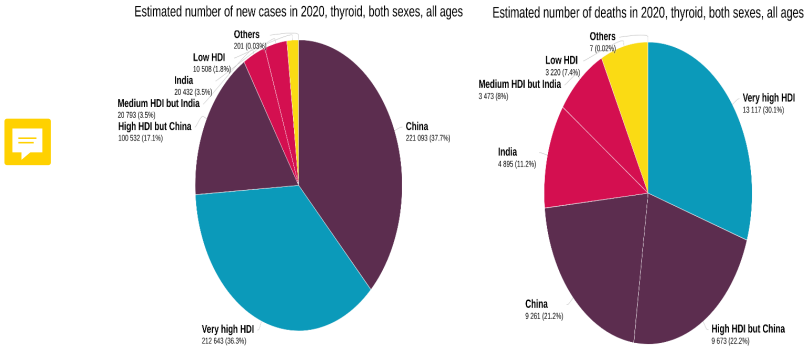

Figure 1. The distribution of the estimated frequency of new cases and deaths of thyroid cancer in 2020 according to HDI classifications.

of new thyroid cancer cases, while those with low HDI had the lowest (Figure 2).

In Figure 3, the categorizations of the HDI are depicted along the x-axis, and the mortality rate of thyroid cancer (ASR) is graphed along the y-axis. The mortality rate distribution was scarcely different among the different HDI categories, in high and medium development index regions was slightly greater than in the low and very high development index areas (Figure 3).

The results of the variance analysis indicated that the incidence of thyroid cancer was highest in very-high developed countries and lowest in low-developed countries, based on both ASRs and crude rates. This difference in incidence rates between very-high developed and low-developed countries was statistically significant. However, although the mean ASR and crude rate for thyroid cancer mortality showed differences in the different HDI classifications, these differences were not statistically significant (Table 1).

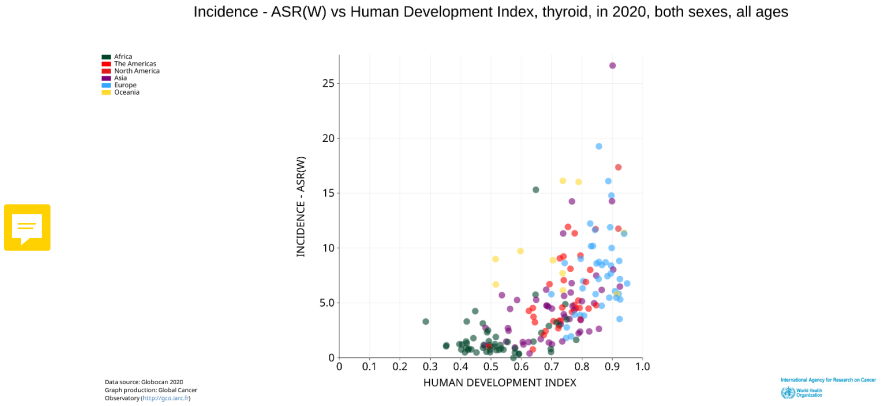

Figure 2. Scatter plot of thyroid cancer new cases in 2020 versus HDI categories based on ASR (world) indicator.

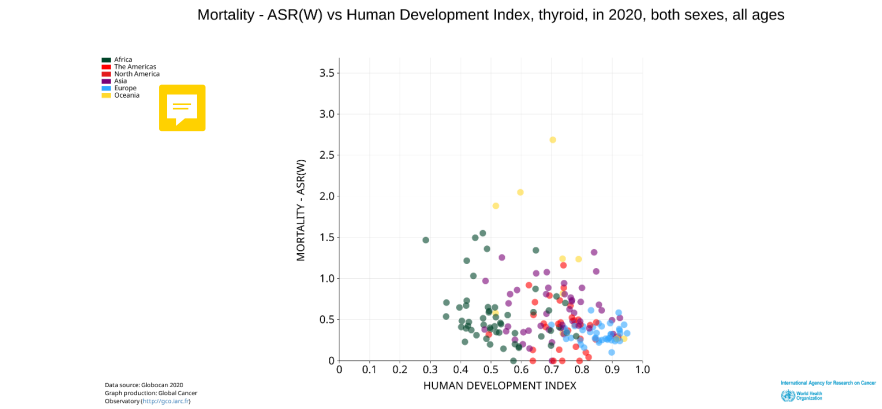

Figure 3. Thyroid cancer mortality in 2020 versus HDI Classification based on ASR (world) using scatter plot.

Table 1. Global thyroid cancer incidence and mortality based on the HDI classification (in 2020)

Variable	Indicator	Human development index				*P* value*
		Very high	High	Medium	Low	
Incidence	ASR	10	8.9	1.8	1.7	<0.001
	CR	13.6	11.10	1.8	1.1	<0.001
Mortality	ASR	0.35	0.47	0.40	0.37	0.075
	CR	0.84	0.65	0.36	0.33	0.053

ASR (world) = Age-standardized rate per 100 000; CR = Crude rate per 100 000.
*F test.

Discussion

The results showed that the distribution of thyroid cancer incidence among the HDI classification regions was statistically significant, with more developed countries having higher incidence rates; however, the mortality rate was not significant. These results, which demonstrate that thyroid cancer incidence is significantly influenced by socioeconomic development, with more developed countries exhibiting higher incidence rates, is in line with previous studies highlighting the role of healthcare access and diagnostic capabilities in cancer detection. Previous studies indicated a positive correlation between the standardized incidence rates of thyroid cancer and HDI, suggesting that higher levels of human development are associated with increased detection and diagnosis of thyroid cancer, likely due to better healthcare access and screening practices. A meta-analysis study by Moon et al, consistent with our study indicated that the increased prevalence of thyroid cancer is largely attributable to enhanced screening practices in developed nations, which often leads to the identification of incidental cases that might otherwise remain undiagnosed (15). This phenomenon is further supported by findings from the Global Burden of Disease Study, which reported rising incidence rates across many high-income countries, suggesting that improvements in health systems contribute to higher detection rates of thyroid cancer (16).

However, the finding that mortality rates do not significantly correlate with the HDI contrasts with some studies that have shown improved survival outcomes in high-HDI countries due to better treatment options and healthcare quality. For example, research has indicated that patients diagnosed with incidental thyroid cancer, often detected through screening exhibit lower mortality rates compared to those with more aggressive forms of the disease (15). This suggests that while incidence may rise due to better detection, the actual mortality may not reflect these trends if effective treatment protocols are in place. Moreover, previous studies have reported decreasing mortality rates in many European nations despite rising incidence, indicating that advancements in medical care and patient management can mitigate the impact of increased diagnosis on overall mortality (16,17). This divergence emphasizes the importance of not only focusing on incidence rates as indicators of disease burden but also considering the quality of healthcare systems and treatment outcomes when evaluating mortality statistics. Moreover, this disparity can be attributed to improved healthcare systems in high HDI countries that facilitate early diagnosis and effective treatment, thus reducing mortality rates despite higher incidence rates. Overall, these findings underscore the complex interplay between socioeconomic development and health outcomes in the context of thyroid cancer.

Overall, this study highlights the significant relationship between socioeconomic development and thyroid cancer incidence, with more developed countries experiencing higher detection rates due to improved healthcare access and diagnostic capabilities. However, the lack of a corresponding increase in mortality rates suggests that effective treatment and patient management in these regions play a critical role in mitigating adverse outcomes. These findings underscore the importance of enhancing healthcare systems, particularly in developing countries, to improve early detection and treatment of thyroid cancer, ultimately aiming for equitable health outcomes across different levels of human development.

Conclusion

In conclusion, the results of this study indicate a clear relationship between socioeconomic development and the incidence of thyroid cancer, with more developed countries reporting higher incidence rates likely due to enhanced healthcare access and diagnostic capabilities. This suggests that increased awareness and screening in these regions may contribute to the detection of cases that might otherwise go unrecognized. Conversely, the lack of a significant correlation between the HDI and mortality rates implies that factors such as treatment efficacy, healthcare quality, and patient management play a more critical role in determining outcomes for thyroid cancer patients than mere economic development alone. These findings highlight the necessity for a nuanced understanding of cancer epidemiology that considers both the benefits of socioeconomic advancement in terms of detection and the imperative to improve treatment strategies across varying levels of human development to ultimately reduce mortality rates associated with thyroid cancer.

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Authors' contribution

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Methodology: Shahrzad Ghaffariyan and Abdul Amir H Kadhum.
Project management: Hossein Mardanparvar.
Resources: All authors.
Supervision: Mahmoud Dehghani Ghorbi.
Validation: Aghdas Dehghani and Mohammed Abdul-Mounther Othman.
Writing–original draft: All authors.
Writing–reviewing and editing: All authors.

Conflicts of interest

As one of the contributing authors of this work, Hamid Nasri acts as the Founder & Editor-in-Chief of the journal. It declares clearly that his editorial role does not influence the integrity of the peer review process.

Ethical issues

The research adhered to the principles outlined in the Declaration of Helsinki. This study resulted from the research project project No. 4020347 and was approved by the Hormozgan University of Medical Sciences (Endocrinology and Metabolism Research Center) under Ethical Code IR.HUMS.REC.1402.303 (https://ethics.research.ac.ir/EthicsProposalView.php?id=405033) in Bandar Abbas, Iran. Besides, the authors have ultimately observed ethical issues (including plagiarism, data fabrication, and double publication).

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