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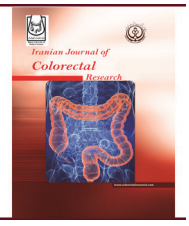

Developing Concerns: Colorectal Cancer Trends and Human Development Index in South-East Asia

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Abstract

Background: From 2008 to 2020, colorectal cancer (CRC) incidence and mortality increased by approximately 50% and 47%, respectively, in South-East Asia (SEA). The human development index (HDI) influences various lifestyle choices (including physical activity), which may contribute to the prevalence of CRC in this region, distinct from factors related to medical or hereditary history. This study aims to evaluate and demonstrate the impacts and association of HDI with age-standardized rates (ASR) of CRC incidence and mortality in SEA.
Methods: Utilizing data from the Global Cancer Observatory (GLOBOCAN) 2020, this study analyzed ASR for CRC incidence and mortality in each SEA country. Concurrently, the HDI for 2021 in these nations was gathered from the Human Development Reports. Using Spearman correlation analysis, we investigated the link between CRC ASR (incidence and mortality) and HDI indicators, including life expectancy at birth, mean years of schooling, and Gross National Income per Capita (2017 Purchasing power parity [PPP$]). The statistical significance threshold was set at $P<0.05$.
Results: The statistical analysis revealed noteworthy positive correlations between HDI and its components (life expectancy at birth, mean years of schooling, and Gross National Income per Capita) with the ASR for incidence. Specifically, Spearman's rho values were 0.834, 0.755, 0.827, and 0.882, respectively. Similarly, significant correlations were observed between HDI and its constituents with ASR for mortality, with corresponding values of 0.720, 0.755, 0.718, and 0.782 at a 5% significance level.
Conclusion: Countries with a high HDI exhibit a dual impact influence by fostering economic growth while potentially posing challenges to public health. Despite very high HDI nations demonstrating successful CRC screening programs that lower both incidence and mortality rates, various SEA countries face impediments in implementing such screenings.

Keywords: Colorectal neoplasms, Incidence, Mortality, Asia Eastern

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Introduction

According to the Global Cancer Observatory (GLOBOCAN), colorectal cancer (CRC) ranks as the third most common cancer in terms of incidence and the second most fatal cancer for both genders (1). Among continents, Asia experienced the second-highest increase in CRC incidence, approximately 50%, and mortality, around 47.0% (1, 2). Particularly noteworthy, South-East Asia (SEA) demonstrated the most substantial rise in incidence at 55.5% and the second-highest mortality at 48.5%.

Comprising 11 nations, SEA displays diverse human development index (HDI) levels, reflecting a country's social and economic progress using indicators such as life expectancy, education levels, and per capita income (3). The HDI categories include very high (0.800-1.000), high (0.700-0.799), medium (0.550-0.699), and low 0.350-0.549 (3). These levels vary from very high, exemplified by Singapore, Brunei Darussalam, and Malaysia, to high, encompassing Thailand, Philippines, Indonesia, and Vietnam, and finally, medium, covering Cambodia, Lao People's Democratic Republic (PDR), Myanmar, and Timor-Leste (3, 4). Studies frequently investigated the impact of HDI on CRC rates, emphasizing the influence of socioeconomic factors on disease patterns and outcomes (5-8).

Earlier studies explored the association between HDI and cancer patterns in diverse nations, revealing that countries with very high HDI often exhibit elevated cases of prevalent cancers, including CRC, lung, breast, prostate, and stomach cancers (5-8). In the context of CRC, global variations in incidence and mortality rates were noted, particularly linked to varying levels of human development. Low- and middle-income countries witnessed a rapid increase in CRC rates, whereas highly developed nations demonstrated stabilized or declining trends, albeit maintaining high rates (8).

Lifestyle factors that contribute to CRC risk are significantly influenced by HDI (8). These factors encompass an aging population, lifestyle changes associated with higher HDI (such as the adoption of a "Westernized" diet characterized by increased consumption of processed fast food and red meat and low fiber intake), smoking, obesity, excessive alcohol consumption, physical inactivity, a family history of CRC, the presence of polyps, inflammatory bowel diseases, and genetic predisposition (8-10).

Higher levels of HDI are associated with increased urbanization, industrialization, mechanization, technological advancements, automation, and economic growth (11). These developments create employment opportunities, enhance human capital, and improve technology, leading to lifestyle and diet modernization (12). The modernization and automation of lifestyle contribute to adopting a "Westernized" diet and increased physical inactivity (8, 9). Significantly, an elevated HDI is linked to increased CRC incidence and mortality across various countries, reflecting improved healthcare infrastructures and enhanced access to early detection and treatment (8, 13, 14). However, most studies have focused on countries with very high HDIs, with limited research conducted in nations with high to medium HDIs. Therefore, this study aimed to assess and illustrate the effect and correlation of HDI with CRC age-standardized rate (ASR) incidence and mortality in SEA.

Methods

Table 1 presents the global incidence and mortality rates of CRC from 2008 to 2020, indicating an increase of 36.1% and 34.9%, respectively.

Table 1: GLOBOCAN incidence, mortality and percentage increase of colorectal cancer across continents (2008-2020).

Continents 2008(1) → 2020(2)	CRC Incidence	Calculated % Increase	CRC Mortality	Calculated % Increase
World	1233.7K → 1931.6K	36.1%	608.0K → 935.2K	34.9%
South America*	63.6K → 134.9K	52.9%	37.8K → 69.4K	45.6%
Asia	509.0K → 1009.4K	49.6%	266.8K → 506.4K	47.3%
South-Eastern Asia†	68.9K → 107.0K	55.5%	44.4K → 57.1K	48.4%
Eastern Asia‡	362.1K → 757.8K	52.2%	168.4k → 368.1K	54.2%
South Central Asia§	59.5K → 103.0K	42.2%	42.6K → 59.2K	28.0%
Western Asia‖	18.5K → 41.6K	36.5%	11.4K → 22.1K	22.2%
Africa¶	34.8K → 66.2K	47.3%	26.9K → 42.9K	37.3%
Europe**	431.2K → 519.8K	17.0%	212.0K →244.8K	13.4%
Oceania††	17.8K → 20.7K	13.8%	6.6K → 7.6K	13.2%
Northern America	177.1K → 180.6K	1.9%	58.4K → 64.0K	8.7%

Legend: CRC, colorectal cancer; K, thousands; South America*, Caribbean, Central America, and South America; South-Eastern Asia†, Brunei, Cambodia, East Timor, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam; East Asia‡, China, Hong Kong, Macau, Japan, Mongolia, North Korea, South Korea and Taiwan; South Central Asia§, Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka; West Asia‖, Turkey, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen, Abkhazia, Armenia, Artsakh, Azerbaijan, Georgia, South Ossetia, Iraq, Israel, Jordan, Lebanon, Palestine, Syria, Autonomous Administration of North and East Syria, Iran, Akrotiri and Dhekelia, Cyprus, Northern Cyprus and Egypt; Africa¶, Eastern Africa, Middle Africa, Northern Africa, Southern Africa. Europe**, Central and Eastern Europe, Western Europe, Southern Europe and Northern Europe. Oceania††, Australia, New Zealand, Melanesia, Micronesia and Polynesia.

The ASR for CRC incidence and mortality in all 11 SEA countries was extracted from GLOBOCAN 2020 (1). The HDI for each of these countries in 2021 was obtained from the Human Development Reports by the United Nations Development Programme (3).

This study employed a bivariate correlation analysis to investigate the relationship between CRC ASR for incidence and mortality and HDI factors, including life expectancy at birth, mean years of schooling, and Gross National Income per Capita (2017 Purchasing power parity [PPP$]). A Shapiro-Wilk normality test was conducted (15), revealing that the distributions of CRC ASR incidence and Gross National Income per Capita did not meet the criteria for normality at a 5% significance level. Consequently, due to the non-normal distribution, the study utilized the Spearman correlation test (16) to examine these variables. The statistical significance threshold was set at $P<0.05$, and all statistical analyses were performed using SPSS software (Version 26, SPSS Inc).

Results

Table 2 displays the HDI levels in 2021 for SEA countries, alongside the CRC ASR incidence and mortality rate for 2020. Brunei Darussalam reported the highest CRC ASR incidence among these nations at 34.9 per 100,000 people, while Singapore had the highest mortality rate at 16.2 per 100,000. In contrast, Timor-Leste exhibited the region's lowest CRC ASR incidence (8.9 per 100,000) and mortality rate (5.0 per 100,000 population).

In terms of statistical analysis, there was a significant positive correlation between HDI and its components (life expectancy at birth, mean years of schooling, and gross national income per capita) with ASIR for CRC incidence, yielding Spearman's rho values of 0.834, 0.755, 0.827, and 0.882, respectively. Moreover, the R-square value for this relationship was documented as 0.717 (Figure 1). A similarly notable correlation was identified between HDI and its components with ASR for CRC mortality, with values of 0.720, 0.755, 0.718, and 0.782 at a 5% significant level. The R-square value for this correlation is reported as 0.691 (Figure 2).

Discussion

Our findings highlight a significant positive association between the ASR of CRC incidence and mortality and the HDI and its components, including life expectancy at birth, mean years of schooling, and gross national income per capita. Higher HDI levels and their components correlate with increased CRC incidence and mortality rates.

Lifestyle changes like physical inactivity and a shift to processed and fast-food diets may contribute to the observed ASR incidence and mortality (8). An increase in HDI has a dual impact, potentially detrimental and offering benefits. On the one hand, it could negatively affect public health due to lifestyle alterations; on the other hand, it could provide financial resources to enhance public health services and implement effective cancer control strategies, such as screening programs (8).

Physical inactivity tends to increase with a rise in

Table 2: Spearman correlation analysis of colorectal cancer age-standardized incidence and mortality rates (2020) in South-Eastern Asia with Human Development Index (2021) and its components (life expectancy at birth, mean years of schooling, and Gross National Income per Capita (2017 PPP$).

South-Eastern Asia countries	Colorectal cancer ASR per 100,000 population (1)		HDI category (3)	HDI (3)	P-value (Incidence, mortality)	Life expectancy at birth (3)	P-value (Incidence, mortality)	Mean years of schooling (3)	P-value (Incidence, mortality)	Gross National Income Per Capita (2017 PPP$) (3)	P-value (Incidence, mortality)
	Incidence	Mortality									
Singapore	33	16.2	Very high	0.939	0.001, 0.013	82.8	0.007, 0.007	11.9	0.002, 0.013	90918.6	<0.001, 0.004
Brunei Darussalam	34.9	14.6	Very high	0.829		74.6		9.2		64489.5	
Malaysia	19.6	10.2	Very high	0.803		74.9		10.6		26657.9	
Thailand	16.9	8.4	Very high	0.8		78.7		8.7		17030.2	
Indonesia	12.4	6.7	High	0.705		67.6		8.6		11466.1	
Vietnam	14.1	7	High	0.703		73.6		8.4		7867.4	
Philippines	18.8	10.1	Medium	0.699		69.3		9.0		8920.4	
Lao PDR	15	8.9	Medium	0.607		68.1		5.4		7699.6	
Timor-Leste	8.9	5	Medium	0.607		67.7		5.4		4460.9	
Cambodia	12.3	7.4	Medium	0.593		69.6		5.1		4078.7	
Myanmar	9.7	5.8	Medium	0.585		65.7		6.4		3850.5	

Legend: HDI, Human Development Index 2021 (https://hdr.undp.org/data-center/country-insights#/ranks); ASR, age-standardized rate (https://gco.iarc.fr/today/home); Lao PDR, Lao People's Democratic Republic.

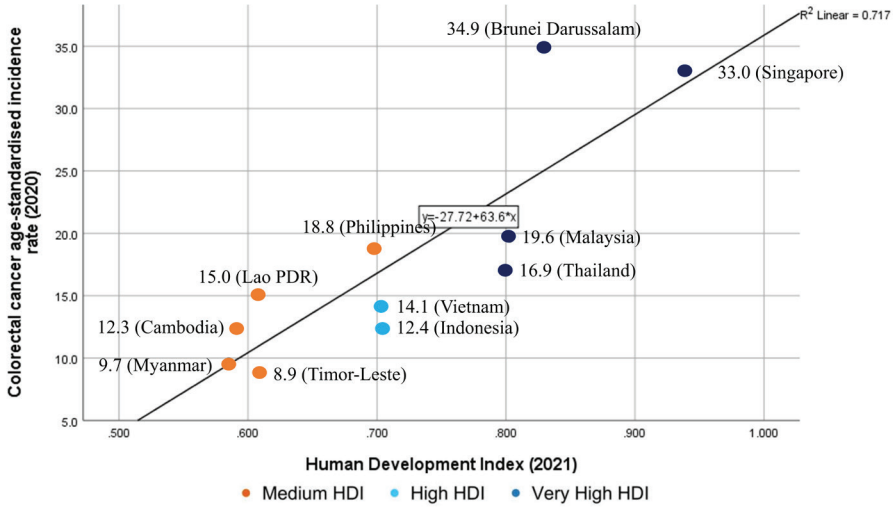

Figure 1: Positive correlation between human development index (2021) and age-standardized incidence (2020) of colorectal cancer (CRC) in South-East Asia, adapted from (8). Legend: HDI, Human Development Index 2021 (https://hdr.undp.org/data-center/country-insights#/ranks); ASR, age-standardized rate (https://gco.iarc.fr/today/home); Lao PDR, Lao People's Democratic Republic.

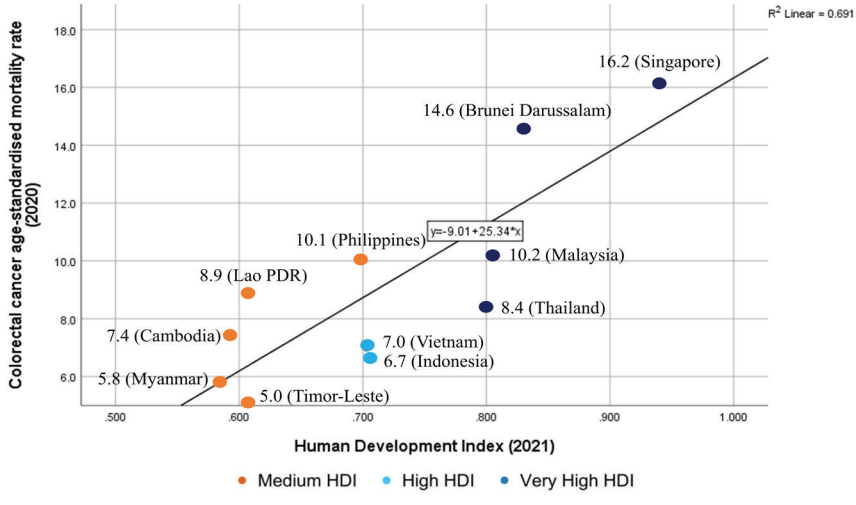

Figure 2: Positive correlation between human development index (2021) and age-standardized mortality (2020) of colorectal cancer (CRC) in South-East Asia, adapted from (8). Legend: HDI, Human Development Index 2021 (https://hdr.undp.org/data-center/country-insights#/ranks); ASR, age-standardized rate (https://gco.iarc.fr/today/home); Lao PDR, Lao People's Democratic Republic.

HDI (17). As a country undergoes economic growth and an elevation in HDI, the occupational structure typically shifts from labor-intensive (agriculture) to sedentary service-oriented professions (white and blue-collar occupations) (18, 19). In higher HDI countries, motorized transportation and household appliances are prevalent, promoting daily physical inactivity and a sedentary lifestyle (17, 19-22). In contrast, manual labor, transportation, and household chores are the norm in low HDI agrarian countries like Cambodia, Lao PDR, Myanmar, and Timor-Leste (23-25). For instance, Lao PDR has 62.4% of its employment in agriculture, Myanmar 48.9%, Timor-Leste 44.5%, Vietnam 34.4%, Cambodia 32.3%, Thailand 31.6%, Indonesia 28.6%, and the Philippines 23.4% (3). In contrast, Singapore, Brunei Darussalam, and Malaysia have significantly lower percentages of employment in agriculture, standing at 0.7%, 1.4%, and 10.4%, respectively (3).

Highly processed meat fast foods are popular in countries with very high HDI scores (21, 26, 27), primarily found in urban areas of high HDI countries like Thailand, Indonesia, and Vietnam (28-30). Conversely, in medium HDI countries such as Cambodia, Lao PDR, Myanmar, Timor-Leste, and Vietnam, processed meat fast food is considered a luxury due to low affordability, and traditional foods like plant-based items, whole grains, beans, and fish constitute the main diet (31, 32).

In contrast, economic growth is pivotal in enhancing healthcare services, advancing medical technology, and making them more widely available and accessible (8). Countries with very high HDI scores possess the financial resources to support screening programs capable of detecting precancerous lesions, such as polyps, adenomas, and irritable bowel diseases, as well as early stages of colorectal cancer (stage I and II). Detecting and intervening with precancerous lesions can prevent their progression to full-blown CRC, and early-stage CRC can be treated more successfully (8).

As an illustration, Singapore has instituted

screening programs such as Screen for Life (2011) (33, 34) and the "Singapore Cancer Society (SCS) CRC Awareness Campaign (2003)" (35, 36). Research conducted by Arnold et al. (2017) has demonstrated that Singapore displays an increasing trend in CRC incidence rates but a declining trend in mortality rates (8). This observation could be attributed to the annual screening of >50,000 Singaporeans (37).

Funding plays a crucial role in determining the availability and accessibility of screening programs, especially in medium HDI countries like Cambodia, Lao PDR, Myanmar, and Timor-Leste (38-44). A screening program requires sufficient funding to sustain essential resources such as workforce, facilities, education materials, and other procedure-related resources. Consequently, successful screening programs are typically more achievable in countries with high HDI levels. Furthermore, in addition to the absence of CRC screening, medium HDI countries also face challenges in cancer treatment due to inadequate government funding, insufficient medical facilities, and a shortage of healthcare professionals (38-44). Additionally, geographical barriers that hinder healthcare access can incur high costs (40-44).

Limitation

The GLOBOCAN database is limited by data availability for estimation within each country (14). Consequently, there is a critical need for current, population-based cancer registries from SEA countries. These registries are essential to offer a more precise depiction of CRC management and early detection plans. Additionally, limitations include the scarcity of recent published literature on the progress of implemented programs, future direction, and the 5-year survival rate as an indicator of treatment management in each SEA country.

Conclusion

The analyzed statistics reveal a positive correlation between HDI and ASR of CRC incidence and mortality. The high HDI of a country acts as a double-edged sword, capable of boosting the economy but potentially detrimental to the overall population's health. Singapore, classified as a very high HDI country, has demonstrated that a screening program can effectively reduce CRC ASR incidence and mortality. Despite its efficacy in alleviating the CRC burden, unfortunately, CRC screening is not feasible for many SEA countries due to resource constraints. Medium HDI countries maintain low ASR incidence and mortality despite lacking a well-developed economy.

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Authors' Contribution

KYL and MTC designed and wrote the manuscript. AFY, SJ, ZIMZ, MFJ, WWDL, SCP, and JKLT conducting and reviewing the manuscript. All authors have read and approved the final version and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of interest: None declared.

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