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ORIGINAL ARTICLE

Epidemiology and Inequality in the Incidence and Mortality of Nasopharynx Cancer in Asia

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Abstract
Objectives: One of the most common head and neck cancers is nasopharynx cancer. Knowledge about the incidence and mortality of this disease and its distribution in terms of geographical areas is necessary for further study and better planning. Therefore, this study was conducted with the aim of determining the incidence and mortality rates of nasopharynx cancer and its relationship with the Human Development Index (HDI) in Asia in 2012.
Methods: The aim of this ecologic study was to assess the correlation between age-specific incidence rate (ASIR) and age-specific mortality rate (ASMR) with HDI and its components, which include the following: life expectancy at birth, mean years of schooling, and gross national income per capita. Data about SIR and SMR for every Asian country for 2012 were obtained from the global cancer project. We used the correlation bivariate method for the assessment. Statistical significance was assumed if $p < 0.05$. All reported p values are two-sided. Statistical analyses were performed using SPSS (Version 15.0, SPSS Inc.).
Results: A total of 68,272 cases (males, 71.02%; females, 28.97%; sex ratio, 2.45) and 40,530 mortalities (males, 71.63%; females, 28.36%; sex ratio, 2.52) were recorded in Asian countries in 2012. The five countries with the highest ASIR of nasopharynx cancer were Malaysia, Singapore, Indonesia, Vietnam, and Brunei, and the five countries with the highest ASMR were Indonesia, Vietnam,

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Singapore, Malaysia, and Brunei. The correlation between HDI and ASIR was 0.097 ($p = 0.520$) [0.105 in men ($p = 0.488$) and 0.119 in women ($p = 0.901$)]. The correlation between HDI and ASMR was −0.102 ($p = 0.502$) [−0.072 in men ($p = 0.633$) and −0.224 in women ($p = 0.134$)].
Conclusion: Nasopharynx cancer is native to Southeast Asia. The highest incidence and mortality rates are found in Malaysia, Singapore, Indonesia, Vietnam, and Brunei. No significant relation was found between the standardized incidence and mortality rates of nasopharynx cancer and the HDI components. Further studies are recommended in Southeast Asian countries in order to find the etiology of cancer, as well as its diagnosis and treatment.

1. Introduction

Cancer is the leading cause of mortality, with a high financial burden, and one of the major public health concerns at the international level [1,2]. Head and neck malignancies are among the relatively common cancers in humans that affect several anatomic sites of the head and the neck [3]. One of the most common head and neck cancers is nasopharynx cancer [4,5], which has a very unique distribution pattern. Worldwide, about 86,500 cases of nasopharynx cancer and 50,000 deaths arising from it [6] are reported annually. According to the International Agency for Research on Cancer report in 2008, more than 80% of patients with nasopharynx cancer are in Asia, and only 5% of these cancers are reported in Europe. Specifically, 71% of new nasopharynx cancer cases are recorded in East and Southeast Asia, and 29% are diagnosed in South and Central Asia and North and East Africa [7].

Nasopharynx cancer is native to Southeast Asia, where the prevalence rate is 15−50 cases per 100,000 people [8]. For the United States and the rest of the world, the incidence of less than 1 case per 100,000 people per year is reported [9]. In addition to geographic diversity, it seems that some ethnic groups are prone to nasopharynx cancer. These groups include the Bidayuh in Borneo, the Nagas in northern India, and the Inuits in the North pole, which have an age-standardized incidence rate of more than 16 per 100,000 people among men each year [10].

In terms of heterogeneous epidemiological patterns, in addition to nonenvironmental risk factors such as sex, ethnicity, and family history [11], other factors—such as smoking [12], salted fish consumption, especially in childhood [12−18], nitrosamine in some food items traditionally used in southern China [19,20], and use of traditional herbal medicines in the Asian population [12,21−23], as well as nonfood risk factors such as occupational exposures to formaldehyde, wood dust, smoke, and chemicals [7,12,22,24]—may be involved in the pathogenesis of nasopharynx carcinoma [25]. Nasopharynx cancer, in comparison to other head and neck tumors, has different epidemiological, staging, and treatment characteristics. Most patients are diagnosed when they are in advanced stages [26,27].

The Human Development Index (HDI) is a useful tool to compare the incidence and mortality rates of cancer at the global level [28−30] and is one of the indicators to check the status of illnesses and deaths between countries. In fact, this index has been observed to be related with the incidence and mortality rates of many diseases; it is considered a good index to obtain information regarding the status of a specific disease in different countries. The HDI is composed of three basic dimensions: life expectancy at birth, adult literacy rate, and gross domestic product (GDP) per capita. The relationship between HDI and some cancers is studied, and investigating this relationship can lead to a more accurate understanding of cancer and its risk factors distribution [31], and it is also suggested to be used for other cancers. Although nutritional and communicable diseases are common causes of death in countries with a low HDI, it is anticipated that by 2030, one common cause of death in these countries will be noncommunicable diseases such as cancer [32]. Because awareness about nasopharynx cancer incidence and mortality can be useful for health programs and research activities, and considering the possible role of the HDI, this study was conducted with the aim of evaluating the incidence and mortality of nasopharynx carcinoma and its relationship with the development index and its components in Asia in 2012.

2. Materials and methods

We conducted an ecologic study in Asia to assess the correlation between age-specific incidence and mortality rate (ASR) with HDI and its components, which include the following: life expectancy at birth, mean years of schooling, and gross national income (GNI) per capita. The ASR data of all Asian countries for the year 2012 were obtained from the global cancer project (available at http://globocan.iarc.fr/Default.aspx) [33], and the HDI data was based on the Human Development Report 2013 [34], which contains information about HDI and its components for every country in the world in 2012.

2.1. Method of estimating ASRs in global cancer project by the International Agency for Research on Cancer

2.1.1. Age-specific incidence rate estimate

The methods of estimation are country-specific, and the quality of the estimation depends on the quality and amount of information available for each country. In theory, there are as many methods as countries, and because of the variety and the complexity of these methods, an overall quality score for the incidence and mortality estimates combined is almost impossible to establish. However, an alphanumeric scoring system that independently describes the availability of incidence and mortality data has been established at the country level. The combined score is presented together with the estimates for each country with the aim of providing a broad indication of the robustness of the estimation.

The methods used to estimate the sex- and age-specific incidence rates of cancer for a specific country fall into one of the following broad categories (by order of priority):

1. Rates projected to 2012 (38 countries).
2. Most recent rates applied to 2012 population (20 countries).
3. Estimated from national mortality by modeling, using incidence mortality ratios derived from recorded data in country-specific cancer registries (13 countries).
4. Estimated from national mortality estimates by modeling, using incidence mortality ratios derived from recorded data in local cancer registries in neighboring countries (9 European countries).
5. Estimated from national mortality estimates using modeled survival (32 countries)
6. Estimated as the weighted average of the local rates (16 countries)
7. One cancer registry covering part of a country is used as representative of the country profile (11 countries).
8. Age/sex-specific rates for “all cancers” were partitioned using data on relative frequency of different cancers (by age and sex) (12 countries).
9. The rates are those of neighboring countries or registries in the same area (33 countries) [33,35].

2.1.2. Age-specific mortality rate estimate

Depending on the degree of detail and accuracy of the national mortality data, six methods were used in the following order of priority:

1. Rates projected to 2012 (69 countries).
2. Most recent rates applied to 2012 population (26 countries).
3. Estimated as the weighted average of regional rates (1 country).
4. Estimated from national incidence estimates by modeling, using country-specific survival (2 countries).
5. Estimated from national incidence estimates using modeled survival (83 countries).
6. The rates are those of neighboring countries or registries in the same area (3 countries) [33,35].

2.2. Human Development Index

HDI is a composite measure of indicators along three dimensions: life expectancy, educational attainment, and command over the resources needed for a decent living. All groups and regions have seen notable improvement in all HDI components, with faster progress in low and medium HDI countries. On this basis, the world is becoming less unequal. Nevertheless, national averages hide large variations in human experience. Wide disparities remain within countries of both the North and the South, and income inequality within and between many countries has been rising [34].

2.3. Statistical analysis

In this study, we used the correlation bivariate method to assess the correlation between ASR and HDI and its components (life expectancy at birth, mean years of schooling, and GNI per capita). Statistical significance was assumed if $p < 0.05$. All reported p values are two-sided. Statistical analyses were performed using SPSS (Version 15.0: SPSS Inc., Chicago).

3. Results

In general, a total of 68,272 nasopharynx cancer cases were recorded in Asian countries in 2012, of which 48,492 cases (2/71%) were diagnosed in men and 19,780 cases (97/28%) were diagnosed in women. These figures indicate that the sex (male/female) ratio is 45:2. Five countries with the highest number of new cases of nasopharynx cancer are as follows: (1) China with 33,198 cases; (2) Indonesia, 13,084 cases; (3) Vietnam, 4,931 cases; (4) India, 3,947 cases; (5) Malaysia, 2,030 cases; these five countries alone accounted for a total of 57,190 cases (76/83%) of all cases in Asia. In Asia, the five countries with the highest standardized incidence of nasopharynx cancer are as follows: (1) Malaysia, with a standardized rate of 7.2 per 100,000 people; (2) Singapore, 6.4 per 100,000 people; (3) Indonesia, 5.6 per 100,000 people; (4) Vietnam, 5.4 per 100,000 people; (5) Brunei, 5 per 100,000 people. Conversely, the five countries with the lowest standardized incidence of nasopharynx cancer are as follows: (1) Maldives, with a rate of 0 per 100,000 people; (2) Tajikistan, 0.1 per 100,000 people; (3) Japan, 0.2 per 100,000 people; (4) Bahrain, 0.2 per 100,000 people; (5) Uzbekistan, 0.3 per 100,000 people. The number and rate of standardized and crude incidence of this cancer in Asian countries according to sex are shown in Table 1. Countries are arranged based on standardized rates, from highest to lowest, in Table 1, so that countries with the highest and

Table 1. Number and amount of standardized and crude incidence of nasopharynx cancer in Asian countries in 2012 (sorted by age-standardized incidence rate, from the highest to the lowest value).

Nasopharynx—estimated incidence, all ages: both sexes				Nasopharynx—estimated incidence, all ages: male				Nasopharynx—estimated incidence, all ages: female			
Population	No.	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	No.	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	No.	Crude rate	ASR (W)
Malaysia	2,030	6.9	7.2	Malaysia	1,487	10.0	10.6	Malaysia	543	3.8	3.9
Singapore	473	9.0	6.4	Singapore	353	13.3	9.7	Vietnam	1,630	3.6	3.4
Indonesia	13,084	5.3	5.6	Indonesia	9,355	7.7	8.3	Singapore	120	4.6	3.2
Vietnam	4,931	5.5	5.4	Vietnam	3,301	7.4	7.7	Indonesia	3,729	3.0	3.0
Brunei	15	3.6	5.0	Brunei	12	5.8	7.6	Bhutan	6	1.7	1.9
Myanmar	1,148	2.4	2.4	Myanmar	789	3.3	3.5	Brunei	3	1.5	1.5
Philippines	1,738	1.8	2.2	Cambodia	159	2.2	3.3	Myanmar	359	1.5	1.5
Bhutan	14	1.9	2.2	Philippines	1,199	2.5	3.2	Philippines	539	1.1	1.3
Thailand	1,867	2.7	2.1	Thailand	1,328	3.9	3.2	Thailand	539	1.5	1.2
China	33,198	2.4	1.9	China	23,581	3.3	2.7	China	9,617	1.5	1.1
Cambodia	220	1.5	1.9	Bhutan	8	2.0	2.5	Yemen	96	0.8	1.1
Lao PDR	81	1.3	1.7	Lao PDR	55	1.7	2.5	Lao PDR	26	0.8	1.0
Yemen	217	0.8	1.5	Timor-Leste	7	1.2	1.9	Cambodia	61	0.8	0.9
Saudi Arabia	295	1.0	1.3	Yemen	121	0.9	1.8	Saudi Arabia	83	0.6	0.9
Korea, Democratic Republic of	383	1.6	1.3	Korea, Democratic Republic of	244	2.0	1.8	Korea, Democratic Republic of	139	1.1	0.8
Timor-Leste	9	0.8	1.2	Saudi Arabia	212	1.3	1.7	Jordan	19	0.6	0.8
Jordan	51	0.8	1.1	Georgia	46	2.3	1.7	Kuwait	4	0.3	0.6
Turkey	779	1.0	1.0	Nepal	178	1.2	1.6	Syrian Arab Republic	51	0.5	0.6
Nepal	233	0.8	1.0	Turkey	588	1.6	1.6	Turkey	191	0.5	0.5
Georgia	57	1.3	0.9	Jordan	32	1.0	1.3	Iraq	56	0.3	0.5
Syrian Arab Republic	138	0.7	0.8	Armenia	19	1.3	1.2	Timor-Leste	2	0.3	0.5
United Arab Emirates	36	0.4	0.8	Kyrgyzstan	25	0.9	1.1	Sri Lanka	50	0.5	0.4
Iraq	139	0.4	0.7	Syrian Arab Republic	87	0.8	1.1	Nepal	55	0.4	0.4
Qatar	10	0.5	0.7	Lebanon	23	1.1	1.1	Iran, Islamic Republic of	140	0.4	0.4
Lebanon	31	0.7	0.7	Korea, Republic of	320	1.3	1.0	United Arab Emirates	10	0.4	0.4
Korea, Republic of	442	0.9	0.7	Israel	38	1.0	0.9	Korea, Republic of	122	0.5	0.4
Iran, Islamic Republic of	418	0.6	0.6	Iraq	83	0.5	0.9	Lebanon	8	0.4	0.3
Israel	53	0.7	0.6	United Arab Emirates	26	0.5	0.9	Pakistan	228	0.3	0.3

(*Continued on next page*)

Table 1 (*Continued*)

Nasopharynx—estimated incidence, all ages: both sexes				Nasopharynx—estimated incidence, all ages: male				Nasopharynx—estimated incidence, all ages: female			
Population	No.	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	No.	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	No.	Crude rate	ASR (W)
Kyrgyzstan	28	0.5	0.6	Qatar	9	0.6	0.8	Israel	15	0.4	0.3
Armenia	22	0.7	0.6	Iran, Islamic Republic of	278	0.7	0.8	Georgia	11	0.5	0.3
Pakistan	795	0.4	0.6	State of Palestine	10	0.5	0.8	Mongolia	3	0.2	0.3
Kuwait	11	0.4	0.5	Pakistan	567	0.6	0.8	Kazakhstan	25	0.3	0.3
State of Palestine	14	0.3	0.5	Azerbaijan	34	0.7	0.7	Qatar	1	0.2	0.3
Kazakhstan	75	0.5	0.4	Kazakhstan	50	0.6	0.7	Uzbekistan	26	0.2	0.2
Azerbaijan	42	0.4	0.4	India	2,956	0.5	0.5	Oman	2	0.2	0.2
Sri Lanka	95	0.4	0.4	Bangladesh	322	0.4	0.5	Bahrain	1	0.2	0.2
Oman	9	0.3	0.4	Oman	7	0.4	0.5	Bangladesh	112	0.1	0.2
Mongolia	8	0.3	0.4	Afghanistan	51	0.3	0.5	India	991	0.2	0.2
India	3,947	0.3	0.4	Turkmenistan	9	0.4	0.4	State of Palestine	4	0.2	0.2
Bangladesh	434	0.3	0.3	Mongolia	5	0.4	0.4	Azerbaijan	8	0.2	0.2
Afghanistan	66	0.2	0.3	Japan	421	0.7	0.4	Afghanistan	15	0.1	0.2
Turkmenistan	11	0.2	0.3	Sri Lanka	45	0.4	0.4	Armenia	3	0.2	0.1
Uzbekistan	64	0.2	0.3	Kuwait	7	0.4	0.4	Kyrgyzstan	3	0.1	0.1
Bahrain	4	0.3	0.2	Uzbekistan	38	0.3	0.3	Turkmenistan	2	0.1	0.1
Japan	553	0.4	0.2	Bahrain	3	0.4	0.2	Japan	132	0.2	0.1
Tajikistan	4	0.1	0.1	Tajikistan	4	0.1	0.1	Maldives	0	0.0	0.0
Maldives	0	0.0	0.0	Maldives	0	0.0	0.0	Tajikistan	0	0.0	0.0

ASR = age-specific incidence and mortality rate.

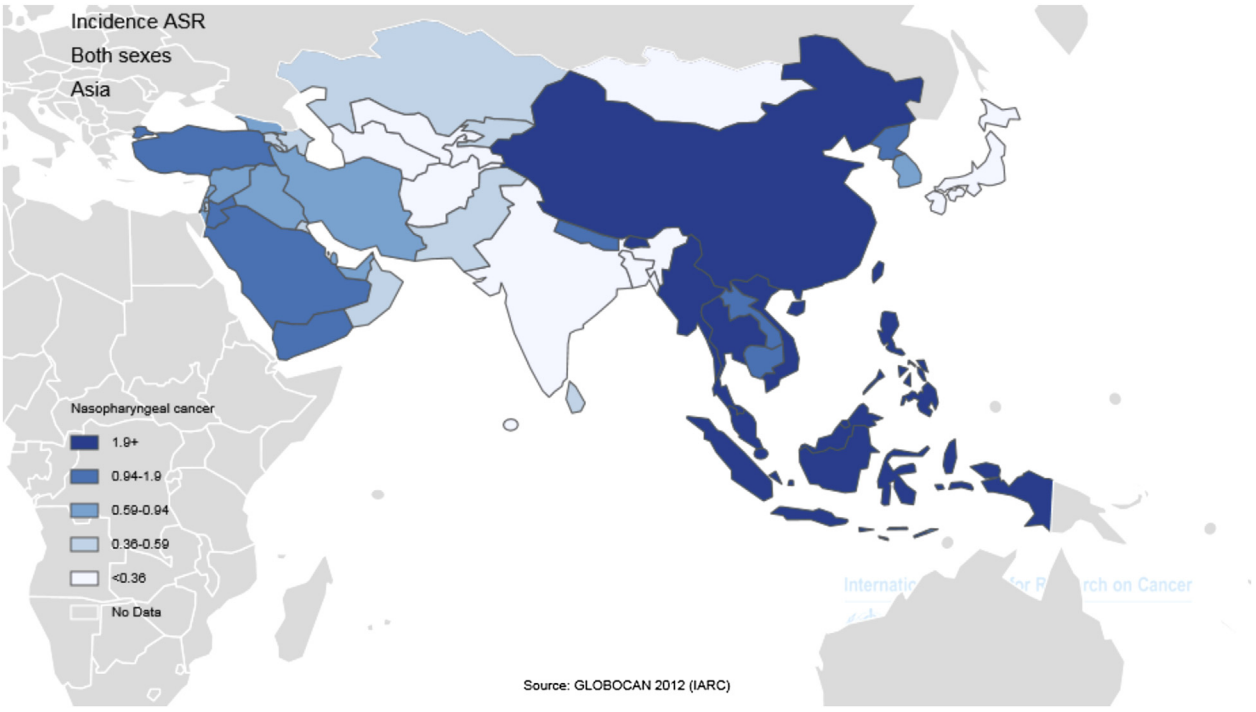

Figure 1. Distribution standardized incidence rate of nasopharynx cancer in Asia in 2012 (extracted from GLOBALCAN). ASR = age-specific incidence and mortality rate.

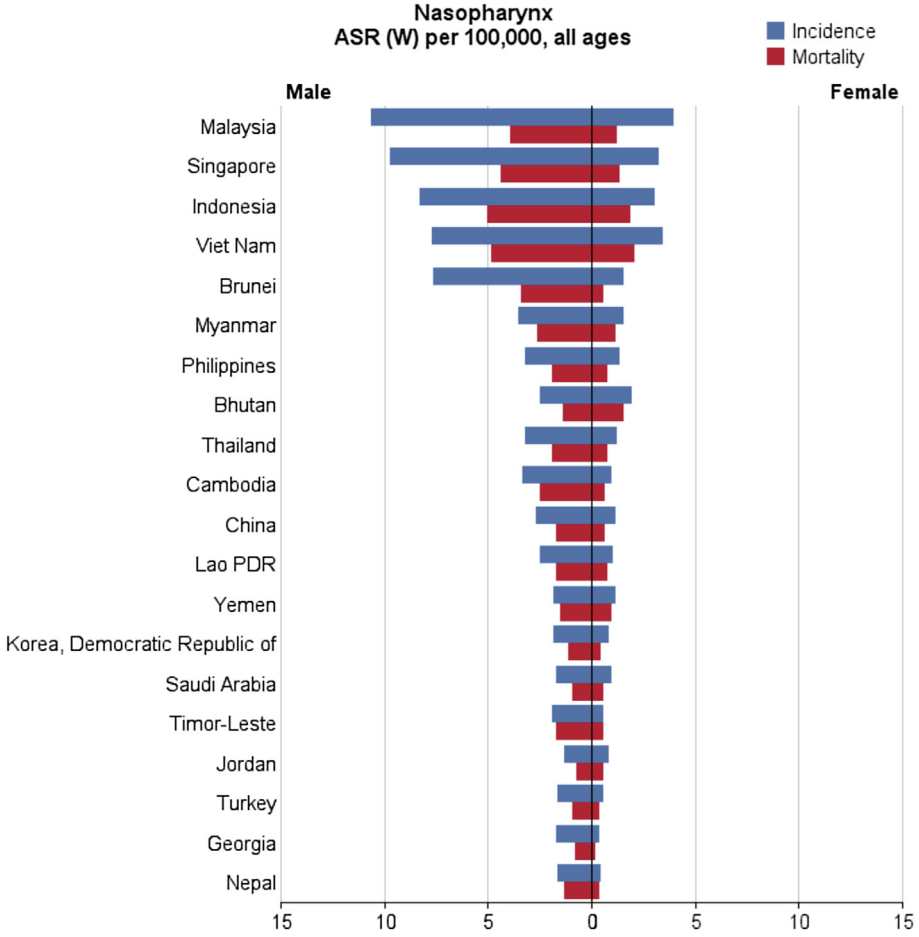

Figure 2. Standardized incidence and mortality rate of nasopharynx cancer in Asia in 2012 (extracted from GLOBALCAN). HDI = Human Development Index; LAO PDR = Laos People's Democratic Republic.

Table 2. Number and amount of standardized and crude mortality of nasopharynx cancer in Asian countries in 2012 (sorted by age-standardized incidence rate, from the highest to the lowest value).

Nasopharynx—estimated mortality, all ages: both sexes				Nasopharynx—estimated mortality, all ages: female				Nasopharynx—estimated mortality, all ages: male			
Population	No.	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	Number	Crude rate	Age-world-standardized incidence rate (ASR(W))	Population	No.	Crude rate	ASR (W)
Indonesia	7,391	3.0	3.3	Indonesia	5,283	4.3	5.0	Vietnam	954	2.1	2.0
Vietnam	2,885	3.2	3.3	Vietnam	1,931	4.4	4.8	Indonesia	2,108	1.7	1.8
Singapore	218	4.1	2.8	Singapore	168	6.3	4.4	Bhutan	4	1.1	1.5
Malaysia	698	2.4	2.5	Malaysia	533	3.6	3.9	Singapore	50	1.9	1.3
Brunei	6	1.5	2.1	Brunei	5	2.4	3.4	Malaysia	165	1.1	1.2
Myanmar	785	1.6	1.8	Myanmar	538	2.2	2.6	Myanmar	247	1.0	1.1
Bhutan	8	1.1	1.4	Cambodia	105	1.5	2.5	Yemen	65	0.5	0.9
Cambodia	144	1.0	1.4	Thailand	793	2.3	1.9	Philippines	272	0.6	0.7
Philippines	873	0.9	1.3	Philippines	601	1.2	1.9	Lao PDR	16	0.5	0.7
Thailand	1,114	1.6	1.3	Lao PDR	35	1.1	1.7	Thailand	321	0.9	0.7
Lao PDR	51	0.8	1.2	Timor-Leste	6	1.0	1.7	China	5,686	0.9	0.6
China	20,404	1.5	1.2	China	14,718	2.1	1.7	Cambodia	39	0.5	0.6
Yemen	152	0.6	1.2	Yemen	87	0.7	1.5	Jordan	9	0.3	0.5
Timor-Leste	8	0.7	1.1	Bhutan	4	1.0	1.4	Timor-Leste	2	0.3	0.5
Nepal	164	0.5	0.8	Nepal	125	0.8	1.3	Saudi Arabia	38	0.3	0.5
Saudi Arabia	136	0.5	0.7	Korea, Democratic Republic of	148	1.2	1.1	Brunei	1	0.5	0.5
Korea, Democratic Republic of	215	0.9	0.7	Saudi Arabia	98	0.6	0.9	Syrian Arab Republic	29	0.3	0.4
Jordan	22	0.3	0.6	Turkey	300	0.8	0.9	Korea, Democratic Republic of	67	0.5	0.4
Turkey	397	0.5	0.5	Georgia	22	1.1	0.8	Nepal	39	0.2	0.3
Syrian Arab Republic	77	0.4	0.5	Kyrgyzstan	14	0.5	0.8	Iraq	32	0.2	0.3
Iraq	82	0.2	0.5	Syrian Arab Republic	48	0.4	0.7	Turkey	97	0.3	0.3
Qatar	4	0.2	0.4	Jordan	13	0.4	0.7	Pakistan	150	0.2	0.2
Georgia	27	0.6	0.4	Iraq	50	0.3	0.6	Iran, Islamic Republic of	72	0.2	0.2
Pakistan	532	0.3	0.4	Armenia	10	0.7	0.6	Sri Lanka	26	0.2	0.2
Kyrgyzstan	16	0.3	0.4	Qatar	4	0.3	0.6	Afghanistan	12	0.1	0.2
United Arab Emirates	13	0.2	0.4	Pakistan	382	0.4	0.6	United Arab Emirates	3	0.1	0.2
Iran, Islamic Republic of	214	0.3	0.3	Lebanon	12	0.6	0.5	Oman	1	0.1	0.1
Afghanistan	54	0.2	0.3	State of Palestine	6	0.3	0.5	Uzbekistan	14	0.1	0.1

State of Palestine	8	0.2	0.3	Afghanistan	42	0.2	0.5	Bangladesh	74	0.1	0.1
Lebanon	15	0.3	0.3	Iran, Islamic Republic of	142	0.4	0.4	Kazakhstan	12	0.1	0.1
Armenia	12	0.4	0.3	Korea, Republic of	145	0.6	0.4	India	742	0.1	0.1
India	2,836	0.2	0.3	United Arab Emirates	10	0.2	0.4	Georgia	5	0.2	0.1
Bangladesh	288	0.2	0.3	India	2,094	0.3	0.4	Lebanon	3	0.1	0.1
Korea, Republic of	185	0.4	0.3	Bangladesh	214	0.3	0.4	Korea, Republic of	40	0.2	0.1
Kazakhstan	36	0.2	0.2	Azerbaijan	18	0.4	0.4	Azerbaijan	4	0.1	0.1
Azerbaijan	22	0.2	0.2	Kazakhstan	24	0.3	0.4	State of Palestine	2	0.1	0.1
Oman	4	0.1	0.2	Turkmenistan	5	0.2	0.3	Kyrgyzstan	2	0.1	0.1
Sri Lanka	49	0.2	0.2	Mongolia	4	0.3	0.3	Armenia	2	0.1	0.1
Turkmenistan	6	0.1	0.2	Oman	3	0.2	0.3	Turkmenistan	1	0.0	0.1
Mongolia	5	0.2	0.2	Israel	9	0.2	0.2	Mongolia	1	0.1	0.1
Uzbekistan	35	0.1	0.2	Uzbekistan	21	0.2	0.2	Japan	90	0.1	0.1
Japan	324	0.3	0.1	Japan	234	0.4	0.2	Israel	1	0.0	0.0
Israel	10	0.1	0.1	Sri Lanka	23	0.2	0.2	Tajikistan	0	0.0	0.0
Kuwait	2	0.1	0.1	Kuwait	2	0.1	0.1	Maldives	0	0.0	0.0
Bahrain	1	0.1	0.1	Bahrain	1	0.1	0.1	Bahrain	0	0.0	0.0
Tajikistan	2	0.0	0.0	Tajikistan	2	0.1	0.1	Qatar	0	0.0	0.0
Maldives	0	0.0	0.0	Maldives	0	0.0	0.0	Kuwait	0	0.0	0.0

ASR = age-specific incidence and mortality rate.

lowest standardized incidence rates in each sex are shown (Table 1, Figures 1 and 2).

Of the 40,530 people who died of nasopharynx cancer in Asia in 2012, 29,032 (63/71%) were men and 11,498 (36/28%) were women, which translates to a male/female mortality ratio of 52:2. The highest number of deaths occurred in China with 20,404 cases, followed by Indonesia with 7,391 cases, Vietnam with 2,885 cases, India with 2,836 cases, and Thailand with 1,114 cases. This brings the total of deaths to 34,630 (44/85%) in just these five countries.

The five countries with the highest standardized mortality rate of nasopharynx cancer are as follows: (1) Indonesia, with a standardized rate of 3.3 per 100,000 people; (2) Vietnam, 3.3 per 1000,000 people; (3) Singapore, 2.8 per 100,000 people; (4) Malaysia, 2.5 per 100,000 people; (5) Brunei, 2.1 per 100,000 people. Conversely, the five countries with the lowest standardized mortality rate of nasopharynx cancer are as follows: Maldives and Tajikistan, with a rate of 0 per 100,000 people; followed by Bahrain, Kuwait, and Israel with a rate of 0.1 per 100,000 people. The number and rate of standardized and crude mortality of this cancer in Asian countries by sex are shown in Table 2. Countries are arranged based on standardized rates, from highest to lowest, in Table 2, so that countries with the highest and lowest standardized rates in each sex are shown (Table 2 and Figures 2 and 3).

In Table 3, values of HDI and its components for all Asian countries, arranged according to HDI, are shown. Thus, Asian countries were classified in terms of HDI as follows: three countries in very high category, four countries in top category, 35 countries in the medium category, three countries in low category, and a country in uncertain category.

3.1. Checking the relationship between standardized incidence rate and HDI

A correlation of 0.097 was obtained between the standardized incidence rate of nasopharynx cancer and HDI; however, this relation was not statistically significant ($p = 0.520$). As for the correlation between components of the HDI and the standardized rate, we obtained the following results: a correlation of 0.174 between the standardized incidence rate and life expectancy at birth ($p = 0.247$), a negative correlation of 0.057 with the average years of schooling ($p = 0.705$), and a correlation of 0.134 with the level of income per person of the population ($p = 0.375$; Figure 4).

In men, a correlation of 0.105 was observed between the standardized incidence rate of nasopharynx cancer and the HDI; however, this relation was not statistically significant ($p = 0.488$).

A correlation was also seen between the components of the HDI and the standardized incidence. Specifically, we obtained a correlation of 0.174 between the standardized incidence rate and life expectancy at birth

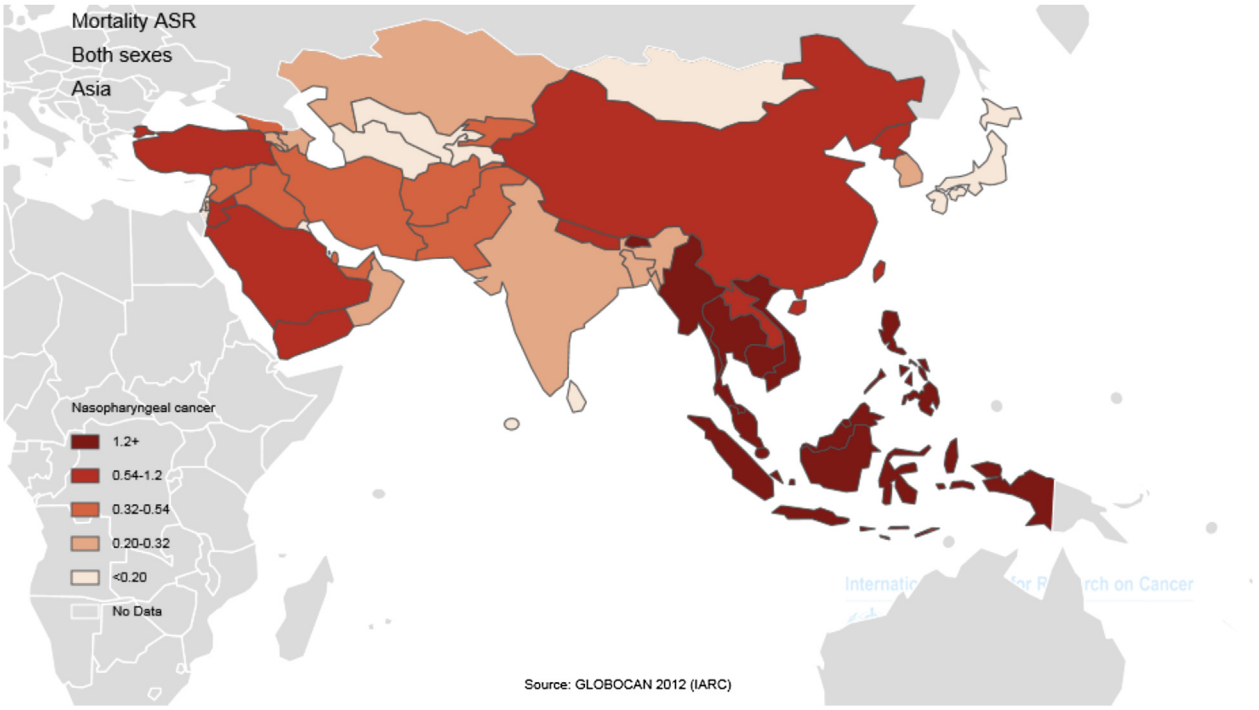

Figure 3. Distribution standardized mortality rate of nasopharynx cancer in Asia in 2012 (extracted from GLOBALCAN). HDI = Human Development Index.

($p = 0.253$), a negative correlation of 0.031 with the average years of schooling ($p = 0.836$), and a correlation of 0.125 with the level of income per person of the population ($p = 0.407$).

In women, a correlation of 0.019 was found between the standardized incidence rate of nasopharynx cancer and the HDI, but this relation was not statistically significant ($p = 0.901$). A correlation between components of the HDI and the standardized incidence rate was also found. Specifically, we noted a correlation of 0.134 between the standardized incidence rate and life expectancy at birth ($p = 0.376$), a negative correlation of 0.142 with the average years of schooling ($p = 0.346$), and a correlation of 0.059 with the level of income per person of the population ($p = 0.696$).

3.2. Checking the relationship between standardized mortality rate and HDI

A negative correlation of 0.102 was found between the standardized mortality rate of nasopharynx cancer and HDI; however, this relation was not statistically significant ($p = 0.502$). A correlation was also found between components of the HDI and the standardized rate. Specifically, we noted a correlation of 0.034 between the standardized incidence rate and life expectancy at birth ($p = 0.824$), a negative correlation of 0.238 with the average years of schooling ($p = 0.112$), and a correlation of 0.001 with the level of income per person of the population ($p = 0.994$; Figure 5).

In men, we observed a correlation of 0.072 between the standardized mortality rate of nasopharynx cancer and the HDI, but this relation was not statistically significant ($p = 0.633$). Furthermore, a correlation between components of the HDI and standardized mortality rate was also found. Specifically, we noted a correlation of 0.040 between the standardized incidence rate and life expectancy at birth ($p = 0.792$), a negative correlation of 0.188 with the average years of schooling ($p = 0.211$), and a correlation of 0.014 with the level of income per person of the population ($p = 0.924$).

In women, a negative correlation of 0.224 was found between the standardized mortality rate of nasopharynx cancer and the HDI, but this relation was not statistically significant ($p = 0.134$). Also, a negative correlation was noted between components of the HDI and the standardized rate. Specifically, we observed a negative correlation of 0.044 between the standardized incidence rate and life expectancy at birth ($p = 0.773$), a negative correlation of 0.345 with the average years of schooling ($p = 0.019$), and a negative correlation of 0.014 with the level of income per person of the population ($p = 0.350$).

4. Discussion

Overall, 68,272 new cases and 40,530 deaths attributed to nasopharynx cancer were recorded in Asian countries in 2012; the sex (male/female) ratio of developing the disease is 2.45, and the sex ratio of nasopharynx cancer mortality is 2.52. The prevalence of nasopharynx cancer in developing countries is higher, and this is attributed to the higher exposure of

Table 3. Human Development Index (HDI) and its components in Asian countries in 2012.

	Population	HDI	Life expectancy at birth	Mean years of schooling	GNI/capita
Very high human development	Japan	0.912	83.6	11.6	32,545
	Korea, Republic of	0.909	80.7	11.6	28,231
	Israel	0.900	81.9	11.9	26,224
	Singapore	0.895	81.2	10.1	52,613
	Brunei	0.855	78.1	8.6	45,690
	Qatar	0.834	78.5	7.3	87,478
	United Arab Emirates	0.818	76.7	8.9	42,716
High human development	Bahrain	0.796	75.2	9.4	19,154
	Kuwait	0.790	74.7	6.1	52,793
	Saudi Arabia	0.782	74.1	7.8	22,616
	Malaysia	0.769	74.5	9.5	13,676
	Kazakhstan	0.754	67.4	10.4	10,451
	Georgia	0.745	73.9	12.1	5,005
	Lebanon	0.745	72.8	7.9	12,364
	Iran, Islamic Republic of	0.742	73.2	7.8	10,695
	Azerbaijan	0.734	70.9	11.2	8,153
	Oman	0.731	73.2	5.5	24,092
	Armenia	0.729	74.4	10.8	5,540
	Turkey	0.722	74.2	6.5	13,710
	Sri Lanka	0.715	75.1	9.3	5,170
Medium human development	Jordan	0.700	73.5	8.6	5,272
	China	0.699	73.7	7.5	7,945
	Turkmenistan	0.698	65.2	9.9	7,782
	Thailand	0.690	74.3	6.6	7,722
	Maldives	0.688	77.1	5.8	7,478
	Mongolia	0.675	68.8	8.3	4,245
	State of Palestine	0.670	73.0	8.0	3,359
	Philippines	0.654	69.0	8.9	3,752
	Uzbekistan	0.654	68.6	10	3,201
	Syrian Arab Republic	0.648	76.0	5.7	4,674
	Indonesia	0.629	69.8	5.8	4,154
	Kyrgyzstan	0.622	68.0	9.3	2,009
	Tajikistan	0.622	67.8	9.8	2,119
	Vietnam	0.617	75.4	5.5	2,970
	Iraq	0.590	69.6	5.6	3,557
	Timor-Leste	0.576	62.9	4.4	5,446
	India	0.554	65.8	4.4	3,285
	Cambodia	0.543	63.6	5.8	2,095
	Lao PDR	0.543	67.8	4.6	2,435
	Bhutan	0.538	67.6	2.3	5,246
Low human development	Bangladesh	0.515	69.2	4.8	1,785
	Pakistan	0.515	65.7	4.9	2,566
	Myanmar	0.498	65.7	3.9	1,817
	Nepal	0.463	69.1	3.2	1,137
	Yemen	0.458	65.9	5.3	928
	Afghanistan	0.374	49.1	3.1	1,000
Other countries or territories	Korea, Democratic People's Republic of	—	—	—	—

GNI = gross national income.

inhabitants to a variety of risk factors and lower budget allocations for health. For these people, diagnosis is often made when the disease is already in advanced stages, and, with the lack of access to treatment, the metastasis of nasopharynx cancer can be observed more often in these areas [36,37].

In this study, no significant relationship was found between the standardized incidence and mortality rate of nasopharynx cancer and the HDI. Moreover, no significant positive relationship was observed between standardized incidence and mortality rate of nasopharynx cancer with proper income level (GDP) and level of

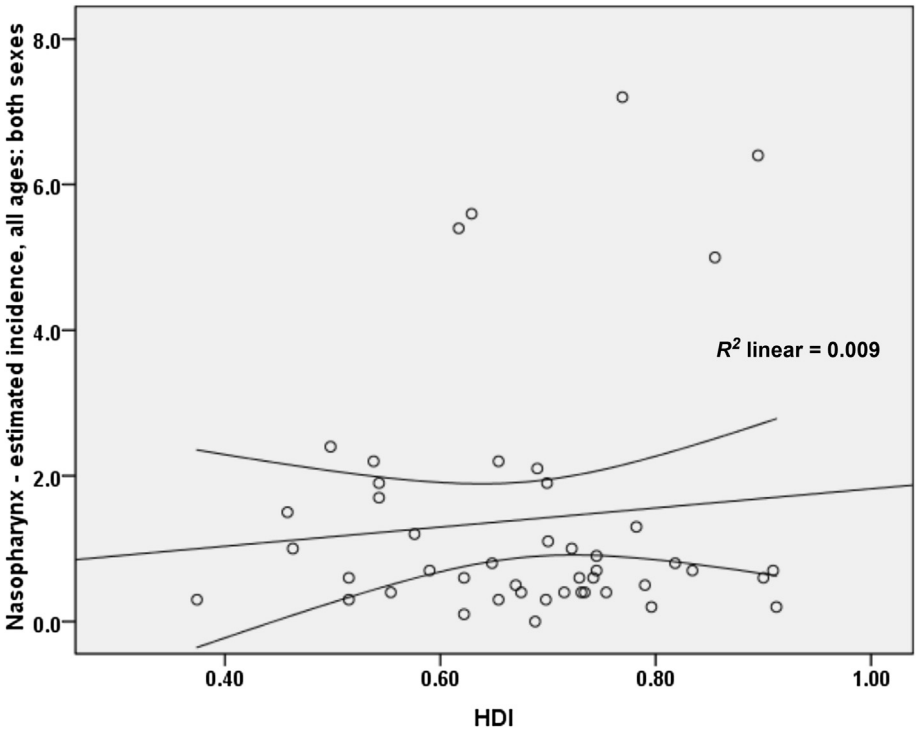

Figure 4. Correlation between HDI and standardized incidence rate of nasopharynx cancer in Asia in 2012. ASR = age-specific incidence and mortality rate.

education or knowledge (mean years of schooling). In other studies, the increase in life expectancy leads to an increase in global cancer burden and future changes in population growth and aging, indicating that new cases of nasopharynx cancer and mortality in elderly people will increase and that this increase will be noticeable in countries with low HDI compared to countries with high HDI (76% vs. 25%) [26,28,38,39]. Furthermore,

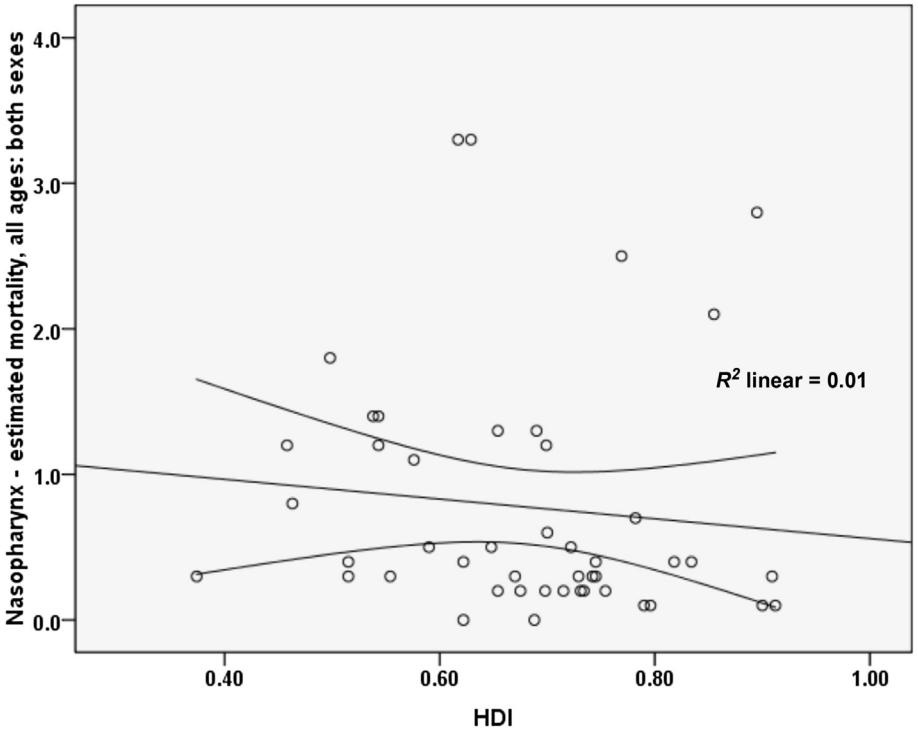

Figure 5. Correlation between HDI and standardized mortality rate of nasopharynx cancer in Asia in 2012. ASR = age-specific incidence and mortality rate.

according to other studies, people who have higher education typically have more healthy habits and behaviors than those with a low education level, especially in terms of cancer incidence and mortality [40,41]. In studies focusing on nasopharynx cancer, the relationship between nasopharynx cancer with socioeconomic status, lifestyle, and geographical positions is known [12]. Thus, in Asian countries, there is an increased incidence of nasopharynx cancer in lower economic classes, especially among men [12]. Also, no difference was found between the deaths of people living in rural areas with low socioeconomic status and the people who live in urban areas [42,43].

In this study, Malaysia, Singapore, Indonesia, Vietnam, and Brunei are the five countries with the highest incidence rate. It is noteworthy that Singapore and Brunei are classified as very high HDI countries, Malaysia is considered a country with a high HDI, and Indonesia and Vietnam are countries with medium HDI. According to previous studies in Singapore, nasopharynx cancer is the eighth most common cancer in men, with age-standardized incidence of 9.5 per 100,000 per year [44]. In Indonesia, a relatively high incidence is reported—at least 5.7 among men and 1.9 among women per 100,000 people—compared with the global incidence average of 1.9 among men and 0.8 among women for every 100,000 individuals [45]. It should be noted, however, that the actual incidence of nasopharynx cancer in Indonesia is not known owing to incomplete registration [11].

Regardless of ethnicity, genetics plays an important part in the pathogenesis of nasopharynx cancer. The incidence of nasopharynx cancer is 20−50 times higher in South China compared with Western countries. It is notable that second and third generations of Chinese people who immigrated to the United States (a low prevalence area) are still at risk of high nasopharynx cancer despite cultural assimilation compared with the resident population [46]. In the present study, Indonesia, Vietnam, Singapore, Malaysia, and Brunei were the five countries with the highest death rates from this cancer. Other studies have shown that one of the main causes of death in Indonesia is nasopharynx cancer, and in early detection, 80% of the patients are already at an advanced stage of the disease. In Indonesia, primary healthcare is generally handled by health centers named Puskesmas. Lack of knowledge among the general practitioners working in these centers regarding the various aspects of nasopharynx cancer, may lead to a delay in diagnosis [11]. Thus, only about 14% of patients who have metastasis at the initial diagnosis and 29% of patients without metastasis show response to therapy, about 70−95% response to therapy is good, so in general response to the therapy is poor. [36]. In Singapore, older patients diagnosed with stage 2 or stage 3 are at higher risk of recurrence and lower overall survival [47]. Eighty percent of patients are now at stage 3 or 4 of the disease, which leads to lower survival and death [11]. In the past two decades, the treatment of nasopharynx cancer has been considerably enhanced by the use of chemotherapy and radiotherapy at the same time. However, the overall incidence of patients with metastasis remains at 25−34%, and survival of these patients is low [48,49].

5. Conclusion

Nasopharynx cancer is the native cancer of Southeast Asia. So that the highest incidence and mortality are related to Southeast Asian countries including Malaysia, Singapore, Indonesia, Vietnam and Brunei. It was not seen a significant relation between the standardized incidence and mortality rate of nasopharynx cancer and the Human Development Index components. Further studies are recommended in Southeast Asian countries in order to find the etiology of cancer, diagnosis and treatment.

5.1. Limitations of the study

This was an ecological study. The ecological fallacy will occur if results are inferred and concluded at the individual level.

Conflicts of interest

The authors declare that they have no conflicts of interest for this work.

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