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Original Research

The incidence and mortality of lip and oral cavity cancer and its relationship to the 2012 Human Development Index of Asia

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Abstract

Introduction: Lip and oral cavity cancer is one of the most prevalent cancers in Asia and considered to be a major public health problem due to the low survival rate. Because of the importance of access to information about this cancer (including incidence, mortality rate and relation to socioeconomic indicators), this study aims at investigating the incidence and mortality of lip and oral cavity cancer and its relationship with the Human Development Index (HDI) of Asia (from 2012). **Method:** This study was an ecological study in Asia for assessment of the correlation between age-specific incidence rate (ASIR) and age-specific mortality rate (ASMR) with the HDI and its components which include: life expectancy at birth, mean years of schooling and gross national income (GNI) per capita. Data on the standardized incidence ratio (SIR) and the standardized mortality ratio (SMR) for every Asian country for the year 2012 were obtained from the global cancer project and data on the HDI and its components were extracted from the World bank site.

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We used a bivariate method for assessment of the correlation between the SIR and SMR with the HDI and its individual components. Statistical significance was assumed if P<0.05. All reported P-values were two-sided. Statistical analyses were performed using SPSS (Version 15.0, SPSS Inc.). **Results:** A total incidence of 162,506 cases and 95,005 deaths were recorded in Asian countries in 2012. Countries with the highest SIR (per 100,000) were the following: Maldives (11), Sri Lanka (10.3), Pakistan (9.8), Bangladesh (9.4), and India (7.2). The highest SMR was observed in the following countries: Pakistan (5.9), Bangladesh (5.6), Afghanistan (5.1), India (4.9), and Maldives (4.1). The correlation between SIR of lip and oral cavity cancer and HDI was -0.378 (p=0.010), with life expectancy at birth at -0.324 (p=0.028), mean years of schooling at -0.283 (p=0.057), and level of income per each person of the population at -0.279 (p=0.060). Moreover, the correlation was -0.664 (p≤0.001**)** between SMR and HDI. **Conclusion:** A significant reverse correlation was seen between the incidence and mortality rate of lip and oral cavity cancer and the HDI in Asia. The incidence and mortality of this type of cancer was high in developing or less developed countries.

Keywords

Lip and oral cavity cancer, Human development index, Incidence, Mortality, Asia

Introduction

Cancers are among the leading causes of disease burden and mortality in the world and are regarded as a significant and growing public health problem around the world (Global Burden of Disease Cancer, 2015; Torre et al., 2015). Among cancers, lip and oral cavity cancer is the result of aggressive tumors originating from external lip and oral cavity and is the eighth most common cancer in men and the fourteenth most common cancer in women worldwide (de Camargo Cancela et al., 2010; Farah et al., 2014). In 2012, 14.1 million new cancer cases and 8.2 million cancer deaths occurred in the world; among them, 300,400 new cases and 145,400 deaths were due to lip and oral cavity cancer, accounting for more than 2% of new cases and 1.7% cases of death in the world, respectively (Torre et al., 2015). Most cancers of the lip and oral cavity have the same preventable risk factors (Warnakulasuriya, 2009). Smoking, alcohol, and chewing tobacco and betel quid (synergistic relationship) are the main risk factors for this type of cancer (Lin et al., 2005; Monteiro et al., 2013; Neville and Day, 2002; Warnakulasuriya, 2009). Poor eating habits, sun overexpsoure, viral infections (particularly human papillomavirus (HPV)), poor oral hygiene, and

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socio-economic factors are also important risk factors for lip and oral cavity cancers (de Camargo Cancela et al., 2010; Farah et al., 2014; Funk et al., 2002; Ribeiro et al., 2015; Warnakulasuriya, 2009).

There is a large geographic variation in the incidence of lip and oral cavity cancer. The highest incidence rates have been reported from Malaysia, South Central Asia, and East and Central Europe, while the lowest rates have been reported from West Africa and East Asia. In recent decades, the incidence rate of lip and oral cavity cancers have decreased in men and women from Asia, North America and Australia, and in men from South and West Europe. However, the rates have increased in men and women from East and North Europe and in women from South and West Europe. The main reasons for this are the rising tobacco epidemic trend as well as the increased prevalence of HPV infection in some countries (Torre et al., 2015; Yako-Suketomo and Matsuda, 2010). Lip and oral cavity cancer is 90% squamous cell carcinoma and is often seen in middle-aged and older people. Its mortality is higher in men and black people, but lower in women (due to less exposure to risk factors such as smoking and alcohol) (de Camargo Cancela et al., 2010; Funk et al., 2002; Neville and Day, 2002; Yako-Suketomo and Matsuda, 2010).

Studies have shown that socioeconomic inequalities which affect behavior and lifestyle have a relation to the incidence and mortality rates of oral cavity cancer. However, some studies have shown conflicting results (Chen et al., 2009; de Camargo Cancela et al., 2010; Patel et al., 2012; Warnakulasuriya, 2009). To review countries' economic and social conditions, various indicators have been defined. One of the most important of the indicators is the Human Development Index (HDI) (Giebel et al., 2010; Hu et al., 2013). This index was first used by the United Nations Development Program and is a combination of three major factors- longevity, knowledge, and standard of living. The HDI is represented as a number between zero and one. Longevity is measured by life expectancy at birth and expressed as Life Expectancy Index. Knowledge is evaluated by a combination of adult literacy rate and the rate of enrollment at primary, secondary and tertiary schools (Education Index). The standard of living is measured by the Gross Domestic Product per capita, with purchasing power parity in US dollars (Gross Domestic Product Index) (Giebel et al., 2010; Hou et al., 2015; Rahi, 2011).

Some studies have shown the relationship between HDI and cancer incidence and mortality (Fidler et al., 2016; Pakzad et al., 2016; Rafiemanesh et al., 2016; Razi et al., 2016). However, to date, no study has been conducted to investigate the relationship between the HDI and the incidence and mortality of lip and oral cavity cancer in Asia. Knowledge of information about the incidence and mortality of lip and oral cavity cancer and its related factors can be useful for planning and developing policies related to health care. This study was aimed to determine the standardized incidence ratio (ASIR) and the standardized mortality ratio (SMR) of lip and oral cavity cancers, and the relationship of ASIR and ASMR with the 2012 HDI of Asian countries.

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Methods

This study was an ecological study in Asia with the goal of assessing the correlation between age-specific incidence and mortality rates of lip and oral cavity cancer with the Human Development Index (HDI) and its components (life expectancy at birth, mean years of schooling, and gross national income per capita. Data about the age-specific incidence and mortality rates for every Asian country for the year 2012 were obtained from the global cancer project available online (http://globocan.iarc.fr/Default.aspx) (Ferlay J S, 2012). The HDI from the Human Development Report of 2013 (Malik, 2013) included information about the HDI and its components for every country in 2012.

A method of age-specific incidence and mortality rates from the global cancer project of the International Agency for Research on Cancer (France) was previously reported (Ferlay et al., 2014; Jemal et al., 2011; Torre et al., 2015).

Human Development Index (HDI)

The Human Development Index (HDI) is derived from a composite measure of indicators along three dimensions: life expectancy at birth, mean years of schooling and level of income per each person of the population (i.e. gross national income per capita) (Malik, 2013).

Statistical analysis

In this study, we used the correlation bivariate method for assessment of correlation between age-specific incidence and mortality rates with HDI and its components (including life expectancy at birth, mean years of schooling and gross national income per capita. Statistical significance was assumed if $P< 0.05$. All reported P-values were two-sided. Statistical analyses were performed using SPSS software (Version 15.0, SPSS Inc.).

Results

Overall, 162,506 cases of lip and oral cavity cancer were recorded in Asian countries in 2012. Of these cases, 106,308 (65.41%) were men and 56,198 cases (34.58%) were women. The sex ratio (male to female) was 1.89. The five countries with the highest number of new cases of lip and oral cavity cancer were:

1) India (77,002 cases),

2) China (21,413 cases),

3) Pakistan (12,761 cases),

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4) Bangladesh (10,550 cases),

5) Japan (8,306 cases).

These 5 countries, collectively, had a sum of 130,033 cases (80.01%).

Of the Asian countries, the 5 countries with the highest standardized incidence rates of lip and oral cavity cancer were:

1) Maldives (standardized rate of 11 per 100,000 people),

2) Sri Lanka (10.3 per 100,000 people),

3) Pakistan (9.8 per 100,000 people),

4) Bangladesh (9.4 per 100,000 people),

5) India (7.2 per 100,000 people).

Conversely, the 5 countries with the lowest standardized rates of lip and oral cavity cancer were:

1) China (1.2 per 100,000 people),

2) Democratic Republic of Korea (1.3 per 100,000 people),

3) Kuwait (1.5 per 100,000 people),

4) Azerbaijan (1.7 per 100,000 people), and

5) Jordan (1.7 per 100,000 people).

The number as well as crude and standardized incidence rates of the cancer, according to sex, of the Asian countries are presented in **Table 1**. The countries are classified from highest to lowest, based on standardized incidence rates. The highest and lowest standardized incidence rates are indicated for both sexes (**Table 1, Fig. 1**).

On the other hand, 195,005 cases of death from of lip and oral cavity cancer have occurred in Asia in 2012. Of the cases, 62,860 (66.16%) were men and 32,145 cases (33.83%) were women. The sex ratio of death from lip and oral cavity cancer in Asian countries was 1.95. Of these, the largest numbers of deaths were seen in:

1) India (52,067 cases),

2) China (11,337 cases),

3) Pakistan (7,766 cases),

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4) Bangladesh (6,571 cases), and

5) Japan (3,994 cases).

These five countries, collectively, had a sum of 80,731 cases (84.97%) of deaths.

Of the Asian countries, the 5 countries with the highest standardized mortality rates of lip and oral cavity cancer were:

1) Pakistan (5.9 per 100,000 people),

2) Bangladesh (5.6 per 100,000 people),

3) Afghanistan (5.1 per 100,000 people),

4) India (4.9 per 100,000 people), and

5) Maldives (4.1 per 100,000 people).

Conversely, the 5 countries with the lowest standardized mortality rates of lip and oral cavity cancer were:

1) Qatar (0.4 per 100,000 people),

2) Kuwait (0.4 per 100,000 people),

3) Bahrain (0.4 per 100,000 people),

4) Oman (0.4 per 100,000 people), and

5) United Arab Emirates (0.5 per 100,000 people).

The number as well as crude and standardized mortality rates of the cancer, according to sex, of the Asian countries are presented in **Table 2**. The countries are classified from highest to lowest, based on standardized mortality rates. The highest and lowest standardized mortality rates are indicated for both sexes (**Table 2, Fig. 1**).

Assessing the relationship between standardized incidence rate and the Human Development Index

Overall, a negative correlation of 0.378 was seen between the standardized incidence rate of lip and oral cavity cancer and the HDI; the correlation was statistically significant (P=0.010). A negative correlation was also seen between components of the HDI and the standardized incidence rate. Moreover, a negative correlation was seen when assessing the relationship of the standardized incidence rate to life expectancy at birth (0.324; P=0.028), to mean age of education (0.283; P=0.057), and to level of income per person of the population (0.279; P=0.060).

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Table 1. Number, crude and standardized incidence rates of lip and oral cavity cancer in Asian countries in 2012 (sorted by age standardized incidence rates of both sexes from highest to lowest)

Lip, oral cavity Estimated incidence, all ages: both sexes				Lip, oral cavity Estimated incidence, all ages: male				Lip, oral cavity Estimated incidence, all ages: female			
POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)
Maldives	28	8.6	11.0	Sri Lanka	1845	17.6	15.4	Pakistan	5693	6.4	9.1
Sri Lanka	2667	12.6	10.3	Maldives	20	12.2	15.4	Brunei	9	4.4	9.0
Pakistan	12761	7.1	9.8	Bangladesh	7120	9.2	13.0	Maldives	8	5.0	6.4
Bangladesh	10550	6.9	9.4	Kazakhstan	788	10.0	11.6	Bangladesh	3430	4.6	5.9
India	77003	6.1	7.2	Pakistan	7068	7.7	10.5	Sri Lanka	822	7.6	5.7
Kazakhstan	1083	6.6	6.3	India	53842	8.3	10.1	Afghanistan	435	2.7	5.4
Afghanistan	1047	3.1	6.3	Turkmenistan	172	6.8	9.3	Timor-Leste	19	3.3	5.3
Myanmar	2775	5.7	6.2	Myanmar	1810	7.5	8.6	Cambodia	304	4.1	5.2
Brunei	18	4.4	6.0	Nepal	701	4.6	7.2	India	2316	3.8	4.3
Cambodia	584	4.0	6.0	Afghanistan	612	3.5	7.1	Lao PDR	91	2.9	4.2
Timor-Leste	40	3.4	5.6	Cambodia	280	3.9	7.1	State of Palestine	46	2.2	4.1
Turkmenistan	224	4.3	5.6	Armenia	116	8.0	6.7	Myanmar	965	3.9	4.1
Nepal	942	3.0	4.4	Timor-Leste	21	3.5	5.9	Philippines	1105	2.3	3.2
Kyrgyzstan	163	3.0	4.0	Kyrgyzstan	108	4.0	5.8	Thailand	1551	4.4	3.0
Thailand	3709	5.3	4.0	Thailand	2158	6.3	5.1	Kazakhstan	295	3.5	2.8
State of Palestine	90	2.1	3.8	Georgia	159	7.8	4.9	Malaysia	363	2.5	2.8
Philippines	2363	2.4	3.6	Brunei	9	4.3	4.5	Kyrgyzstan	55	2.0	2.5
Armenia	165	5.3	3.6	Bhutan	14	3.5	4.3	Turkmenistan	52	2.0	2.4
Lao PDR	140	2.2	3.4	Uzbekistan	425	3.0	4.2	Yemen	157	1.2	2.3
Bhutan	19	2.5	3.2	Philippines	1258	2.6	4.1	Nepal	241	1.5	2.1
Malaysia	776	2.6	3.0	Japan	4881	7.9	3.9	Saudi Arabia	164	1.3	2.1
Uzbekistan	661	2.4	3.0	Tajikistan	75	2.2	3.7	Israel	116	3.0	2.0

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Japan	8306	6.6	2.9	Singapore	125	4.7	3.4	Bhutan	5	1.4	2.0
Tajikistan	123	1.7	2.7	State of Palestine	44	2.0	3.4	Japan	3425	5.3	2.0
Georgia	205	4.8	2.6	Malaysia	413	2.8	3.3	Uzbekistan	236	1.7	1.9
Singapore	190	3.6	2.5	Viet Nam	1392	3.1	3.3	Indonesia	2327	1.9	1.9
Viet Nam	2147	2.4	2.4	Bahrain	14	1.6	3.2	Qatar	3	0.6	1.9
Indonesia	5329	2.2	2.3	Iraq	227	1.3	3.0	Tajikistan	48	1.3	1.8
Iraq	411	1.2	2.3	Korea, Republic of	965	4.0	2.9	Iran, Islamic Republic of	617	1.7	1.8
Bahrain	18	1.3	2.2	Indonesia	3002	2.5	2.8	Mongolia	18	1.2	1.8
Korea, Republic of	1575	3.2	2.2	Turkey	939	2.5	2.7	Iraq	184	1.1	1.7
Israel	231	3.0	2.2	Syrian Arab Republic	185	1.7	2.7	Singapore	65	2.5	1.7
Yemen	283	1.1	2.2	Lebanon	54	2.6	2.6	Oman	12	1.0	1.7
United Arab Emirates	80	1.0	2.1	Lao PDR	49	1.5	2.5	Korea, Republic of	610	2.5	1.6
Qatar	23	1.2	2.1	Israel	115	3.0	2.4	Viet Nam	755	1.7	1.6
Turkey	1502	2.0	2.1	Azerbaijan	97	2.1	2.4	Lebanon	37	1.7	1.5
Iran, Islamic Republic of	1380	1.8	2.0	United Arab Emirates	59	1.1	2.4	United Arab Emirates	21	0.8	1.5
Syrian Arab Republic	301	1.4	2.0	Iran, Islamic Republic of	763	2.0	2.2	Turkey	563	1.5	1.5
Saudi Arabia	358	1.2	2.0	Jordan	47	1.4	2.2	Syrian Arab Republic	116	1.1	1.5
Lebanon	91	2.1	2.0	Mongolia	19	1.4	2.2	Armenia	49	2.9	1.4
Mongolia	37	1.3	2.0	Korea, Democratic Republic of	283	2.3	2.1	Kuwait	9	0.8	1.3
Oman	34	1.2	1.8	Saudi Arabia	194	1.2	2.0	Jordan	27	0.9	1.2
Jordan	74	1.1	1.7	Qatar	20	1.4	2.0	Bahrain	4	0.8	1.2
Azerbaijan	160	1.7	1.7	Yemen	126	1.0	2.0	Azerbaijan	63	1.3	1.1
Kuwait	25	0.9	1.5	Oman	22	1.3	1.9	Georgia	46	2.0	0.9
Korea, Democratic Republic of	402	1.6	1.3	China	13656	1.9	1.6	China	7757	1.2	0.9
China	21413	1.6	1.2	Kuwait	16	0.9	1.5	Korea, Democratic Republic of	119	1.0	0.7

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In men, a negative correlation of 0.323 was seen between the standardized incidence rate of lip and oral cavity cancer and the HDI; the correlation was statistically significant (P=0.029). A negative correlation was also seen between components of the HDI and the standardized rate. Moreover, a negative correlation was seen when assessing the relationship of the standardized incidence rate to life expectancy at birth (0.279; P=0.061), to mean age of education (0.167; P=0.267), and to level of income per person of the population (0.323; P=0.029).

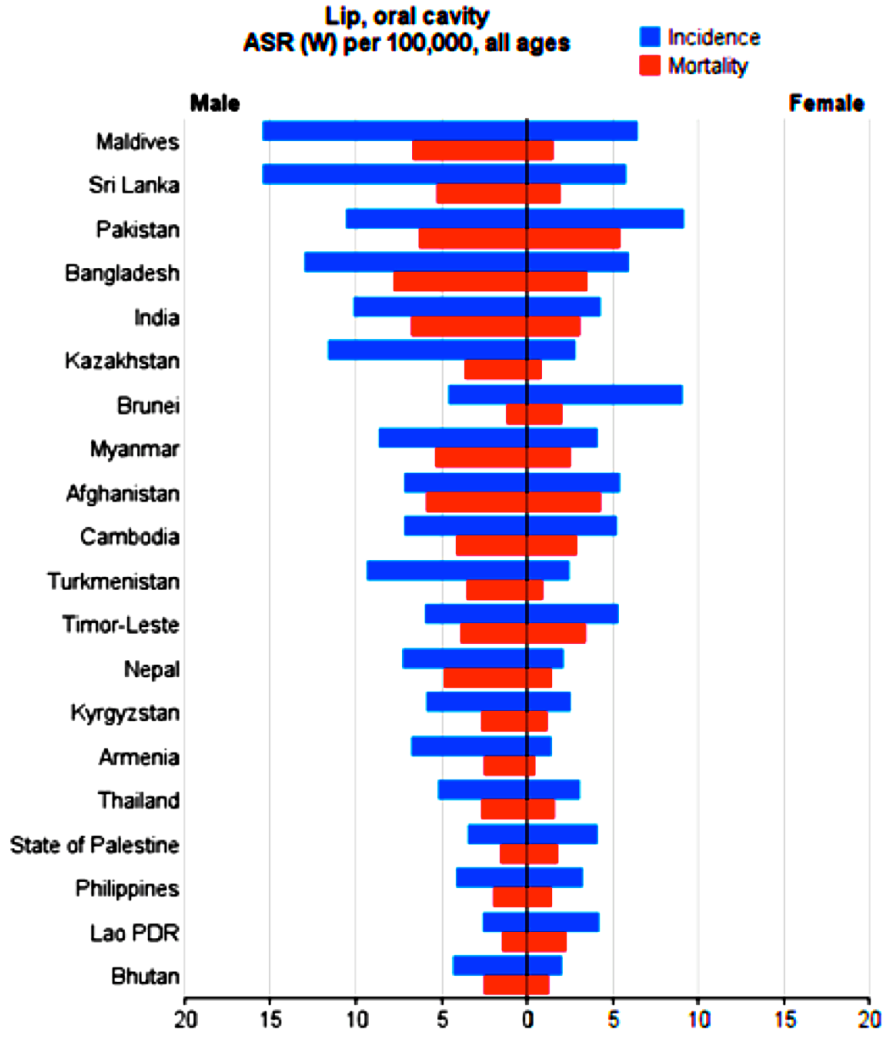

Figure 1. **Standardized incidence and mortality rates of lip and oral cavity cancer in Asia in 2012 (extracted from GLOBOCAN 2012).**

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In women, a negative correlation of 0.337 was seen between the standardized incidence rate of lip and oral cavity cancer and the HDI; the correlation was statistically significant (P=0.022). A negative correlation was also seen between components of the HDI and the standardized rate. Moreover, a negative correlation was seen when assessing the relationship of the standardized incidence rate to life expectancy at birth (0.310; P=0.036), to mean age of education (0.348, P=0.018), and to level of income per person of the population (0.132; P=0.382).

Assessing the relationship between standardized mortality rate and the Human Development Index

Overall, a negative correlation of 0.664 was seen between the standardized mortality rate of lip and oral cavity cancer and the HDI; the correlation was statistically significant (P≤0.001). Also, a significant negative correlation was seen between components of the HDI and the standardized rate. In fact, a negative correlation was seen when assessing the relationship of the standardized mortality rate to life expectancy at birth (0.592; P≤0.001), to mean age of education (0.528; P≤0.001), and to level of income per person of the population (0.421; P=0.004).

In men, a negative correlation of 0.603 was seen between the standardized mortality rate of lip and oral cavity cancer and the HDI; the correlation was statistically significant (P≤0.001). Also, a significant negative correlation was seen between components of the HDI and the standardized rate. In fact, a negative correlation was seen when assessing the relationship of the standardized mortality rate to life expectancy at birth (0.518; P≤0.001), to mean age of education (0.448; P=0.002), and to level of income per person of the population (0.429; P=0.003).

In women, a negative correlation of 0.666 was seen between the standardized mortality rate of lip and oral cavity cancer and the HDI; the correlation was also statistically significant (P≤0.001). Moreover, a significant negative correlation was seen between components of the HDI and the standardized rate. In fact, a negative correlation was seen when assessing the relationship of the standardized mortality rate to life expectancy at birth (0.639; P≤0.001), to mean age of education (0.559; P≤0.001), and to level of income per person of the population (0.365; P≤0.001).

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Table 2. Number, crude and standardized mortality rates of lip and oral cavity cancer in Asian countries in 2012 (sorted by age standardized rates of both sexes from highest to lowest)

Lip, oral cavity - Estimated mortality, all ages: both sexes				Lip, oral cavity - Estimated mortality, all ages: female				Lip, oral cavity - Estimated mortality, all ages: male			
POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)
Pakistan	7266	4.0	5.9	Bangladesh	4094	5.3	7.7	Pakistan	3220	3.6	5.4
Bangladesh	6071	4.0	5.6	India	36436	5.6	6.7	Afghanistan	318	2.0	4.3
Afghanistan	771	2.3	5.1	Maldives	8	4.9	6.6	Bangladesh	1977	2.6	3.5
India	52067	4.1	4.9	Pakistan	4046	4.4	6.3	Timor-Leste	11	1.9	3.4
Maldives	10	3.1	4.1	Afghanistan	453	2.6	5.8	India	15631	2.6	3.0
Myanmar	1668	3.4	3.8	Myanmar	1090	4.5	5.3	Cambodia	165	2.2	2.9
Timor-Leste	23	1.9	3.6	Sri Lanka	634	6.1	5.2	Myanmar	578	2.3	2.5
Sri Lanka	916	4.3	3.5	Nepal	451	2.9	4.8	Lao PDR	48	1.5	2.3
Cambodia	316	2.2	3.4	Cambodia	151	2.1	4.1	Brunei	2	1.0	2.0
Nepal	606	2.0	2.9	Timor-Leste	12	2.0	3.8	Sri Lanka	282	2.6	1.9
Thailand	1913	2.7	2.1	Kazakhstan	238	3.0	3.6	State of Palestine	17	0.8	1.7
Turkmenistan	79	1.5	2.1	Turkmenistan	60	2.4	3.5	Thailand	799	2.2	1.6
Kazakhstan	325	2.0	1.9	Kyrgyzstan	44	1.6	2.6	Yemen	99	0.8	1.6
Lao PDR	74	1.2	1.9	Thailand	1114	3.2	2.6	Maldives	2	1.2	1.5
Bhutan	10	1.3	1.8	Bhutan	7	1.8	2.4	Nepal	155	1.0	1.4
Kyrgyzstan	69	1.3	1.8	Armenia	41	2.8	2.4	Philippines	451	0.9	1.4
State of Palestine	35	0.8	1.6	Philippines	527	1.1	1.9	Bhutan	3	0.9	1.2
Philippines	978	1.0	1.6	Uzbekistan	173	1.2	1.8	Kyrgyzstan	25	0.9	1.1
Yemen	180	0.7	1.5	Tajikistan	34	1.0	1.7	Turkmenistan	19	0.7	0.9
Brunei	4	1.0	1.4	Mongolia	14	1.0	1.7	Mongolia	8	0.6	0.9
Uzbekistan	270	1.0	1.3	Iraq	107	0.6	1.5	Iraq	87	0.5	0.8
Tajikistan	55	0.8	1.2	Viet Nam	632	1.4	1.5	Uzbekistan	97	0.7	0.8
Armenia	58	1.9	1.2	State of Palestine	18	0.8	1.5	Tajikistan	21	0.6	0.8

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Mongolia	22	0.8	1.2	Georgia	49	2.4	1.4	Indonesia	987	0.8	0.8
Iraq	194	0.6	1.1	Japan	2188	3.6	1.4	Kazakhstan	87	1.0	0.8
Viet Nam	971	1.1	1.1	Lao PDR	26	0.8	1.4	Malaysia	97	0.7	0.8
Japan	3994	3.2	1.1	Yemen	81	0.6	1.3	Viet Nam	339	0.7	0.7
Indonesia	2250	0.9	1.0	Malaysia	156	1.0	1.2	Japan	1806	2.8	0.7
Malaysia	253	0.9	1.0	Indonesia	1263	1.0	1.2	Kuwait	4	0.3	0.7
Syrian Arab Republic	119	0.6	0.8	Brunei	2	1.0	1.1	Iran, Islamic Republic of	200	0.5	0.6
Georgia	63	1.5	0.8	Syrian Arab Republic	73	0.7	1.1	Syrian Arab Republic	46	0.4	0.6
Singapore	58	1.1	0.7	Singapore	41	1.5	1.1	Saudi Arabia	44	0.3	0.6
Turkey	503	0.7	0.7	Korea, Democratic Republic of	138	1.1	1.0	Turkey	187	0.5	0.5
Iran, Islamic Republic of	449	0.6	0.7	Korea, Republic of	339	1.4	1.0	Israel	35	0.9	0.5
Korea, Republic of	517	1.1	0.6	Turkey	316	0.9	0.9	United Arab Emirates	5	0.2	0.5
Korea, Democratic Republic of	200	0.8	0.6	China	7370	1.0	0.8	Lebanon	11	0.5	0.4
China	11333	0.8	0.6	Azerbaijan	33	0.7	0.8	Armenia	17	1.0	0.4
Saudi Arabia	97	0.3	0.6	Lebanon	16	0.8	0.8	Jordan	8	0.3	0.4
Israel	70	0.9	0.6	Iran, Islamic Republic of	249	0.6	0.7	China	3963	0.6	0.4
Lebanon	27	0.6	0.6	Jordan	15	0.5	0.7	Singapore	17	0.7	0.4
Jordan	23	0.4	0.6	Israel	35	0.9	0.7	Korea, Republic	178	0.7	0.4
Azerbaijan	54	0.6	0.6	Saudi Arabia	53	0.3	0.6	Azerbaijan	21	0.4	0.3
United Arab Emirates	19	0.2	0.5	Oman	7	0.4	0.6	Korea, Democratic Republic of	62	0.5	0.3
Oman	8	0.3	0.4	Qatar	5	0.3	0.5	Georgia	14	0.6	0.3
Bahrain	4	0.3	0.4	Bahrain	3	0.4	0.5	Bahrain	1	0.2	0.2
Kuwait	8	0.3	0.4	United Arab Emirates	14	0.2	0.5	Oman	1	0.1	0.1
Qatar	5	0.3	0.4	Kuwait	4	0.2	0.3	Qatar	0	0.0	0.0

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Discussion

Although lip and oral cavity cancer accounts for less than 3% of all cancer cases worldwide, its low survival rate and adverse consequences on quality of life have garnered it to be considered as a significant public health problem; in fact, two thirds of its burden occurs in developing countries (Costa et al., 2016; Farah et al., 2014; Global Burden of Disease Cancer, 2015; Ribeiro et al., 2015; Torre et al., 2015; Warnakulasuriya, 2009). Studies show that 162,506 new cases of lip and oral cavity cancer have been recorded in Asia in 2012, accounting for 56.1% of all new cancer cases worldwide in 2012. There was a significant inverse relationship between the lip and oral cavity cancer and the HDI in Asia. The highest standardized incidence rates for this type of cancer, among the Asian countries, were seen in Maldives, Sri Lanka, Pakistan, Bangladesh and India, respectively. These countries were among the countries with medium HDI.

Since people who live in developing countries are exposed to a wider range of risk factors for cancer of the lip and oral cavity, the highest incidence rates are reported from these countries (Byakodi et al., 2012; de Camargo Cancela et al., 2010; Gupta et al., 2016; Rastogi et al., 2004). The most important risk factors of this cancer are tobacco use, alcohol, chewing tobacco, betel quid, poor eating habits, sun exposure, viral infections (especially HPV), and poor oral hygiene (de Camargo Cancela et al., 2010; Farah et al., 2014; Funk et al., 2002; Ribeiro et al., 2015; Warnakulasuriya, 2009). In India and Pakistan, about 100 million people use various types of smokeless tobacco and betel-quid chewing (Jayalekshmi et al., 2009). In addition to these countries, these tobacco and chewing habits are also common in Bangladesh, Afghanistan, Maldives, Sri Lanka and Nepal, which has led to an increased risk of lip and oral cavity cancers in these areas (Ariyawardana and Warnakulasuriya, 2011; Funk et al., 2002; Khan et al., 2016; Neville and Day, 2002; Sreeramareddy et al., 2014).

In the present study, an inverse relationship was seen between the incidence of lip and oral cavity cancer and the HDI components. The correlation was significant for life expectancy but insignificant for education and income. Studies have shown that the incidence of lip and oral cavity cancer is higher in people with lower education and income (de Camargo Cancela et al., 2010; Farah et al., 2014; Jayalekshmi et al., 2009; Johnson et al., 2010; Ribeiro et al., 2015; Swaminathan et al., 2009). People with less education are at greater risk of lip and oral cavity cancer due to less awareness of cancer risk factors, poor sanitary habits, greater consumption of alcohol and tobacco, and use of chewing tobacco (Gupta et al., 2016; Hashibe et al., 2003; Videnovic et al., 2016; Warnakulasuriya, 2009). Also, people with less income are more likely to have this type of cancer due to limited access to dental care, poor oral hygiene, consumption of fewer fruits and vegetables, greater HPV risk, and less protection against the sun (Arnold et al., 2016; Farah et al., 2014; Guha et al., 2007; Johnson et al., 2010; Monteiro et al., 2013; Morris et al., 2000; Pavia et al., 2006). Chen and colleagues also found an inverse relationship between income

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per capita and the incidence of lip and oral cavity cancer (Chen et al., 2009). In a systematic review and meta-analysis, done by Conway et al. on 41 case control studies from all around the world, economic and social conditions were found to be risk factors for oral cancer. These socioeconomic conditions included: low educational attainment ((odds ratio (OR): 1.85, 95% confidence interval (CI): 1.60–2.15)), low occupational social class (OR: 1.84, 95% CI: 1.47–2.31), and low income (OR: 2.41, 95% CI: 1.59–3.65) (Conway et al., 2008).

Based on the data from Asia, 95,005 deaths occurred due to lip and oral cavity cancer in 2012, which was equivalent to 66.9% of all cancer deaths in the world that year. A significant inverse relation was seen between lip and oral cavity cancer mortality and the HDI. Asian countries with the highest standardized mortality rate from lip and oral cavity cancer were Pakistan, Bangladesh, Afghanistan, India and Maldives, respectively. Afghanistan had low HDI while the rest had medium HDI. The findings showed a significant inverse relation between mortality from lip and oral cavity cancer and the HDI components (including life expectancy, education and income). Studies have shown that less education, lack of awareness about the symptoms of lip and oral cavity cancer, and delayed diagnosis are all factor which contribute to higher mortality rates (Albano et al., 2007; Kilander et al., 2001; Warnakulasuriya, 2009).

Despite advances in medical sciences, over the past several decades the overall five-year survival rate for lip and oral cavity cancer has not improved significantly, remaining at about 50-55% (Neville and Day, 2002; Warnakulasuriya, 2009). In studies that were conducted in Asia, the overall five-year survival rate was 18% in Malaysia (Razak et al., 2010), 30.5 % in India (Yeole et al., 2003), 52.8% in Korea (Choi et al., 2014), and 61% in Taiwan (Liu et al., 2010). Due to limited access to diagnostic and treatment services in low-income communities and to the high cost of services, people present with advanced stage lip and oral cavity cancer at the time of diagnosis. All the aforementioned are among the important reasons for the low 5-year survival of patients as well as the higher mortality rates in developing countries (Funk et al., 2002; Global Burden of Disease Cancer, 2015; Patel et al., 2012; Sargeran et al., 2008). McDonald et al. reported in their study that there was lower survival of head and neck cancers, including oral cavity cancer, in people of low socioeconomic statuses (McDonald et al., 2014).

Mortality and high burden of lip and oral cavity cancer, particularly in developing countries, continues to warrant public education. Awareness about the risk factors and symptoms of lip and oral cavity cancer, screening of high-risk groups, and planning for preventative measures can help the population most at risk for this kind of cancer and will be essential for effective prevention (de Camargo Cancela et al., 2010; Warnakulasuriya, 2009).

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Conclusion

In general, a significant inverse correlation was observed between the incidence of lip and oral cavity cancer and the HDI in Asia. Moreover, the incidence of this cancer was higher in developing countries. This correlation was also observed between cancer incidence and the HDI components; it was significant for life expectancy but insignificant for education and income. A significant inverse correlation was observed between deaths from lip and oral cavity cancer and the HDI and its components, and the mortality rate from this cancer was higher in developing countries.

Abbreviations

HDI: Human Development Index:

ASIR: Age-specific incidence rate

ASMR: Age-specific mortality rate

HPV: Human papillomavirus

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Data on CANCER were obtained from the global cancer project and data on the HDI and its components were extracted from the World Bank site. Hereby we appreciate of the cooperation of all employees involved in data collection in the GLOBOCAN project and World Bank

Author contribution

All authors contributed to the design of the research. AMH, EI and HSG collected the data. AMH, EI and HS conducted analysis and interpretation of data. All authors drafted the first version. HS, AT and AMH edited the first draft. All authors reviewed and commented on final draft.

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