RESEARCH ARTICLE

Lack of Any Relationship of Stomach Cancer Incidence and Mortality with Development in Asia

Elahe Rafiei[1], Abdollah Mohammadian-Hafshejani[2], Farhad Towhidi[3], Behnam Reza Makhsosi[3], Hamid Salehiniya[4,5]*

Abstract

Background: The aim of this study was to evaluate the incidence and mortality of stomach cancer, and its relationship with the Human Development Index (HDI) and its components in Asia in 2012. Materials and Methods: This ecological study wa conducted based on GLOBOCAN project of WHO for Asian countries. We assessed the correlations between standardized incidence rates (SIR) and standardized mortality rates (SMR) of stomach Cancer with HDI and its components using SPSS18. Results: A total of 696,231 cases (68.7% in males and 31.3% in females, ratio of 2.19:1) and 524,465 deaths (67.1% in men and 33.0% in women, ratio 2.03:1) were included in 2012. Five countries with the highest SIR of stomach cancer were Republic Korea, Mongolia, Japan, China and Tajikistan. Five countries with the highest SMR of stomach cancer were Mongolia, Tajikistan, Kyrgyzstan, Kazakhstan and China. Correlation between HDI and SIR was 0.241 (p = 0.106), in men 0.236 (p = 0.114) and in women -0.250 (p = 0.094). Also between HDI and SMR -0.250 (p = 0.871) in men -0.018 (p = 0.903) and in women -0.014 (p = 0.927). Conclusions: No significant correlation was observed between the SIR of stomach cancer, and the HDI and its dimensions, such as life expectancy at birth, mean years of schooling, and income level of the population.

Keywords: Asia - epidemiology - stomach cancer - inequality - incidence - mortality

Asian Pac J Cancer Prev, **17 (8)**, 3777-3783

Introduction

Cancer is the main cause of deaths in developed countries and the second leading cause of death in developing countries. The burden of cancer is increasing in developing countries because of aging and population growth, as well as cancer-related lifestyle choices, such as smoking, physical inactivity, and Western food regimes (Jemal et al., 2011). It is predicted that by 2030, the number of new cancer cases will be more than 20 million and 13.2 million people will die from cancer (Bray et al., 2012). Stomach cancer is the fifth most common malignancy and the third leading cause of cancer death in both sexes in the world. It was estimated about one million new cases of stomach cancer in 2012, and 50% of those in Asia (mostly in China) have been detected (Thaler and Cummings, 2009).

Even though the incidence and mortality of stomach cancer have substantially declined during the past few decades, the cancer burden has remained very high in several countries of Asia, Latin America, and Central and East Europe (Ferro et al., 2014). Asia is the most populous continent in the world. Asian population compared with Europe and America is more quickly growing, and makes about 4 billion people (60% of the current population) in the world (Pourhoseingholi et al., 2015). The highest mortality rate from stomach cancer in both sexes was seen in some Asian countries, including china, Republic Korea, Japan, and Mongolia, where the rate was 7 times more than the United States (McDonald et al., 2008). Although the total incidence rate of cancer is almost twice in economically developed countries compared with developing countries in both sexes, the total cancer mortality rate in developed countries is nearly 21% in men and 2% in women higher. However, causes of these inequalities are not well known (Jemal et al., 2011).

To identify and reduce health inequalities, there are broad political interest and research on the socioeconomic level, race and ethnicity, gender, and geographic location (Oakes and Kaufman, 2006). Causes of health inequality in developed countries may be different in developing countries. In developed countries, access to health care for

*[1]Department of Epidemiology, Guilan University of Medical Sciences, Rasht, [2]Department of Social Medicine, School of Medicine, Rafsanjan University of Medical Sciences, Rafsanjan, [3]Imam Reza Hospital, Kermanshah University of Medical Sciences, Kermanshah, [4]Zabol University of Medical Sciences, Zabol, [5]Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran *For correspondence: alesaleh70@yahoo.com*

all people is possible but, health inequalities are related to income and other socio-economic factors (Orach, 2009). The risk of stomach cancer is related to socio-economic status, which is determined by the level of education, occupation, and income (Nagel et al., 2007). According to the American Cancer Society, the death rate from cancer increases with decreasing socioeconomic status, so that people with lower educational and economical levels had a higher death rate (Kim et al., 2012). Socioeconomic inequality reflects regional imbalance in the Human development index (HDI). HDI is estimated based on the parameters of a long and healthy life, access to knowledge, and a decent standard of living. As well as an indicator of socioeconomic health, it may be used as the gold standard for international comparisons in the field of development (Klugman, 2011; Hou et al., 2014). In a study it was found that 35% of cancer deaths are related to 9 modifiable risk factors, which are widely different among populations in various regions with different levels of development (Danaei et al., 2005). Other results showed that the mortality to incidence ratio (MIR) for cancer of the gastrointestinal tract is different in countries with different levels of development which measured by the national HDI. In other words, there is an inverse relationship between the national HDI and MIRs of gastrointestinal tract cancer (Hu et al., 2013) and other cancers(Ghoncheh et al., 2015a; Ghoncheh et al., 2015b; Pakzad et al., 2015). The findings confirm the impact of HDI and socio-economic factors on the incidence and mortality of stomach cancer. However, there is a little knowledge about the inequalities in patients with stomach cancer. This study aimed to investigate Incidence and Mortality of Stomach Cancer and Their Relationship with HDI in Asian Countries in 2012.

Materials and Methods

This study was an ecologic study in Asia for assessment the correlation between age-specific incidence and mortality rate (ASR) of Stomach Cancer with Human Development Index (HDI) and its details that include: Life expectancy at birth, Mean years of schooling and Gross national income (GNI) per capita. Data about the age-specific incidence and mortality rate (ASR) for every Asian counter for year 2012 get from global cancer project that available in (http://globocan.iarc.fr/Default.aspx) and Human Development Index (HDI) from Human Development Report 2013 (Malik, 2013). That include information about HDI and its details for every country in the word for year 2012. Method of estimate the age-specific Incidence and mortality rates in global cancer project by international agency for research on cancer.

Age-specific incidence rate estimate

The methods of estimation are country specific and the quality of the estimation depends upon the quality and on the amount of the 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, which 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 an aim of providing a broad indication of the robustness of the estimation.

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

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) (Thaler and Cummings, 2009; Smith et al., 2013; Ferlay et al., 2015).

Age-specific mortality rate estimate

Depending of the degree of detail and accuracy of the national mortality data, six methods have been utilized in the following order of priority:

i). Rates projected to 2012 (69 countries) *ii*). Most recent rates applied to 2012 population (26 countries) *iii*). Estimated as the weighted average of regional rates (1 country) *iv*). Estimated from national incidence estimates by modeling, using country-specific survival (2 countries) *v*). Estimated from national incidence estimates using modeled survival (83 countries) v*i*). The rates are those of neighboring countries or registries in the same area (3 countries) (Thaler and Cummings, 2009; Smith et al., 2013; Ferlay et al., 2015).

Human Development Index (HDI)

Human Development Index (HDI), 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 (Malik, 2013).

Statistical analysis: In this study, we use of correlation bivariate method for assessment the correlation between age-specific incidence and mortality rate (ASR) with

Human Development Index (HDI) and its details that include: Life expectancy at birth, Mean years of schooling and Gross national income (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).

Results

In 2012, 696,231 stomach cancer cases occurred in the world. Overall, 478,069 cases (68.66%) were males and 218,162 cases (31.34%) females. Sex ratio in Asia was 2.19. The highest number of cancer cases was seen in countries such as China with 404,996 cases, Japan with 107,898 cases, India with 63,097 cases, Republic Korea with 31,269 cases, and Vietnam with 14, 203 cases, respectively. The above countries included 621,463 new cases (89.26%) of all cases in Asia.

Among Asian countries, five countries with the highest standardized incidence rates of the cancer were Republic Korea with 41.8 per 100,000, Mongolia with 32.5 per 100,000, Japan with 29.9 per 100,000, China with 21.7 per 100,000, and Tajikistan with 21.7 per 100,000, respectively. Five countries with the lowest standardized incidence rates of the cancer were Timor-Leste with 2.3 per 100,000, Kuwait with 2.6 per 100,000, Indonesia with 2.8 per 100,000, Pakistan with 3 per 100,000, and Thailand with 3.1 per 100,000, respectively. The number, crude, and standardized incidence rates of the cancer in Asian countries based on sex are presented in Table 1.

Table 1. Number, Crude, and Standardized Incidence Rates of Stomach Cancer in Asian Countries in 2012 (Sorted by Age Standardized Rates from Highest to Lowest)

Stomach - Estimated incidence, all ages: both sexes				Stomach - Estimated incidence, all ages: male				Stomach - Estimated incidence, all ages: female			
POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)
Korea, Republic of	31269	64.4	41.8	Korea, Republic of	21338	88.1	62.3	Korea, Republic of	9931	40.7	24.7
Mongolia	646	22.7	32.5	Mongolia	431	30.7	47.4	Mongolia	215	14.9	20.2
Japan	107898	85.3	29.9	Japan	73970	120.2	45.7	Japan	33928	52.3	16.5
China	404996	29.7	22.7	Kyrgyzstan	616	22.9	35.7	Tajikistan	340	9.4	15
Tajikistan	871	12.3	21.7	Kazakhstan	2310	29.4	35.2	Turkmenistan	293	11.2	13.6
Kazakhstan	3650	22.3	21.6	China	283487	40.1	32.8	China	121509	18.6	13.1
Kyrgyzstan	847	15.5	21.4	Tajikistan	531	15.3	30.1	Kazakhstan	1340	15.7	12.8
Turkmenistan	701	13.6	18.2	Turkmenistan	408	16	23.9	Turkey	4182	11.2	10.9
Bhutan	92	12.3	17.2	Armenia	429	29.6	23.7	Bhutan	28	7.9	10.8
Viet Nam	14203	15.8	16.3	Viet Nam	9406	21.2	23.7	Kyrgyzstan	231	8.4	10.3
Iran, Islamic Republic of	9660	12.8	15.2	Bhutan	64	16.1	23	Viet Nam	4797	10.6	10.2
Armenia	691	22.2	15.1	Korea, Democratic Republic of	2809	23.3	22.1	Iran, Islamic Republic of	3020	8.1	9.7
Korea, Democratic Republic of	4403	17.9	14.3	Iran, Islamic Republic of	6640	17.3	20.6	Armenia	262	15.8	9.1
Turkey	10120	13.6	14.2	Azerbaijan	774	16.6	18.2	Azerbaijan	476	10	8.8
Azerbaijan	1250	13.3	13	Turkey	5938	16	17.9	Uzbekistan	1000	7.1	8.8
Afghanistan	1781	5.3	12.7	Afghanistan	1169	6.8	16.9	Korea, Democratic Republic of	1594	12.8	8.8
Uzbekistan	2561	9.1	12.5	Uzbekistan	1561	11.2	16.8	Afghanistan	612	3.8	8.6
Myanmar	4913	10.1	11.2	Myanmar	3109	13	15.3	Myanmar	1804	7.3	7.7
Georgia	711	16.5	9.6	Georgia	406	20	13.2	Georgia	305	13.4	7
Singapore	647	12.3	8.2	Singapore	402	15.2	10.9	Singapore	245	9.4	5.8
Malaysia	1900	6.5	7.8	Brunei	14	6.7	9.9	Malaysia	723	5	5.7
Brunei	23	5.6	7.4	Malaysia	1177	7.9	9.8	Qatar	9	1.9	5.6
Israel	777	10.1	7.1	Israel	480	12.6	9.7	Brunei	9	4.4	5.5
India	63097	5	6.1	India	43386	6.7	8.6	Jordan	106	3.4	5.3
Jordan	237	3.7	5.9	Cambodia	310	4.4	7.6	Sri Lanka	705	6.6	5.2
Qatar	39	2	5.8	Bangladesh	4055	5.3	7.5	State of Palestine	51	2.4	5.2
Sri Lanka	1470	6.9	5.8	Nepal	675	4.4	7.1	Israel	297	7.6	4.9
Bangladesh	6583	4.3	5.7	Iraq	492	2.9	6.6	Syrian Arab Republic	366	3.5	4.8
Syrian Arab Republic	818	3.9	5.6	Maldives	8	4.9	6.6	Lebanon	120	5.5	4.7
State of Palestine	119	2.8	5.5	Syrian Arab Republic	452	4.2	6.5	Iraq	444	2.6	4.4
Lebanon	257	6	5.5	Sri Lanka	765	7.3	6.5	Bangladesh	2528	3.4	4.1
Nepal	1126	3.6	5.3	Lebanon	137	6.5	6.5	Oman	24	2	3.9
Iraq	936	2.8	5.3	Jordan	131	3.9	6.5	Nepal	451	2.9	3.8
Oman	79	2.7	5.3	Oman	55	3.2	6.4	India	19711	3.2	3.7
Cambodia	507	3.5	5	Qatar	30	2	6	United Arab Emirates	30	1.2	3.4
United Arab Emirates	103	1.3	4.8	State of Palestine	68	3.1	5.8	Cambodia	197	2.7	3.3
Yemen	422	1.7	4	Yemen	279	2.2	5.8	Bahrain	10	2	3.1
Bahrain	29	2.1	3.9	United Arab Emirates	73	1.3	5.5	Philippines	1007	2.1	2.9
Philippines	2415	2.5	3.8	Philippines	1408	2.9	4.8	Yemen	143	1.1	2.5
Maldives	9	2.8	3.7	Bahrain	19	2.2	4.5	Thailand	1231	3.5	2.5
Saudi Arabia	531	1.8	3.1	Indonesia	3811	3.1	3.9	Saudi Arabia	195	1.5	2.4
Thailand	2841	4.1	3.1	Saudi Arabia	336	2.1	3.8	Pakistan	1432	1.6	2.2
Pakistan	3840	2.1	3	Pakistan	2408	2.6	3.8	Kuwait	12	1	2.1
Indonesia	6011	2.5	2.8	Thailand	1610	4.7	3.8	Indonesia	2200	1.8	1.9
Kuwait	40	1.4	2.6	Lao PDR	57	1.8	3	Timor-Leste	6	1	1.9
Lao PDR	99	1.6	2.3	Kuwait	28	1.6	2.8	Lao PDR	42	1.3	1.7
Timor-Leste	13	1.1	2.3	Timor-Leste	7	1.2	2.7	Maldives	1	0.6	0.7

Table 2. Number, Crude, and Standardized Mortality Rates of Stomach Cancer in Asian Countries in 2012 (Sorted by Age Standardized Rates from Highest to Lowest)

Stomach - Estimated mortality, all ages: both sexes				Stomach - Estimated mortality, all ages: female				Stomach - Estimated mortality, all ages: male			
POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)	POPULATION	Numbers	Crude Rate	ASR (W)
Mongolia	486	17.1	25.3	Mongolia	325	23.2	37.1	Mongolia	161	11.2	15.5
Tajikistan	790	11.2	19.8	Kyrgyzstan	551	20.5	32.9	Tajikistan	307	8.5	13.5
Kyrgyzstan	765	14	19.6	Kazakhstan	1923	24.4	30.3	Turkmenistan	255	9.7	12
Kazakhstan	3046	18.6	18	Tajikistan	483	13.9	27.7	China	103688	15.8	10.7
China	325166	23.9	17.9	China	221478	31.3	25.5	Kazakhstan	1123	13.2	10.5
Bhutan	89	11.9	16.5	Bhutan	62	15.6	22.2	Bhutan	27	7.7	10.3
Turkmenistan	608	11.8	16.3	Viet Nam	8591	19.4	21.9	Kyrgyzstan	214	7.8	9.5
Viet Nam	12931	14.4	14.9	Turkmenistan	353	13.9	21.6	Turkey	3577	9.6	9.3
Korea, Republic of	10746	22.1	13	Korea, Republic of	6911	28.5	19.6	Viet Nam	4340	9.6	9.1
Iran, Islamic Republic of	8247	10.9	12.9	Armenia	369	25.5	19.6	Afghanistan	585	3.6	8.5
Afghanistan	1690	5.1	12.7	Japan	33967	55.2	18.8	Iran, Islamic Republic of	2582	6.9	8.3
Japan	52326	41.4	12.4	Iran, Islamic Republic of	5665	14.8	17.3	Uzbekistan	902	6.4	8
Armenia	596	19.2	12.4	Afghanistan	1105	6.4	16.9	Korea, Republic of	3835	15.7	7.9
Turkey	8662	11.6	12.2	Korea, Democratic Republic of	2005	16.6	16.1	Azerbaijan	414	8.7	7.5
Uzbekistan	2296	8.2	11.5	Azerbaijan	665	14.2	16	Armenia	227	13.7	7.4
Azerbaijan	1079	11.5	11.2	Uzbekistan	1394	10	15.5	Myanmar	1693	6.8	7.3
Myanmar	4611	9.5	10.7	Turkey	5085	13.7	15.5	Japan	18359	28.3	7.3
Korea, Democratic Republic of	3283	13.4	10.5	Myanmar	2918	12.2	14.8	Korea, Democratic Republic of	1278	10.2	6.7
Georgia	597	13.9	7.6	Georgia	340	16.8	10.6	Georgia	257	11.3	5.4
India	59041	4.7	5.7	India	40721	6.3	8	State of Palestine	45	2.1	4.6
Brunei	16	3.9	5.5	Cambodia	286	4	7.4	Jordan	89	2.8	4.5
Bangladesh	6170	4	5.4	Brunei	10	4.8	7.2	Qatar	7	1.5	4.5
Singapore	431	8.2	5.3	Singapore	262	9.9	7	Sri Lanka	613	5.7	4.4
Qatar	31	1.6	5.1	Bangladesh	3816	4.9	7	Syrian Arab Republic	327	3.1	4.4
Nepal	1065	3.4	5.1	Nepal	640	4.2	6.9	Brunei	6	2.9	4.2
State of Palestine	107	2.5	5.1	Maldives	8	4.9	6.6	Iraq	407	2.4	4
Syrian Arab Republic	729	3.5	5.1	Iraq	449	2.7	6.2	Singapore	169	6.5	3.9
Jordan	202	3.1	5.1	Syrian Arab Republic	402	3.8	5.9	Bangladesh	2354	3.1	3.9
Sri Lanka	1276	6	4.9	Oman	47	2.7	5.8	Lebanon	99	4.5	3.8
Iraq	856	2.5	4.9	Israel	289	7.6	5.7	Nepal	425	2.7	3.7
Cambodia	469	3.2	4.8	Jordan	113	3.4	5.6	Israel	227	5.8	3.4
Oman	68	2.3	4.7	State of Palestine	62	2.9	5.6	Oman	21	1.8	3.4
Israel	516	6.7	4.5	Yemen	261	2	5.6	India	18320	3	3.4
Lebanon	211	4.9	4.5	Sri Lanka	663	6.3	5.5	Cambodia	183	2.5	3.1
United Arab Emirates	79	1	4.3	Qatar	24	1.6	5.4	Bahrain	7	1.4	2.9
Yemen	398	1.6	3.9	Lebanon	112	5.3	5.2	United Arab Emirates	21	0.8	2.8
Maldives	9	2.8	3.7	United Arab Emirates	58	1	5.2	Malaysia	350	2.4	2.8
Malaysia	873	3	3.6	Malaysia	523	3.5	4.5	Yemen	137	1.1	2.5
Bahrain	21	1.5	3.5	Philippines	1195	2.5	4.3	Philippines	848	1.8	2.5
Philippines	2043	2.1	3.3	Bahrain	14	1.6	3.9	Pakistan	1334	1.5	2.1
Pakistan	3583	2	2.8	Pakistan	2249	2.5	3.6	Saudi Arabia	161	1.2	2.1
Saudi Arabia	434	1.5	2.7	Indonesia	3430	2.8	3.5	Thailand	991	2.8	2
Indonesia	5406	2.2	2.5	Saudi Arabia	273	1.7	3.3	Timor-Leste	6	1	1.9
Thailand	2286	3.3	2.5	Thailand	1295	3.8	3.1	Lao PDR	40	1.3	1.7
Timor-Leste	13	1.1	2.3	Lao PDR	53	1.7	2.8	Indonesia	1976	1.6	1.7
Lao PDR	93	1.5	2.2	Timor-Leste	7	1.2	2.7	Kuwait	11	0.9	1.7
Kuwait	25	0.9	1.6	Kuwait	14	0.8	1.5	Maldives	1	0.6	0.7

Countries in the table are sorted from high to low based on the standardized incidence rate. The countries with the highest and lowest standardized incidence rate in both sexes are observable in Table 1 and Figure 1.

However, in 2012, in Asia, the number of deaths due to stomach cancer was 524,465 cases, 351,466 cases (67.1%) in men and 172,990 cases (32.99%) in women. The sex ratio (male to female) of mortality was equal to 2.03. The five countries with the highest number of deaths were china (325,166 cases), India (59,041 cases), Japan (52,326 cases), Vietnam (12,931 cases), and Republic Korea (10,746 cases), respectively. The countries included a total of 460,210 cases (87.74%) of the total mortality in Asia.

In Asian countries, 5countries with the highest standardized mortality rates from the cancer were Mongolia with 25.3 per 100,000, Tajikistan with 19.8 per 100,000, Kyrgyzstan with 19.6 per 100,000, Kazakhstan with 18 per 100,000, and China with 17.9 per 100,000, respectively. Five countries with the lowest standardized mortality rates from the cancer were Kuwait with 1.6 per 100,000, Lao PDR with 2.2 per 100,000, Timor-Leste with 2.3 per 100,000, Thailand with 2.5 per 100,000, and Indonesia with 2.5 per 100,000, respectively. The number, crude, and standardized incidence rates of the cancer in Asian countries based on sex are presented in Table 2. Countries in the table are sorted from high to low based on the standardized incidence rate. The countries with the highest and lowest standardized incidence rate are observable in both sexes in Table 2 and Figure 2.

Standardized incidence rate and HDI

A positive correlation was seen between the standardized incidence rate of stomach cancer and HDI about 0.241. This association was not statistically significant (p=0.106). There was a positive correlation between the standardized incidence rate and life expectancy at birth about 0.103 (p=0.498), positive correlation between the standardized incidence rate and mean years of schooling about 0.405 (p=0.005), and negative correlation between the level of income per each person of the population and the standardized incidence rate equal to 0.031 (p=0.838).

In men, a positive correlation of 0.236 was observed between the standardized incidence rate of stomach cancer and HDI. It was not statistically significant (p=0.114). There was a positive correlation between the standardized incidence rate and life expectancy at birth about 0.102 (p=0.502), positive correlation between mean years of schooling and the standardized incidence rate about 0.419 (p=0.005), and negative correlation between the level of income per each person of the population and the standardized incidence rate equal to -0.044 (p=0.774).

In women, a negative correlation of -0.250 was observed between the standardized incidence rate of stomach cancer and HDI. It was not statistically significant (p=0.094). There was a positive correlation between the standardized incidence rate and life expectancy at birth about 0.092 (p=0.545), positive correlation between mean years of schooling and the standardized incidence rate about 0.419 (p=0.004), and negative correlation between the level of income per each person of the population and the standardized incidence rate equal to -0.015 (p=0.923).

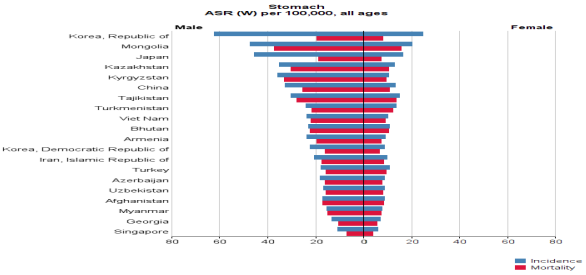

Figure 1. Standardized Incidence and Mortality Rates for Stomach Cancer in Asia in 2012

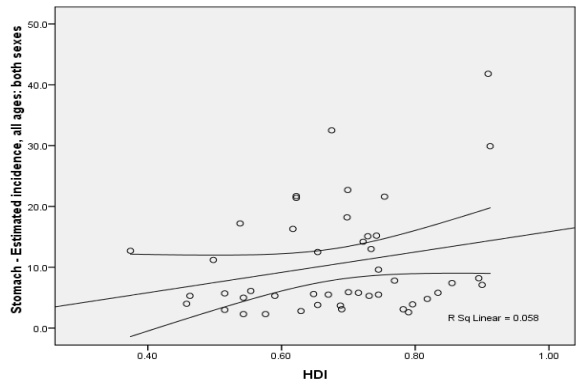

Figure 2. Correlation between HDI and Standardized Incidence of Stomach Cancer in Asia in 2012 (mean ± 95% Confidence Interval)

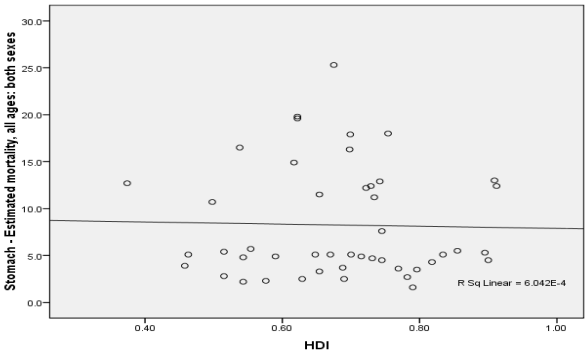

Figure 3. Correlation between HDI and Standardized Mortality Rates for Stomach Cancer in Asia in 2012 (mean ± 95% Confidence Interval)

The standardized mortality rate and HDI

There was between the standardized mortality rate for stomach cancer and HDI a negative correlation of 0.250 (p=0.871), expectancy at birth a negative correlation of -0.173 (p=0.252), mean years of schooling a negative correlation equal to-0.233 (p=0.119), and the level of income per each person of population a negative correlation of -0.213 (p=0.155).

In men, there was between the standardized mortality rate for stomach cancer and HDI a negative correlation of 0.018 (p=0.903), expectancy at birth a negative correlation of 0.165 (p=0.274), mean years of schooling a positive correlation equal to 0.253 (p=0.090), and the level of income per each person of population a negative correlation of 0.223 (p=0.136).

In women, there was between the standardized mortality rate for stomach cancer and HDI a negative correlation of 0.014 (p=0.927), expectancy at birth a negative correlation of 0.178 (p=0.237), mean years of schooling a negative correlation equal to 0.241 (p=0.106), and the level of income per each person of population a negative correlation of 0.190 (p=0.207).

Discussion

According to the International Agency for Research on Cancer in 2013, global and regional burden of stomach cancer is very high. However, the incidence and mortality of the cancer are widely different according to geographic, social, cultural, and economic conditions of regions. Also in 2008, stomach cancer is the third most common cancer and the second leading cause of cancer death in both sexes in Asia (Rahman et al., 2014). Therefore, it seems necessary to investigate standardized incidence and mortality rates of stomach cancer and heir relationship with HDI in Asian countries.

The findings of our study showed that there was a positive linear correlation between the standardized incidence rate stomach cancer and HDI. Among Asian countries, the Republic of Korea, Mongolia, Japan, China, and Tajikistan with very high and middle HDI had the highest standardized incidence of the cancer. The lowest standardized incidence of the cancer was seen in Timor-Leste, Kuwait, Indonesia, Pakistan, and Thailand with middle HDI. Life expectancy at birth is

one of the components of the HDI. In this study, the standardized incidence rate was positively correlated with life expectancy at birth. Although the increase in life expectancy is taken into account as a great success, a proven global development, and improvement of the standard of living, population aging has profound implications on the burden of diseases (Kaplan et al., 2013). It is anticipated the proportion of new cases of cancer diagnosed in less developed countries will be 56% in 2008 to over 60% in 2030Because of the increase in cancer rates and increased life expectancy and population growth (Jemal et al., 2010). Chen also revealed that the incidence of stomach cancer in the periods studied (1998-2010) was increased with age in both sexes (Chen et al., 2013).

In our study, the standardized incidence rate was positively correlated with mean years of schooling. There was also negative correlation between the standardized incidence rate and the level of income per person of population. Patients with higher incomes than those with lower income may have more opportunistic and organized screening and therefore the disease is earlier diagnosed (Lee et al., 2010). Routes through which socio-economic status increases the risk of stomach cancer have not been proven. However, studies have shown that risk factors for stomach cancer include Helicobacter pylori infection, genetic, and lifestyle factors, such as dietary habits, obesity, and smoking, which are associated with low SEP. Thus, increasing the risk of stomach cancer among people with lower levels of education and low-income may be influenced by the above factors (Uthman et al., 2013). The findings of our study showed that the standardized mortality of stomach cancer is different in countries in Asia (from 25.3 in Mongolia to 1.6 in Kuwait). Five countries with the highest standardized mortality rates from stomach cancer were Mongolia, Tajikistan, Kyrgyzstan, Kazakhstan, and China, respectively. Also, Kuwait, Lao PDR, Timor-Leste, Thailand, and Indonesia had the lowest standardized mortality of stomach cancer. The standardized mortality of stomach cancer had a negative linear correlation with the HDI. The negative correlation was observed between the components of the HDI (life expectancy at birth, mean years of education, and income levels) and standardized mortality. In general, the observed difference in incidence, mortality, and survival of cancer in developed countries compared with less developed countries reflects regional differences in the prevalence, distribution of individual and social risk factors, improving access to health care, diagnostic practices, or the availability of treatment (Patel et al., 2012). Kuwahara et al. studied the relationship between occupation and education, and the survival of stomach cancer in Japan. They reported that mainly due to less access to screening programs for unemployed people and manual workers, and therefore diagnosis in more advanced stages of disease and poor prognosis of survival was less in those than skilled and administrative staff (Kuwahara et al., 2010). Another study in 2007 showed that cancer mortality rate in the United States for people with the lowest educational level (less than 12 years) was more than double than those with the highest educational level (greater than 16 years). As well as, elimination of educational and racial inequality can potentially prevent about 37% of premature mortality from cancer in people 25 to 64 years (Siegel et al., 2011). The results of a study to evaluate the effect of SES on mortality in patients with stomach cancer in Taiwan between 2002 and 2006 revealed that the risk of death in patients less than 65 years who suffered from stomach cancer with high SES was 68% lower than patients with low SES (Wu et al., 2014). Tanaka et al. reported that age-standardized mortality rates (ASMR) of stomach cancer was lower in all four regions during the period of observation. Japan had the highest ASMR in both sexes, and then Singapore, Hong Kong, and the United States had the next ranks. Possible causes for the reduction in ASMR of stomach cancer were improvements in the social and economic conditions in childhood, reducing the prevalence of H. pylori infection, rand salt intake in the diet, and improvements of cancer diagnosis and treatment (Tanaka et al., 2012).

In conclusion: the incidence of Stomach cancer is high in countries with greater development. A no significant and positive correlation was observed between the SIR of Stomach cancer, and the HDI and its dimensions, such as life expectancy at birth, mean years of schooling, and income level of the population per each person of population. In addition, there was no significant correlation between the SMR, and the HDI and its dimensions.

The limitations of study: Our study was an ecological study and due to special limitations of this study including ecological misleading and lack of relation of group results with individuals. Also in this study exact survey about the connection between exposure and outcome is not clearly obvious and all other seen relations were in group and regional level.

References

Bray F, Jemal A, Grey N, et al (2012). Global cancer transitions according to the human development index (2008–2030): a population-based study. *Lancet Oncol*, **13**, 790-801.

Chen WY, Cheng HC, Wang JD, et al (2013). Factors that affect life expectancy of patients with gastric adenocarcinoma. *Clinical Gastroenterology Hepatol*, **11**, 1595-600.

Danaei G, Vander Hoorn S, Lopez AD, et al (2005). Causes of cancer in the world: comparative risk assessment of nine behavioural and environmental risk factors. *Lancet*, **366**, 1784-93.

Ferlay J, Soerjomataram I, Dikshit R, et al (2015). Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *Int J Cancer*, **136**, 359-86.

Ferro A, Peleteiro B, Malvezzi M, et al (2014). Worldwide trends in gastric cancer mortality (1980–2011), with predictions to 2015, and incidence by subtype. *European J Cancer*, **50**, 1330-44.

Ghoncheh M, Mirzaei M, Salehiniya H (2015a). Incidence and mortality of breast cancer and their relationship with the human development index (HDI) in the world in 2012. *Asian Pac J Cancer Prev*, **16**, 8439-43.

Ghoncheh M, Mohammadian-Hafshejani A, Salehiniya H (2015b). Incidence and mortality of breast cancer and their relationship to development in Asia. *Asian Pac J Cancer Prev*, **16**, 6081-7.

Hou J, Walsh PP, Zhang J (2015). The dynamics of human development index. *The Social Science Journal*, **52**, 331-347.

Hu Q-D, Zhang Q, Chen W, et al (2013). Human development index is associated with mortality-to-incidence ratios of gastrointestinal cancers. *World J Gastroenterol*, **19**, 5261.

Jemal A, Bray F, Center MM, et al (2011). Global cancer statistics. *CA Cancer J Clin*, **61**, 69-90.

Jemal A, Center MM, DeSantis C, et al (2010). Global patterns of cancer incidence and mortality rates and trends. *Cancer Epidemiol Biomarkers Prevent*, **19**, 1893-907.

Kaplan W, Wirtz VJ, Mantel-Teeuwisse A, et al (2013). Priority medicines for Europe and the World 2013 update. world health organization 20 avenue appia 1211 geneva 27 switzerland.

Kim JM, Kim HM, Jung BY, et al (2012). The association between cancer incidence and family income: analysis of Korean National Health Insurance cancer registration data. *Asian Pac J Cancer Prev*, **13**, 1371-6.

Klugman J (2011). Human Development Report 2011. Sustainability and Equity: A Better Future for All. Sustainability and equity: a better future for All (November 2, 2011). UNDP-HDRO Human Development Reports.

Kuwahara A, Takachi R, Tsubono Y, et al (2010). Socioeconomic status and gastric cancer survival in Japan. *Gastric Cancer*, **13**, 222-30.

Lee HY, Park EC, Jun JK, et al (2010). Trends in socioeconomic disparities in organized and opportunistic gastric cancer screening in Korea (2005-2009). *Cancer Epidemiol Biomarkers Prev*, **19**, 1919-26.

Malik K (2013). Human development report 2013. The rise of the South: Human progress in a diverse world. The Rise of the South: Human Progress in a Diverse World (March 15, 2013). UNDP-HDRO Human Development Reports.

McDonald M, Hertz RP, Lowenthal SWP (2008). The burden of cancer in Asia. Pfizer Medical Division. Pfizer Incorporation, USA.

Nagel G, Linseisen J, Boshuizen HC, et al (2007). Socioeconomic position and the risk of gastric and oesophageal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC-EURGAST). *Int J Epidemiol*, **36**, 66-76.

Oakes JM, Kaufman JS 2006. Methods in social epidemiology, John Wiley & Sons.

Orach CG (2009). Health equity: challenges in low income countries. *African Health Sciences*, **9**, 49-51.

Pakzad R, Mohammadian-Hafshejani A, Mohammadian M, et al (2015). Incidence and Mortality of Bladder Cancer and their Relationship with Development in Asia. *Asian Pac J Cancer Prev*, **16**, 7365-74.

Patel AR, Prasad SM, Shih Y-CT, et al (2012). The association of the human development index with global kidney cancer incidence and mortality. *J Urol*, **187**, 1978-83.

Pourhoseingholi MA, Vahedi M, Baghestani AR (2015). Burden of gastrointestinal cancer in Asia; an overview. *Gastroenterol Hepatol Bed Bench*, **8**, 19.

Rahman R, Asombang AW, Ibdah JA (2014). Characteristics of gastric cancer in Asia. *World J Gastroenterol*, **20**, 4483.

Siegel R, Ward E, Brawley O, et al (2011). Cancer statistics, 2011. *CA Cancer J Clin*, **61**, 212-36.

Smith RA, Brooks D, Cokkinides V, et al (2013). Cancer screening in the United States, 2013: a review of current American Cancer Society guidelines, current issues in cancer screening, and new guidance on cervical cancer screening and lung cancer screening. *CA Cancer J Clin*, **63**, 88-105.

Tanaka M, Ma E, Tanaka H, et al (2012). Trends of stomach cancer mortality in Eastern Asia in 1950-2004: comparative study of Japan, Hong Kong and Singapore using age, period and cohort analysis. *Int J Cancer*, **130**, 930-6.

Thaler JP, Cummings DE (2009). Minireview: Hormonal and metabolic mechanisms of diabetes remission after gastrointestinal surgery. *Endocrinol*, **150**, 2518-25.

Uthman OA, Jadidi E, Moradi T (2013). Socioeconomic position and incidence of gastric cancer: a systematic review and meta-analysis. *J Epidemiol Community Health*, jech-2012.

Wu CC, Hsu TW, Chang CM, et al (2014). The effect of individual and neighborhood socioeconomic status on gastric cancer survival. *PLoS One*, **9**, e89655.