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Assessment the relationship between Testis Cancer incidence and mortality rate with human development index in the European countries in 2012

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ABSTRACT

Testis Cancer (TC) is the most common cancer in 15-39 year-old men and with the white Caucasian race. This cancer consists of 0.7 percent of men's cancer all over the world. The aim of this study is to investigate the relationship between the Age-Standardised Incidence Rates (ASIR) and Age-Standardised Mortality Rates (ASMR) of TC with Human Development Index (HDI) and its components at the European countries in 2012. This study was an ecologic study in European countries for assessment the correlation between ASIR and ASMR with HDI and its details including: Life expectancy at birth, Mean years of schooling and Gross National Income (GNI) per capita. We use correlation bivariate method for assessment the correlation between SIR and SMR with HDI and its components. Data of study was analyzed by SPSS15statistical analysis software; the significance level of the tests was considered P<0.05. The results of the data investigation showed that the maximum ASIR of TC was observed respectively in the countries of Norway, Switzerland, and Denmark. Moreover findings showed the highest ASMR was in the countries of Hungary, Bulgaria and FYR Macedonia. The ASIR was positively correlated with HDI equal to 0.623(p≤0.001), with Life expectancy at birth equal to 0.602(p≤0.001), with the average years of schooling equal to 0.339(p=0.032) and with country's Gross National Income (GNI) per capita equal to 0.466(p=0.002).The ASMR was negatively correlated with HDI equal to 0.537(p≤0.001), life expectancy at birth equal to

0.598($p \leq 0.001$),average years of schooling equal to 0.107($p=0.510$) and with counter's GNI per capita equal to 0.521($p \leq 0.001$). Data from this study shows importance of using HDI and its components as relative factor on the ASIR and ASMR of TC.

Keywords: Testis Cancer, HDI, Correlation, Incidence, Mortality, Europe.

INTRODUCTION

Testis Cancer (TC) is the most common cancer in 15-39 years-old men with the white Caucasian race. This cancer consists 0.7 percent of men's cancer all over the world [1]. In western societies the TC is the agent of 1-1.5 percent of men's cancer and 5 percent of all urinary tract cancer; the annual incidence rate of TC in these societies is equal to 3-6 new cases per 100,000 person at risk[2]. The incidence rate of TC in the past 50 years in the worldwide has increased trend, [3]. So that the number of new cases of TC in the world in 2008 is more than 52000 cases [4]; in 2012 it is estimated 55,000 cases [1]. The largest increase in the incidence of TC was observed in Caucasian white race while the lowest rate of TC was observed in non-white races [5]. So, the highest incidence of TC has occurred in the west (8.7) and northern Europe (7.2) and the lowest incidence has occurred in Asian and Africa (less than 1) in 2012 [3]. Among European countries there is a 7 times difference in the incidence rate of TC [6]. The mortality rate from TC in the past 50 years has decreased in developed countries such as Denmark [7], England, wales [8] and Scotland [9]. But the reduction in the mortality rate of TC is not observed in the countries of west, central and east Europe [10]. In addition, significant differences can be seen in ASIR for TC among white Caucasian race and non-white [11-13]. The prognosis of TC in the late1970 has been much improved by increasing the survival rate of patients to 90-95 percent [14]. As a result, from the 10,000 TC deaths in the word in 2012, only 2200 deaths occurred in advanced areas.

In the last 30 years, numerous studies have been conducted to identify the risk factors for TC [15]. One of these risk factors is socioeconomic status (SES) [16]. Most of the studies that have examined the relationship between SES and TC have used social category and education as indicators of SES [15]. In these studies, various results were observed regarding the association among SES and morbidity and mortality from TC [17]. For example, in a study conducted in Finland, a significant relationship has been observed between the high socioeconomic level and TC [18], while in the studies conducted in America and Denmark; no relationship was seen [19-21]. Also, in the studies in other regions of the world inverse relationship was observed [22, 23]. According to our information, no study has been done still about the relationship between the ASIR and ASMR of TC with HDI and its two components including: life expectancy at birth and the country's level of income per one person in European countries. Therefore in this study, the relationship between the ASIR and ASMR of TC with HDI and its components including: Life expectancy at birth, the average years of schooling, and the country's (GNI) per capita in European countries in 2012 has been investigated. We used GLOBOCAN data and the human development reports. Also, in the study human development index was used as an indicator of socio-economic development [24].

MATERIALS AND METHODS

This study was an ecologic study in European countries for appraisal the correlation among age-specific incidence rate (ASIR) and age-specific mortality rate (ASMR) with Human Development Index (HDI) and its details including: Life expectancy at birth, average years of schooling and Gross National Income (GNI) per capita. Data about the ASIR and ASMR for every European countries for year 2012 had gathered from global cancer project that is available in (http://globocan.iarc.fr/Default. aspx)[25], and Human Development Index (HDI) from Human Development Report 2013 which include information about HDI and its details for every country in the word for year 2012 [26].

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 (ASIR)

The methods of estimation are country specific and the quality of the estimation depends upon the quality and on the amount of the available information for each country. In the 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 which 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 both with the estimation for each country with an aim of providing a broad indication of the robustness of the estimation.

The methods for estimating the sex and ASIR 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 modelling, which uses incidence mortality ratios derived from recorded data in country-specific cancer registries (13 countries)-4- Estimated from national mortality estimated by modeling which uses incidence mortality ratios derived from recorded data in local cancer registries in neighboring countries (9 European countries)-5-Estimated from national mortality estimates that uses survival models(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 neighbore countries or registries in the same area (33 countries) [1,27,28].

Age-specific mortality rate (ASMR)

Depending on the degree of details and accuracy of the national mortality data, six methods have been utilized 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 which estimates by modelling, and country-specific survival (2 countries)-5-Estimated from national incidence that estimates by using survival models (83 countries)-6-The rates are those of neighboring countries or registries in the same area (3 countries)[1,28,29].

Human development index (HDI)

Human Development Index (HDI) is a composite measure of indicators along three dimensions including: 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. Nevertheless, national averages hide large variations in human experience. Wide disparities which remain within countries of both the North and the South, and income inequality within and between many countries has been rising [26].

Ethical issues

The research followed the tenets of the Declaration of Helsinki.

Statistical analysis

In this study, we used the bivariate correlation method for assessment. We calculated the correlation between ASIR and ASMR with 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 by $P<0.05$. All reported P-values are two-sided. Statistical analyses were performed using SPSS (Version 15.0, SPSS Inc.).

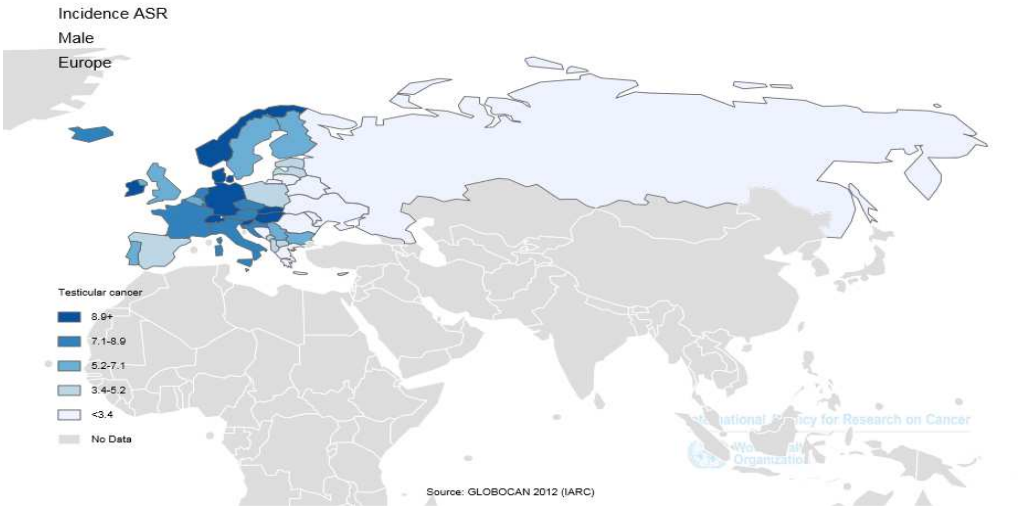
RESULTS

Overall in 2012, European countries have recorded 21548 new cases of TC, in that the 5 countries with the highest number of cases are as follow: Germany with 4031 cases, Italy with 2664 cases, France (metropolitan) with 2332 cases, the united kingdom with 20163 cases, Russian federation with 1330 cases, that these five countries totally have allocated 12520 cases (58.14%) of new cases of TC to themselves.

Table1. Number, crude, and ASIR of TC in European countries in 2012

Testis - Estimated incidence, all ages				Testis - Estimated mortality, all ages			
Population	**Numbers**	**Crude Rate**	**ASR (W)**	**Population**	**Numbers**	**Crude Rate**	**ASR (W)**
Norway	313	12.6	12.2	Bulgaria	41	1.1	0.9
Switzerland	453	11.9	12.1	Hungary	50	1.1	0.9
Denmark	336	12.1	11.9	FYR Macedonia	10	1.0	0.8
Hungary	566	12.0	10.9	Belarus	41	0.9	0.7
Slovenia	111	11.1	10.8	Croatia	18	0.9	0.7
Germany	4031	10.0	9.7	Bosnia Herzegovina	15	0.8	0.7
Slovakia	284	10.7	9.3	Serbia	39	0.8	0.7
Ireland	216	9.4	9.3	Slovakia	18	0.7	0.6
Croatia	194	9.2	8.8	Ukraine	133	0.6	0.5
The Netherlands	709	8.5	8.7	Poland	116	0.6	0.5
Italy	2664	8.9	8.7	Republic of Moldova	10	0.6	0.5
Czech Republic	496	9.6	8.6	Russian Federation	399	0.6	0.5
Luxembourg	22	8.4	8.2	Slovenia	5	0.5	0.5
Austria	368	8.9	8.2	Estonia	3	0.5	0.5
France (metropolitan)	2332	7.5	7.6	Romania	63	0.6	0.5
Iceland	12	7.3	7.2	Austria	25	0.6	0.5
Sweden	329	6.9	7.0	Czech Republic	30	0.6	0.4
Malta	16	7.7	6.9	Latvia	6	0.6	0.4
United Kingdom	2163	7.0	6.8	Switzerland	19	0.5	0.4
Bulgaria	220	6.2	6.2	Greece	27	0.5	0.4
Portugal	302	5.8	6.0	Denmark	11	0.4	0.3
Belgium	300	5.7	5.8	Norway	12	0.5	0.3
Finland	144	5.4	5.7	Albania	7	0.4	0.3
Serbia	285	5.8	5.5	Cyprus	2	0.3	0.3
Poland	939	5.1	4.7	The Netherlands	26	0.3	0.3
Montenegro	14	4.5	4.6	Portugal	18	0.3	0.3
Latvia	55	5.3	4.6	France (metropolitan)	98	0.3	0.3
FYR Macedonia	51	4.9	4.4	Germany	146	0.4	0.3
Albania	75	4.6	4.3	Lithuania	5	0.3	0.3
Cyprus	28	4.9	4.2	Italy	82	0.3	0.2
Estonia	23	3.7	3.5	Ireland	5	0.2	0.2
Spain	823	3.6	3.5	Belgium	13	0.2	0.2
Bosnia Herzegovina	59	3.3	3.0	United Kingdom	64	0.2	0.2
Romania	340	3.3	2.9	Sweden	9	0.2	0.2
Belarus	131	3.0	2.6	Spain	42	0.2	0.1
Ukraine	570	2.8	2.5	Finland	4	0.2	0.1
Greece	157	2.8	2.5	Iceland	0	0.0	0.0
Lithuania	34	2.2	2.0	Montenegro	0	0.0	0.0
Republic of Moldova	37	2.2	2.0	Luxembourg	0	0.0	0.0
Russian Federation	1330	2.0	1.7	Malta	0	0.0	0.0

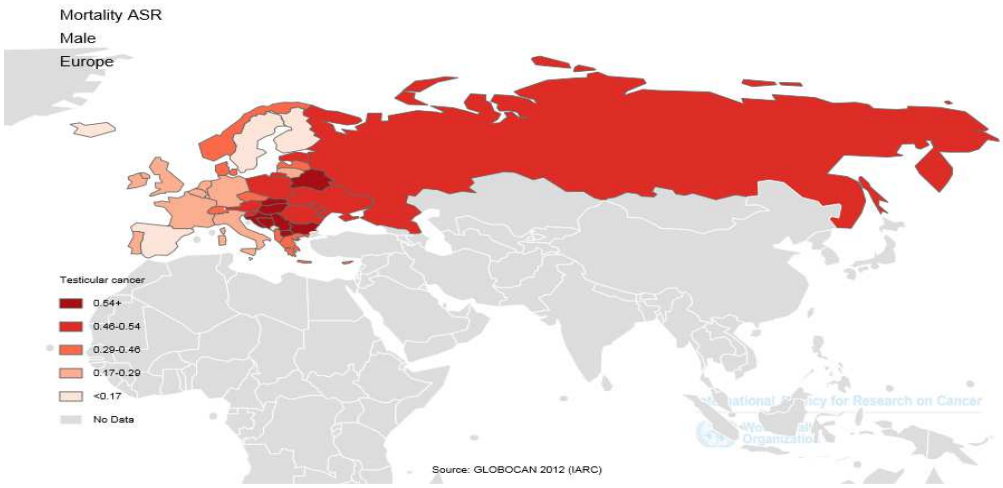
Among European countries, five countries with the highest ASIR of the TC are as follow; Norway with 12.2 per 100,000, Switzerland with 12.1 per 100,000, Denmark with 11.9 per 100,000, Hungary with 10.9 per 100,000, and Slovenia with 10.8 per 100,000, respectively. Five countries with the lowest ASIR of the TC were Russian Federation with 1.7 per 100,000, Republic of Moldova with 2 per 100,000, Lithuania with 2 per 100,000, Ukraine with 2.5 per 100,000, and Greece with 2.5 per 100,000, respectively. The number, crude rates and ASIR of the TC in European countries based on sex are presented in Table 1. The countries with the highest and lowest ASIR in both sexes are observable in Table 1, Figure 1 and Map 1.



Map 1: Distribution of the ASIR of TC in European countries in 2012

On the other hand in Europe countries in 2012, 1612 cases of deaths occurred due to TC, that among them the five countries with the highest number of death as are as follows; Russian federation with 399 cases, Germany with 146 cases, Ukraine with 133 cases, Poland with 116 cases and France (metropolitan) with 98 cases, that these five countries totally have allocated 892 cases (55.33%) of death cases of TC to themselves.

In European countries, the five countries with the highest ASMR from TC are as follows: Bulgaria with 0.9% per 100,000, Hungary with 0.9% per 100,000, FYR Macedonia with 0.8% per 100,000, Serbia with 0.7% per 100,000 and Croatia with 0.7% per 100,000, respectively. Similarly, the five countries with the lowest ASMR from TC are as follow: Malta, Luxembourg, Montenegro, ice land with ASMR that is equal to 0 and Finland with ASMR that is equal to 0.1 per 100,000 (Table and Figure number 1 and Map number 2).



Map 2: Distribution of ASMR of TC in European countries in 2012

In 2012, the number of 21548 new cases of TC were observed in the European countries, that the number of 20741 cases(96.25%) are in the age group below 65 years old and 807 cases, (03.75%) are in the age group 65 years old and more. According to the forecasts it is expected that in the years 2015,2020,2025,2030,2035 the number of new cases respectively be equal to 21175,20555,20091,19672,19206 which shows that over these years compared to the year 2012. The number of new cases of TC respectively reduced to 373, 993, 1457, 1876 and 2342 cases. In fact, over these years compared to the year 2012, the number of new cases respectively has been reduced to 1.73%, 4.60%, 06.76%, 08.70% and 10.88%. Although, it is predicted that the number of new cases of TC has been reduced

between the years 2012 and 2035, but it is expected that this reduction will be more in the age group below 65 and in the age group 65 and more number of new cases will increases.

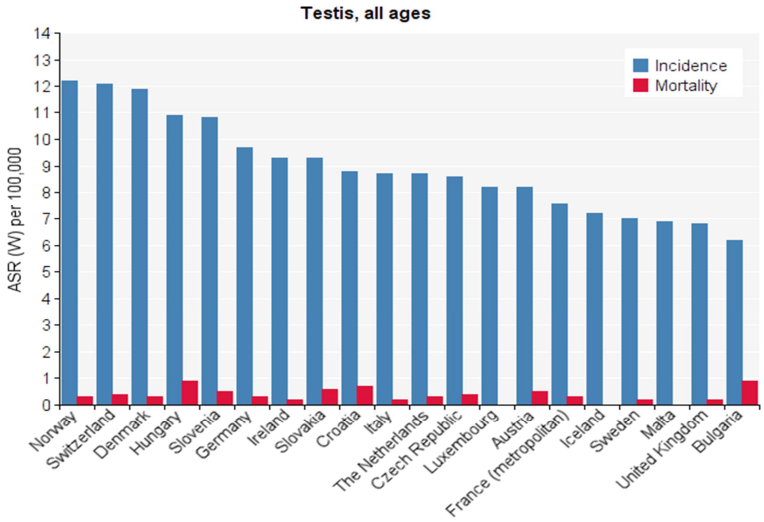


Figure 1: ASIR and ASMR from TC in European countries in 2012

Table 2: Estimated number of morbidity and mortality from TC in Europe in 2012-2035

Year	Age group	Estimated number of new cancers	Age group	Estimated number of cancer deaths
2012		21548		1612
	ages < 65	20741	ages < 65	1221
	ages >= 65	807	ages >= 65	391
2015		21175		1619
	ages < 65	20316	ages < 65	1207
	ages >= 65	859	ages >= 65	412
	Demographic change	-373		7
	ages < 65	-425	ages < 65	-14
	ages >= 65	52	ages >= 65	21
2020		20555		1623
	ages < 65	19616	ages < 65	1174
	ages >= 65	939	ages >= 65	449
	Demographic change	-993		11
	ages < 65	-1125	ages < 65	-47
	ages >= 65	132	ages >= 65	58
2025		20091		1644
	ages < 65	19061	ages < 65	1149
	ages >= 65	1030	ages >= 65	495
	Demographic change	-1457		32
	ages < 65	-1680	ages < 65	-72
	ages >= 65	223	ages >= 65	104
2030		19672		1666
	ages < 65	18545	ages < 65	1120
	ages >= 65	1127	ages >= 65	546
	Demographic change	-1876		54
	ages < 65	-2196	ages < 65	-101
	ages >= 65	320	ages >= 65	155
2035		19206		1683
	ages < 65	18002	ages < 65	1092
	ages >= 65	1204	ages >= 65	591
	Demographic change	-2342		71
	ages < 65	-2739	ages < 65	-129
	ages >= 65	397	ages >= 65	200

Population forecasts were extracted from the United Nations, World Population prospects, the 2012 revision.
Numbers are computed using age-specific rates and corresponding populations for 10 age-groups.
GLOBOCAN 2012 (IARC) - 15.3.2016

Also, in 2012, the number of 1612 cases of death were observed in European countries that among them 1221 case(75.74%) were in the age group below 65 years and 391 cases, (24.26%) were in the age group 65 year and more. According to the forecasts it is expected that in the years 2015,2020,2025,2030 and 2035 the number of death cases respectively be equal to 1683,1666,1644,1623 and 1619 cases which shows that over these years compared to 2012 the number of deaths from the disease respectively will reduce to 7,11,32,54,71 cases. Although it is expected that the number of deaths from TC reduces between 2012 and 2035, but it is expected that this reduction will be observed more in the age group below 65 and in the age group 65 and more number of deaths will increases.

In the table number 3 the respective value of the HDI and its components has been shown for each of European countries that are arranged according to the HDI index. Thus in European countries in terms of HDI is classified as follows, so that 29 countries in the HDI classified in very high category ,9 countries in high category and 2 countries in the medium category.

Table3. Human development index (HDI) in European countries in 2012

HDI status	POPULATION	Human Development Index(HDI)	Life expectancy at birth	Mean Year of schooling	Gross national income (GNI) per capita
Very high human development	Norway	0.955	81.3	12.6	48688
	The Netherlands	0.921	80.8	11.6	37282
	Germany	0.92	80.6	12.2	35431
	Ireland	0.916	80.7	11.6	28671
	Sweden	0.916	81.6	11.7	36143
	Switzerland	0.913	82.5	11	40527
	Iceland	0.906	81.9	10.4	29176
	Denmark	0.901	79	11.4	33518
	Belgium	0.897	80	10.9	33429
	Austria	0.895	81	10.8	36438
	France (metropolitan	0.893	81.7	10.6	30277
	Finland	0.892	80.1	10.3	32510
	Slovenia	0.892	79.5	11.7	23999
	Spain	0.885	81.6	10.4	25947
	Italy	0.881	82	10.1	26158
	Luxembourg	0.875	80.1	10.1	48285
	United Kingdom	0.875	80.1	9.4	32538
	Czech Republic	0.873	77.8	12.3	22067
	Greece	0.86	80	10.1	20511
	Cyprus	0.848	79.8	9.8	23825
	Malta	0.847	79.8	9.9	21184
	Estonia	0.846	75	12	17402
	Slovakia	0.84	75.6	11.6	19696
	Hungary	0.831	74.6	11.7	16088
	Poland	0.821	76.3	10	17776
	Lithuania	0.818	72.5	10.9	16858
	Portugal	0.816	79.7	7.7	19907
	Latvia	0.814	73.6	11.5	14724
	Croatia	0.805	76.8	9.8	15419
High human development	Belarus	0.793	70.6	11.51	13385
	Montenegro	0.791	74.8	10.5	10471
	Russian Federation	0.788	69.1	11.7	14461
	Romania	0.786	74.2	10.4	11011
	Bulgaria	0.782	73.6	10.6	11474
	Serbia	0.769	74.7	10.2	9533
	Albania	0.749	77.1	10.4	7822
	Ukraine	0.74	68.8	11.3	6428
	Bosnia Herzegovina	0.735	75.8	8.3	7713
Medium human development	Republic of Moldova	0.66	69.6	9.7	3319
	FYR Macedonia	0.59	69.6	5.6	3557

ASIR and HDI

Between the ASIR of TC and HDI is a positive correlation equal to 0.623, this relationship was statically significant ($p \leq 0.001$). Also between the components of the HDI and ASIR is a positive correlation. So that the ASIR with life expectancy in birth had positive correlation equal to 0.602($p \leq 0.001$), with the average years of education had

positive correlation equal to 0.339(p=0.032), and with GNI per capita had positive correlation equal to 0.466(p=0.002) (figure 2).

ASMR and HDI

On the other hand between the ASMR of TC and HDI is a negative correlation equal to 0.537, this association was statistically significant (p≤0.001). Also between the components of the HDI and ASMR was a negative correlation, so that the ASMR with life expectancy at birth has a negative correlation equal to 0.598(p≤0.001), with the average years of education had a negative correlation equal to 0.107(p=0.510), and with GNI per capita had a negative correlation equal to 0.521(p≤0.001) (figure 3).

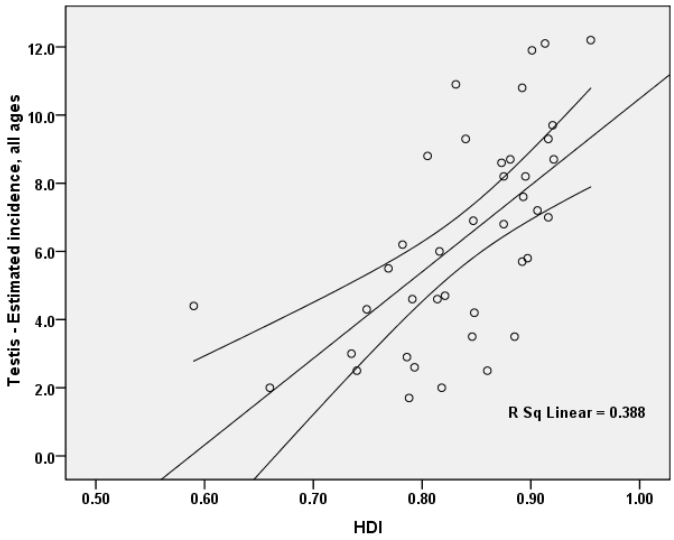


Figure2: Correlation between HDI and ASIR of TC in European countries in 2012

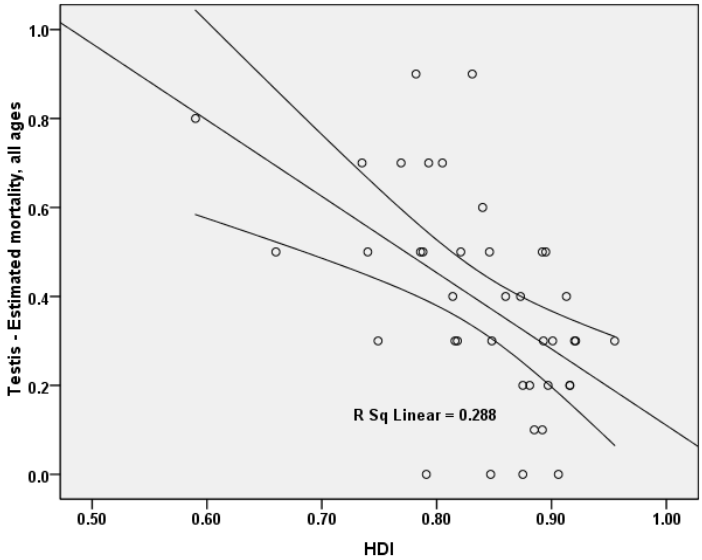


Figure3: Correlation between HDI and ASMR for TC in European countries in 2012

DISCUSSION

In the present study the relationship between the ASIR and ASMR of TC with HDI and its three components were examined in European countries in 2012. We found that between the ASIR of TC and HDI and its components was a

positive correlation and between the ASMR of TC and HDI and its components was a negative correlation .Also, it is anticipated that between 2012 and 2035, the number of new cases and the number of deaths from TC in the age group below 65 years has been declined and in the age group of 60 and more has been increased.

According to our information no studies has been done about the relationship between the ASIR and ASMR of TC with HDI and its two components including: life expectancy at birth and country's GNI per capita in European countries. But about the relationship between the incidence rate of TC and third component of HDI which is the average years of schooling across these countries, several studies have been conducted, the results of some of these studies showed the direct link between the risk of TC incidence and high levels of education. For example, in a study conducted by Rimpelä AH in 1987 in Finland, a direct relationship was observed between the ASIR of TC and high level of education [18]. Also, in a study conducted in England by Swerdlow and et al in a 1991, a direct relationship was observed between the risk of TC and the high level of education [16]. In another study conducted in Germany by Schmeisser in 2013, also the same results were observed [17]. This is while according to other studies conducted in other European countries no relationship was obseved between the incidence rate of TC and the level of education or even this relationship is inverse in some researches. So that in a study conducted in Denmark by Moller and et al, in 1996 there is no relationship between TC risk and level of education [21]. Similarly in another study conducted by Marså and et al in Denmark in 2008, also no relationship was observed between the incidence rate of TC and education level [20]. In another study conducted by Pukkala and et al in Finland in 2002, the reduced incidence rate of TC in people with high social class and increased incidence rate in people with low social class was observed [23].

In the present study, the probable cause of the observed direct correlation between the ASIR of TC with HDI and its components could be that in countries with higher levels of HDI, diagnostic and screening programs are done formally and with better facilities and equipment than those in the lower level of HDI. So in these countries, the likelihood of identifying and patients reporting is more. On the other hand the probable cause of the inverse relationship and reduced level of mortality with increase in HDI could be due to patient's access to medical facilities and equipment's and better care in these countries than countries with lower levels of HDI.

The limitation of this study was the observed differences in the ASIR and ASMR of TC in European countries which could be due to different quality of collection methods and data reporting, and also access to different methods of diagnosis and care among these countries. It should also be noted that this study is an ecological study and its results can be interpret only at the population level and attribution of the results of this study to individual levels lead to occurrence of ecological fallacy.

This study also has some advantages. The first advantage is that we studied all European countries. So the data have perfect integrity. The second advantage is that our findings showed the introduction of HDI and its components as risk factors for ASIR and ASMR of TC in European countries which can help determining the risk factors of this disease more. The third advantage is the novelty of findings because we couldn't find a study that shows the relationship between the ASIR and ASMR of TC with HDI and its components. Accordingly, it is proposed that similar studies in other parts of the word should be done so that the relationship hypothesis between the incidence and mortality rate of TC and HDI in these regions can be examined.

CONCLUSION

According to the results of this study, between the ASIR of TC with HDI, life expectancy at birth, the average level of education and GNI per capita are positive correlation. Also, between ASMR of TC with HDI, life expectancy at birth, the average level of education and GNI per capita is a negative correlation. So the data from this study shows the importance of using HDI and its components as factors affecting the ASIR and ASMR of TC.

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Conflicts of interest
The authors declare no conflict of interests.

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