

## RESEARCH ARTICLE

# Estimation of the Projections of the Incidence Rates, Mortality and Prevalence Due to Common Cancer Site in Isfahan, Iran

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## Abstract

**Background:** Accurate statistics on the cancer burden are essential, both for purposes of research and for setting priorities in healthcare management. So that in vast countries with partial registration coverage, such as Iran, local data are more useful. We here estimated the incidence, prevalence and mortality time trend of four major cancer site, lung, stomach, breast and prostate, over the period 2001-2010 and provided short-range projections to 2015 in Isfahan. **Materials and Methods:** Estimates were derived by applying the mortality-incidence analysis method, a back-calculation approach to estimate and project incidence, prevalence and mortality of chronic degenerative disease, starting from knowledge of mortality and relative survival information. **Results:** Age adjusted incidence, mortality and prevalence rates in Isfahan exhibited a clear upward trend for all four sites during the period 2001-2015, with marked increases in prostate and breast predicted for the future. Difference in incidence trends between males and females might be attributable to the difference in risk factors specific to certain cancer sites, with smoking being the main risk factor. **Conclusions:** In this study, males and females displayed an increasing pattern for incidence and mortality rate over the entire study period until 2015. This information can be used as basis for planning healthcare management and allocating resources in public health.

**Keywords:** Cancer - estimate - incidence - mortality - prevalence - Isfahan, Iran

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## Introduction

The burden of cancer is increasing in the middle-income developing countries as a result of populating aging along an adoption with lifestyle associated cancer risk factors, including smoking, physical inactivity and unhealthy diets (Thun et al., 2010; Jemal et al., 2011). Accurate statistics on the cancer burden are essential, both for purposes of research and for defining setting priorities in healthcare management and planning cancer control programs (Parkin, 2006). Thus, these are necessary for epidemiological measures to defining preferences and allocate resources (Francisci et al., 2009).

Cancer is a major public health problem in Iran. Based on the recent report from Ministry of Health and Medical Education (MOHME) it is the third-leading cause of death after coronary heart disease and accident (Mousavi et al., 2009). Unfortunately only few cancer control program according world health organization (WHO) guideline is running in Iran (Mousavi et al., 2008). In Iran national cancer registry (NCR) is a pathology based and only small number of province Such as Isfahan, Lorestan and Golestan collect population based data according to the MOHME guideline since 2005 (Mohagheghi and Mosavi, 2010; Mokarian et al., 2011). Other regional population based cancer registries were established in Kerman, Tehran, Ardabil and Semnan previously (Etemadi

et al., 2008; Mohagheghi and Mosavi, 2010). Because mortality is registered systematically in almost every country in regional or national level, Mortality rates are a useful indicator in assessing cancer variation over the time (Ravakhah, 2006). Other important indicator such as incidence and prevalence are provided by population-based cancer registries (PBCRs) which give only a partial picture of cancer patterns at regional level (Parkin, 2006). This is a case for Iran where the registries cover a small fraction (about 16%) of Iran population (Etemadi et al., 2008; Mohagheghi and Mosavi, 2010).

Suitable information of cancer indicator and analysis of time trend in special geographic areas is highly informative for success preventive approaches. Projections of cancer to the future are also useful to define medical treatment and screening of high risk group and map out the risk of cancer. Therefore it is need for statistical method fitted to empirical data to provide epidemiological indicator at national and regional level (Verdecchia et al., 1989; Verdecchia et al., 2007).

This paper will focus on estimate incidence, prevalence and mortality time trend of four major cancer site including lung, stomach, breast and prostate cancer over the period 2001-2010 and to provide short-range projections of them to 2015 in Isfahan, by applying statistical approach names MIAMOD method (Verdecchia et al., 1989; De Angelis et al., 1994).

## Materials and Methods

To performing the study, we considered mortality information for all cause and for major cancer site including Stomach (International Classification of Disease for Oncology 3<sup>rd</sup> revision: codes C16), Lung (C34), Breast (C50) Prostate (C61) from two sources; ministry of health death registration system and national death registration office. Mortality data in Isfahan province is collected from various sources such as hospitals, medical forensic, cemetery and health centers. In addition population data by sex, age and calendar year for the period of 2001-2010 were obtained from the Statistical Center of Iran. Tabulated Relative survival probabilities for the selected cancer were estimated based on observed cancer death and population expected mortality data. Observed cancer survival rate was derived with passive follow-up by comparison of two sources of data, the death certificate of vital statistics and patient registry data from registered cases by the actuarial method (Swaminathan and Brenner, 2011). This data was stratified by period of diagnosis into two-year interval and following age group diagnosis: 15-44, 45-54, 65-74 and 75-99 years.

Incidence and prevalence estimates were computed with MIAMOD (Mortality-incidence Analysis Model) method. That is a back calculation approach to the estimation and projection of chronic degenerative disease from mortality and survival data (Verdecchia et al., 1989; Verdecchia et al., 2001; Verdecchia et al., 2007). This method is based on the mathematical relationship between mortality, prevalence, incidence and survival when presumed disease is posited to be irreversible. Incidence was modeled as polynomial function of age, period and birth cohort covariates. The incidence model parameters were back calculated using Poisson maximum likelihood regression based on observed mortality data. Incidence in future years can be projected after last year of observed mortality data based on age-period-cohort covariate. Furthermore mortality and prevalence are consequently, forward projected by MIAMOD. Ad-hoc software named MIAMOD/PIAMOD (Mortality-incidence Analysis Model/Prevalence-incidence Analysis Model) was used for producing estimation (De Angelis et al., 1994; Grande et al., 2006; 2007).

## Results

### Stomach cancer

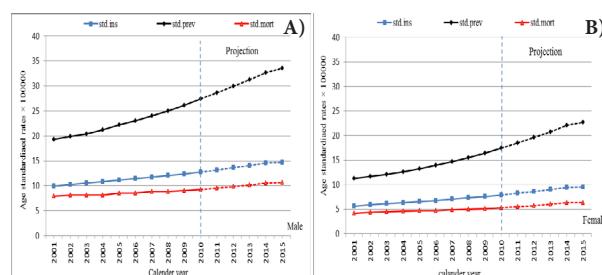
It estimated age adjusted stomach cancer incidence and mortality rates in Isfahan exhibited a clear upward trend over the period 2001-2015. Annual incidence rates were estimated to have increased 48% for men (a rise from 9.91 to 14.66 per 100000 person year) and 70% among women (a rise from 5.58 to 9.5 per 10000 PY). Male-to-female ratio was estimated 1.65 for incidence and 1.8 for mortality rates in the entire study period. Prevalence rates were estimated to increase 74% and 100% by 2015 among male and female respectively. Projection for the year 2015 shows that there would be 390 incident cases and 283 deaths among man and 250 incident cases and 166 deaths among women (see Table 1).

### Lung cancer

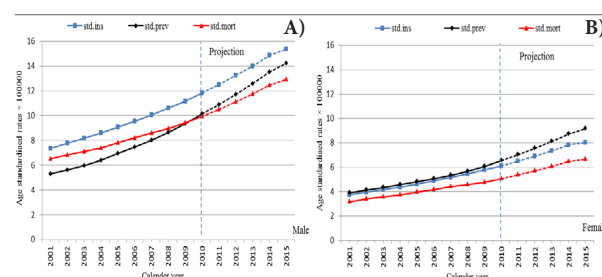
Estimates of age standardized of Lung cancer incidence, mortality and prevalence rates show an increasing trend as long of time. A 2 fold male-to-female ratio was estimated for Incidence and mortality rates. In both of sex incidence, mortality and prevalence curves are close to each other because of high lethality of lung cancer. Among males, prevalence trends displayed lower rates than the incidence trend as long as time in the study and projection stage. Furthermore, in comparison with mortality, a clear fewer prevalence rate was displayed for male's lung cancer in the study period. However, mortality rates rise up more than prevalence during the projection period (Figure 2A). Despite the relatively high incident of lung cancer cases, our result projected a low prevalence incident case, about 360 cases by 2015 (Table 1).

### Female breast cancer

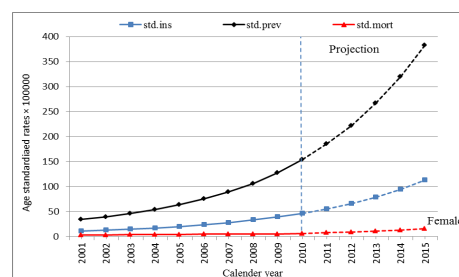
Breast cancer mortality, incidence and prevalence rates in Isfahan show an increasing trend in the period 2001-2015. The annual mortality percentage changes were



**Figure 1. Estimated Mortality (Std. mort), Incidence (Std. ins) and Prevalence (Std. prev) for Stomach Cancer in Isfahan. A) Males, B) Females.** Age standardized rates (world population) per 100,000, 0-99 age



**Figure 2. Estimated Mortality (Std. mort), Incidence (Std. ins) and Prevalence (Std. prev) for Lung Cancer in Isfahan. A) Males, B) Females.** Age standardized rates (world population) per 100,000, 0-99 age

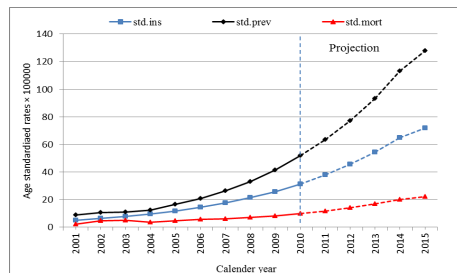


**Figure 3. Estimated Mortality (Std. mort), Incidence (Std. ins) and Prevalence (Std. prev) for Female Breast in Isfahan.** Age standardized rates (world population) per 100,000, 0-99 age

estimated to have increased by 12% (an increase from 2.83 to 15.58 per 100000 PY) and annual incidence percentage change increased by 17% (an increase from 10.7 to 112.7 per 100000 PY). It is estimated that the Isfahan would have faced to a total 9167 prevalent case by 2012 (Table 1).

#### Prostate cancer

Mortality, incidence and prevalence due to prostate cancer registered a high increasing rate among Isfahan



**Figure 4. Estimated Mortality (Std. mort), Incidence (Std. ins) and Prevalence (Std. prev) for Prostate Cancer in Isfahan.** Age standardized rates (world population) per 100,000, 0-99 age

**Table 1. Estimated Cancer Mortality, Incidence and Prevalence in Isfahan for Years 2001, 2010 and 2015**

Years		Male			Female		
		No. of cases	Crude rates	ASR	No. of cases	Crude rates	ASR
2001							
Mortality	Stomach	116	5.3	7.9	68	3.3	4.2
	Lung	126	5.8	6.5	56	2.7	3.2
	Breast	-	-	-	35	1.7	2.8
	Prostate	42	1.9	2	-	-	-
Incidence	Stomach	190	8.7	9.9	104	5	5.6
	Lung	140	6.5	7.3	69	3.3	3.7
	Breast	-	-	-	190	9.2	10.7
	Prostate	92	4.3	5	-	-	-
Prevalence	Stomach	366	16.9	19.3	209	10.1	11.2
	Lung	100	4.6	5.3	74	3.6	3.9
	Breast	-	-	-	593	28.6	34.2
	Prostate	156	7.2	8.6	-	-	-
2010							
Mortality	Stomach	183	7.6	9.3	97	4.2	5.2
	Lung	202	8.4	9.9	92	4	5.1
	Breast	-	-	-	96	4.2	6.5
	Prostate	156	6.5	9.7	-	-	-
Incidence	Stomach	272	11.4	12.8	162	7.1	7.9
	Lung	252	10.5	11.8	126	5.5	6.1
	Breast	-	-	-	944	41.4	46.7
	Prostate	692	28.9	31.1	-	-	-
Prevalence	Stomach	582	24.3	27.4	357	15.6	17.5
	Lung	214	8.9	10.1	134	5.9	6.6
	Breast	-	-	-	3006	131.6	154.3
	Prostate	1193	47.7	51.7	-	-	-
2015							
Mortality	Stomach	283	11.2	10.6	166	6.9	6.3
	Lung	345	13.7	12.9	173	7.2	6.7
	Breast	-	-	-	386	16	15.6
	Prostate	645	25.6	22	-	-	-
Incidence	Stomach	390	15.5	14.7	250	10.3	9.5
	Lung	410	16.3	15.4	209	8.7	8.1
	Breast	-	-	-	2813	116.5	112.7
	Prostate	2114	83.9	71.7	-	-	-
Prevalence	Stomach	852	33.8	33.6	559	23.2	22.7
	Lung	360	14.3	14.2	226	9.3	9.2
	Breast	-	-	-	9164	379.5	382.5
	Prostate	3571	141.7	128	-	-	-

**Table 2. Estimated Incidence Rate (Est. inc) Versus Observed Incidence (Obs. inc) and Observed Mortality Rate (Obs. mort) for Lung Cancer by Gender in Isfahan: Age Adjusted Rates Per 100000 PY. Age 0-99 Years**

	Male			Female		
	Est. inc	Obs. inc	Obs. mort	Est. inc	Obs. inc	Obs. mort
2001	7.33	-	5.8	3.72	-	2.7
2002	7.76	-	5.5	3.96	-	2.8
2003	8.17	1.51	5.6	4.17	0.66	2.3
2004	8.6	1.93	6.2	4.39	1.26	3.4
2005	9.06	3.41	7.2	4.64	2.01	4
2006	9.54	3.68	8.2	4.9	0.84	4.2
2007	10.06	2.6	8.5	5.18	1.55	5.3
2008	10.61	4.07	8.5	5.48	2.49	4.3
2009	-	-	7.3	-	-	3.4
2010	-	-	8.4	-	-	4

men for the entire period 2001-2015 (Figure 4). The ASR mortality trend was estimated to have lifted from 1.98 to 22 per 100000 men in the 2001-2015. Likewise, ASR incidence was projected to have climbed from 4.98 to 71.7 per 100000 men in the same period. We projected that the prostate cancer would be reached to 3571 prevalent cases and 2114 incident cases in Isfahan by 2015 (Table 1).

#### Discussion

Understanding the current trend of all cancers combined because of multiplicity of disease nature is very difficult. So, this study prepared an updated estimate of four major cancer site indicators in Isfahan, in terms of time trend through 2015 and point estimates in 2001, 2010 and 2015. The results show an upward pattern and no sex-related differences in incidence for stomach and lung cancer, and also for all cancer combined with exception non melanoma skin cancers which reported previously (Maracy et al., 2012). Incidence trends in European countries is quietly associated with sex and rates in male are decreasing or reached a turning point while for females continue to rise (Grande et al., 2006; 2007; Moller et al., 2007; Sanchez et al., 2010). In this study, males and females displayed an increasing pattern for incidence and mortality rate over the entire study period by 2015.

Stomach cancer, despite the progress in cancer treatment protocol and improvement of fresh food preservation, stomach cancer is one of the common causes of cancer and first leading cancer death in Iran (Mousavi et al., 2009). A combination of high prevalence of *Helicobacter pylori* infection, westernized diet and low intake fruits and vegetables resulted in the increase in incidence and by extension in the mortality (Ashktorab et al., 2007; Derakhshan et al., 2008). Except for Ardabil, stomach cancer has a steady rate in other parts of Iran (Babaei et al., 2009). However in this study incidence rates were estimated 12.2 and 7.4 per 100000 PY in average for males and females respectively. In general, stomach cancer in Isfahan has an intermediate incidence in comparison with other studies performed in Iran (Sadjadi et al., 2007; Mohagheghi et al., 2009). In spite of increasing trend in stomach cancer, because of improvement in survival,

Mortality and incidence have a slowly diverging trend over the period 2001-2015.

Lung cancer is the first leading cause of death worldwide. It has a very low survival and so, mortality due to lung cancer is high (Jemal et al., 2011; Siegel et al., 2012). However, observed lung cancer incident in Iran is so different in comparison to the other countries. Empirical incidence rate in Isfahan like other regions of Iran is very low. However, its trends have an increasing rate over the time (Ferlay, 2001; Mokarian et al., 2011). This study showed a different estimation of lung cancer incidence with respect to the empirical data collected from Isfahan cancer registry (Table 2). There are some plausible reasons for low incidence of lung cancer. First, the smoking pattern in Iran is quiet differs from that in other countries, and it seems to have a lower prevalence rate than for the other countries. Probably, an important reason is an information defect in data collection with respect to the respiratory system in our cancer registries (Mokarian et al., 2011). Because of survival function, estimated mortality-incidence ratio is very close to 1 (mortality-incidence ratio was  $\sim 0.85$ ) therefore, the incidence, mortality and prevalence patterns are very close to each other. The downward incidence trend was registered among men in several studies. In contrast, the incidence rate for a woman is continuing to increase (Inghelmann et al., 2007; Sanchez et al., 2010). It is being compatible with fall in and rising in cigarette smoking in males and females respectively in recent decades (Adami et al., 2008). Furthermore, our study estimated an increasing trend for incidence in both males and females, which being coincided with climbing in smoking prevalence.

Female breast cancer, the breast cancer has a low incidence in Iran in comparison with developed countries, the number of newly diagnosed cases displayed increasing rates annually, and today it becomes a first common malignancy among Iranian females as well as in Isfahan women population (Sadjadi et al., 2007; Mohagheghi et al., 2009; Mousavi et al., 2009; Mokarian et al., 2011). Western countries such as Italy and Spain reached a top of incidence and mortality rates. Therefore, now down turning or plateau trend has seen with respect to the breast cancer (Grande et al., 2007; Sanchez et al., 2010; Jemal et al., 2011). The extensive rise in estimated breast cancer incidence during our study period is almost consistent with the up-to-date data from Isfahan population based cancer registry (2010). This increased risk of developing cancer is related to an event in female reproductive history such as sex-related endogenous hormones and increased age in first live birth. As well as Lifestyle factors, including westernized diet and anthropometric index include Body Mass Index (BMI) (Montazeri et al., 2008; Bidgoli et al., 2011; Ghiasvand et al., 2011; James et al., 2011).

However, estimated sharp rise in the incidence of breast cancer, and improving patient survival in recent years as long as progress in screening policies and medical care facilities lead to the incredible increasing of prevalent cases. So, it's predicted that the health care system will be faced to the extraordinary burden of female's breast cancer in the near future.

Prostate cancer, in the past few decades, prostate

cancer was a non-common cancer in Iran. It's only including 1.6 percent of all cancers in the 1986 (thirtieth rank among all cancer sites) (2010). In the recent years prostate cancer had a remarkable increase in the incidence and become a fourth cause of cancer (8.5 percent of all cancers in men) with an ASR 9 per 100000 PY (Mousavi et al., 2009). Such increasing trends in prostate cancer have been estimated in our study. The diverging trend seen in mortality, incidence and prevalence rate may be due to the increase in patient survival. Although prostate cancer in Isfahan has a higher incidence rate after Tehran (Sadjadi et al., 2007) in comparison of our results, it seems to occur underestimation. These observed differences might be due to the defect in data collection and lack of national screening program and early detection for prostate cancer in Iran (Mousavi, 2009).

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