RESEARCH COMMUNICATION

Pancreatic Cancer Mortality and Misclassification - Bayesian Analysis

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Abstract

Background: Pancreatic cancer is a fatal cancer with a 5-year survival of only about 4% for all tumors. Mortality is a familiar projection to address the burden of cancers, but according to the Iranian death registry, about 20% of death statistics are still recorded in misclassified categories. The aim of this study wasto estimate pancreatic cancer mortality for Iranian population, using a Bayesian approach in order to revise this misclassification. Methods: National Death Statistics reported by the Ministry of Health from 1999 to 2004, stratified by age group, sex and cause of death, were the basis for this analysis. Pancreas cancer [ICD-10; 25] were expressed as the annual mortality rates/100,000, overall, by sex and by age group (<50 and ≥50 years of age) and age standardized rate (ASR). The Bayesian approach to correct and account for misclassification effects in Poisson count regression was employed with a beta prior to estimate the mortality rate by age and sex group. Results: According to the Bayesian analysis, there were between 20 to 30 percent underreported mortality records in deaths due to pancreatic cancer and the rate decreased slightly during the years of the study. Conclusion: Our findings suggest a substantial undercount of pancreatic cancer mortality in the Iranian population. Therefore policy makers who determine research and treatment priorities should note these underreported data for death rates.

Key words: Pancreatic cancer - mortality - Bayesian analysis - under-reporting - Iran

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Introduction

Gastrointestinal (GI) cancers are the most frequent category of cancer among Iranians (Pourhoseingholi et al., 2009a; 2009b; 2010a; 2010b; 2011). Pancreatic cancer is a rapidly fatal GI cancer (Ries et al., 2002; American Cancer Society, 1996) with a 25-30% five-year survival after surgery (Ryu et al., 2010) and there are currently no effective means of screening, early detection, or treatment (Coughlin, 2000). This cancer accounts for about 220,000 deaths annually and is the sixth major cause of cancer-related mortality due to its low survival (Lowenfels and Maisonneuve., 2005; Parkin et al., 2005) with the mortality approaching the incidence (Karanjawala et al., 2008).

Mortality is a familiar projection to address the burden of cancers (Burnet et al., 2005), but requries reliable death registry systems. Therefore analysis of death statistic subject to misclassification is a major problem in epidemiological analysis leading to biases estimates, and underestimation of health risks (Stamey et al., 2008). According to the Iranian death registry, between 15% to 20% death statistics were recorded in misclassified categories such as septicemia, senility without mention of psychosis, unknown cancers and other ill-defined conditions (Naghavi, 2004).

In statistical literature two approaches are recommended for misclassification. First is using a small validation sample (Lyles, 2002) and the second is Bayesian analysis in which subjective prior information on at least some subset of the parameters is used to re-estimate death statistic (Whittemore and Gong, 1991; Sposto et al., 1992). Recently we developed a Bayesian model to estimate the burden of GI cancer and applied this model on colorectal cancer (Pourhoseingholi et al., 2009b), gastric cancer (Pourhoseingholi et al., 2010c) and liver cancer (Pourhoseingholi et al., 2010b).

The aim of the present study was to re-estimate pancreatic cancer mortality rate for Iranian population, using this Bayesian approach.

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Materials and Methods

We employed national death statistic to provide a trend analysis of pancreatic cancer. National death Statistic reported and published by the Ministry of Health and Medical Education (MOH&ME) from 1999 to 2004 (Naghavi, 2000; Naghavi, 2001; Naghavi, 2003; Naghavi, 2004; Naghavi, 2005; Naghavi, 2007) stratified by age group, sex, and cause of death (coded according to the 9th revision of the International Classification of Diseases [ICD-10]) are included in this analysis. Pancreas cancer [ICD-10; 25] were expressed as the annual mortality rates/100,000, overall, by sex and by age group (<50 and ≥50 years of age) and age standardized rate (ASR). The populations of Iran in 1999-2004 were estimated, using the censuses conducted by Statistics Centre of Iran and number of covered provinces in death registration data-base.

The Bayesian approach which considered here derived from models proposed by Stamey et al to correct and account for misclassification in a Poisson regression (Stamey et al., 2008). Stamey's technique extended the model recently proposed to overcome the problem of misclassification in cancer data (Whittemore and Gong, 1991; Sposto et al., 1992) and Pourhoseingholi et al developed this technique to estimate mortality rate of colorectal cancer (Pourhoseingholi et al., 2009b), gastric cancer (Pourhoseingholi et al., 2010c) and liver cancer (Pourhoseingholi et al., 2010b). The misclassification probability estimate which is proposed in prior distribution was based on Iranian death registration introduced up to 20% misclassified records in total deaths and a beta prior assumed to re-estimate death statistics from misclassified groups. All analysis performed by a Macro, developed in S-Plus.

Table 1. Age Standardized Rate (per 100,000) for Pancreas Cancer Mortality, by Sex Group Before and after Adjusting for Misclassification with the Bayesian Model

Year	Male		Female		Total	
	FR	BR	FR	BR	FR	BR
1999	1.54	1.81	0.77	0.91	1.16	1.37
2000	1.25	1.46	0.70	0.82	1.03	1.20
2001	1.22	1.49	0.86	1.05	1.05	1.28
2002	1.13	1.35	0.64	0.77	0.89	1.07
2003	1.10	1.29	0.70	0.82	0.90	1.05
2004	0.89	1.06	0.57	0.68	0.73	0.87

FR, Frequency Rate; BR, Bayesian Rate

Table 2. Age Specific Rate (per 100,000) for Pancreas Cancer Mortality Stratified by Sex Group Before and after Adjusting for Misclassification by Bayesian Model

Year	<50 Years		>=50 Years	
	FR	BR	FR	BR
1999	0.14	0.17	5.48	6.48
2000	0.13	0.15	4.84	5.66
2001	0.14	0.17	4.86	5.92
2002	0.10	0.12	4.21	5.05
2003	0.12	0.14	4.22	4.94
2004	0.11	0.13	3.38	4.02

FR, Frequentist Rate; BR, Bayesian Rate

Results

All death records due to pancreas cancer from 1999 to 2004 are included in this study. The rate of Pancreas cancer mortality classified by sex and age, generated from original database (Frequentist Rate) and their Bayesian corresponding projections (Bayesian Rate) appeared in Table 1 and Table 2. According to the Bayesian re-estimate there were between 20 to 30 percent underreported mortality records in death due to Pancreas cancer (Figure 1). The age standardized mortality rate showed that the mortality slightly

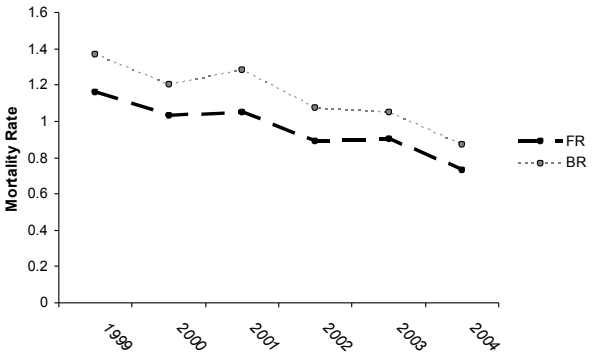

Figure 1. Trends of Pancreas Cancer Mortality During the Period 1999-2004

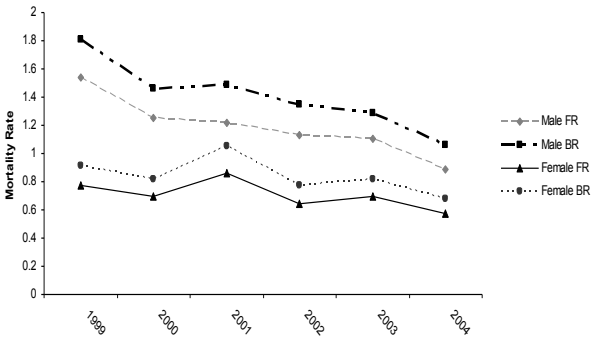

Figure 2. Trends of Pancreas Cancer Mortality During the Period 1999-2004 by Sex Group

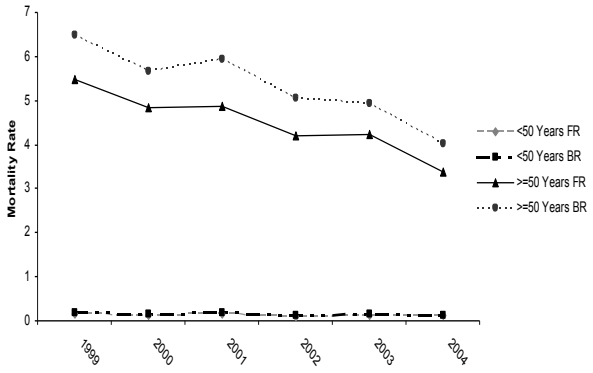

Figure 3. Trends of Pancreas Cancer Mortality During the Period 1999-2004

decreased during the years under study. Moreover Pancreatic cancer mortality was higher for male (Table 1 and Figure2) and older age (Table2 and Figure3). Also decreasing trend for older age in male was higher than female's (Table2). Age specific rate indicated that the mortality increased with age (Table 2 and Figure 3).

Discussion

Our results indicated that up to 20-30% of mortality due to pancreatic cancer remains underreported and suggested a substantial undercount of pancreatic cancer mortality in Iranian population. Also this study indicated that the trend of pancreatic cancer mortality was slightly decreased in the years under study. This declining trend is in contrast to western countries (Katanoda and Yako-Suketomo., 2010) and some Asian countries, such as South Korea and Singapore (Worldwide cancer mortality statistics, 2006) and China (Wang et al., 2003).

In Iranian Death Registration System, data on causes of death are collected from vari¬ous sources and have been assessed to be about 80% complete (Khosravi et al., 2007). In spite of this, there is still up to 20% undefined death records categorized as misclassification.

Recently Bayesian approach received much attention in the case of misclassification. Whittemore and Gong used this approach to estimate cervical cancer mortality rates (Whittemore and Gong, 1991), Sposto et al developed this model to assess the effect of diagnostic misclassification on non-cancer and cancer mortality dose–response in A-bomb survivors (Sposto et al., 1992), Stamey et al used Bayesian approach in data consisting of the number of deaths due to cancer and non-cancer among residents of Hiroshima and Nagasaki, who were present during the atomic bombings in August of 1945 (Stamey et al., 2008) and we used this technique to estimate mortality rate of colorectal cancer (Pourhoseingholi et al., 2009b), gastric cancer (Pourhoseingholi et al., 2010c) and liver cancer (Pourhoseingholi et al., 2010b) according to Iranian death statistics.

In conclusion, this study provides comprehensive projection for burden of death due to pancreatic cancer based on the national death registry, suggested that the trend of this fatal cancer is still low and may be leveled off in recent years. The burden of disease was higher for male and older age. Besides there is a substantial undercount of pancreatic cancer mortality according to the Bayesian model. So healthcare policy makers who determine research and treatment priorities on death rates as an indicator of burden of disease should notice to this underreported data.

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