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ORIGINAL ARTICLE

Bayesian analysis of gastric cancer mortality in Iranian population

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ABSTRACT

Aim: The aim of this study is to estimate gastric cancer (GC) mortality rate for Iranian population, using Bayesian approach in order to revise the existing classification which is thought to be a misclassification.

Background: Gastric cancer (GC) is an important cause of mortality among many other types of cancer. Data on cancer mortality can be used to guide policy makers in order to setup cancer prevention programs. According to Iranian death registry, about 20% death statistics are still recorded in misclassified categories.

Patients and methods: National Death Statistics Reported by the Ministry of Health and Medical Education (MOH&ME) from 1995 to 2004 is included in this analysis. The Bayesian approach to correct and account for misclassification effects in Poisson count regression with a beta prior is employed to estimate the mortality rate of GC in age and sex group.

Results: According to the Bayesian analysis there were between 30 to 40 percent underreported mortality records in death due to GC and the mortality rate is increased through recent years.

Conclusion: Our findings suggest a substantial undercount of GC mortality in Iranian population. So healthcare policy makers who determine research and treatment priorities on death rates as an indicator of public health priorities should notice this underreported data.

Keywords: *Gastric Cancer, Mortality, Bayesian Analysis.*

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INTRODUCTION

Gastric cancer (GC) is an important cause of mortality due to cancer (1, 2) and is predicted to be the eighth leading cause of all deaths worldwide in the year 2010 (3).

Although the incidence of GC is decreasing, it rarely is detected early, and the prognosis remains poor. The majority of GC shows distant metastasis at the time of diagnosis (4). In approximately 50% of newly diagnosed patients, the carcinoma is advanced beyond its original local-regional boundaries (5). Iranian data suggested that GC is a fatal cancer in the term of life lost (6-8) with high burden of hospitalization among gastrointestinal tract cancers (9, 10).

A familiar projection to address the burden of cancers is the mortality rates. With regards to cancer mortality, data are important to monitor the effects of screening program, earlier diagnosis, demographic data and other prognostic factors (11). Data on cancer mortality can be used to guide policy makers in order to setup cancer prevention programs. But this aim needs reliable death registry systems which reports death statistics annually. On the other hand the analysis of death statistic subject to misclassification is a major problem in epidemiological analysis leading

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to biases estimates, and can therefore cause one to underestimate health risks (12). Similar to some other developing countries, Iranian mortality information is incomplete (13). According to Iranian death registry, between 15% to 20% death statistics were recorded in misclassified categories such as septicemia, senility without mention of psychosis Symptoms and other ill-defined conditions (14).

In statistical literature two approaches recommended for misclassification. First is using a small validation sample yielding more accurate parameter estimates (15) and the second is Bayesian analysis in which subjective prior information on at least some subset of the parameters used to estimate misclassified parameter and then re-estimate death statistic (16, 17).

The aim of this study is to re-estimate GC mortality rate for Iranian population, using Bayesian approach.

PATIENTS and METHODS

National death Statistic Reported by the Ministry of Health and Medical Education (MOH&ME) from 1995 to 2004, stratified by age group, sex, and cause of death (coded according to the 9th revision of the International Classification of Diseases [ICD-9]) included in this analysis. GC mortality [ICD-9; 151] expressed as the mortality rate for each 100,000 people.

The Bayesian approach we considered here derived from models proposed by Stamey et al to correct and account for misclassification in Poisson regression (12). Stamey's technique extended the model recently proposed to overcome the problem of misclassification in cancer data (16, 17). Whittemore and Gong used a likelihood approach to estimate regression parameters when the counts are underreported (16) and Sposto *et al* developed this likelihood to allow for misclassification across two groups (17). Stamey et al extended these approaches but did not rely on asymptotic results in order to perform inferences and also did not assume that the misclassification parameters are known in a Poisson regression model (12). We studied Iranian death statistic in a Bayesian Poisson regression using Stamey's approach to re-estimate mortality rate of GC. All analysis performed by a Macro, developed in S-Plus according to Stamey's approach.

RESULTS

The misclassification probability estimate we proposed here was based on Iranian death registration which introduced up to 20% misclassified records in total deaths. We considered data consisting of all deaths due to GC from 1995 to 2004, (up to 32416 records) and a beta prior assumed to re-estimate death statistic of GC from misclassified groups. The rate of GC mortality classified by sex and age, generated from original database (Frequentist Rate) and their Bayesian corresponding projections (Bayesian Rate) appeared in table 1. According to the Bayesian re-estimate there were between 30 to 40 percent underreported mortality records in death due to GC (Figure 1).

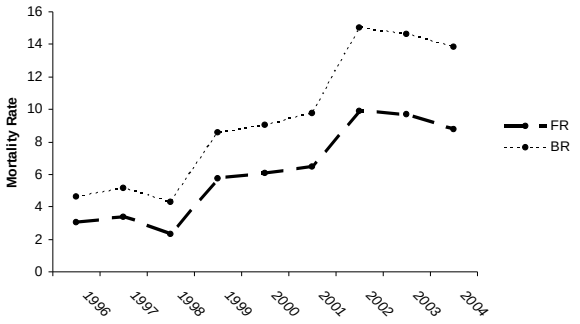

Figure 1. Bayesian GC mortality rate and Frequentist rate through the years. FR: Frequentist Rate, BR: Bayesian Rate

The rate of GC mortality sharply increased from 1995 to 2002 and seems to be leveled off

since 2002. Figure 2 showed GC mortality and its Bayesian projection according to gender, indicating that the mortality rate for male was high comparing to female considerably. Also GC mortality was higher for older age (Table 1).

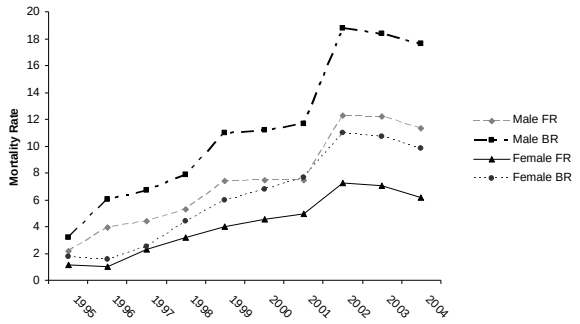

Figure 2. Bayesian GC mortality rate and Frequentist rate adjusted for sex groups. FR: Frequentist Rate, BR: Bayesian Rate

DISCUSSION

In the new Iranian Death Registration System, data on causes of death are collected from various sources and have been assessed to be about 80% complete (13). In spite of this new registry system, there is still up to 20% undefined death records that categorized as misclassification. Response misclassification for mortality rates leads to biases and underestimates.

In a study conducted by Khosravi et al, validation data from hospital death were used to find the impact of misclassification on measures of cardiovascular disease mortality (18). But they didn't employ any Bayesian projections. So our study is the first Bayesian analysis on Iranian mortality data. Recently Bayesian approach received much attention in the case of misclassification. McInturff et al used a Bayesian approach to estimate the parameters of a binomial regression with misclassification (19). Whittemore and Gong used this approach to estimate cervical cancer mortality rates (16) and Sposto et al developed this likelihood to assess the effect of diagnostic misclassification on non-cancer and cancer mortality dose–response in A-bomb survivors (17). Stamey et al (which we considered their producer in here) used Bayesian approach in

Table1: Bayesian GC mortality rate and Frequentist rate adjusted for sex and age groups

		<5 Years		5-14 Years		15-49 Years		>=50 Years		All ages		Total
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
1995	FR*	.04	.04	.00	.04	.36	.26	15.58	8.25	2.17	1.18	1.68
	BR†	.08	.08	.01	.09	.52	.38	22.73	12.13	3.16	1.74	2.47
1996	FR	.42	.12	.08	.04	.78	.69	27.44	13.81	3.95	1.03	3.04
	BR	.71	.20	.13	.06	1.21	1.06	41.73	21.05	6.02	1.57	4.64
1997	FR	.41	.16	.09	.06	.93	.73	30.74	15.02	4.44	2.29	3.38
	BR	.65	.28	.15	.10	1.45	1.15	46.23	22.74	6.71	2.49	5.13
1998	FR	.48	.31	.06	.06	1.21	.92	36.55	21.65	5.32	3.22	2.29
	BR	.88	.59	.20	.21	1.70	1.28	53.95	28.99	7.85	4.39	4.29
1999	FR	.59	.66	.14	.08	1.70	1.15	50.39	26.41	7.36	3.97	5.70
	BR	.91	1.05	.23	.13	2.60	1.78	75.07	39.54	11.01	5.98	8.55
2000	FR	.59	.54	.08	.15	1.69	1.26	53.51	32.40	7.47	4.55	6.04
	BR	.93	1.15	.13	.24	2.55	1.92	79.79	47.56	11.16	6.75	9.00
2001	FR	.17	.11	.08	.11	1.71	1.10	49.91	30.40	7.49	4.93	6.47
	BR	.31	.22	.14	.20	2.57	1.69	73.13	47.42	11.68	7.68	9.73
2002	FR	.00	.00	.11	.07	2.40	1.57	86.09	48.88	12.29	7.27	9.86
	BR	.13	.14	.19	.17	3.83	2.42	130.69	73.48	18.78	11.00	15.00
2003	FR	.00	.25	.12	.00	2.10	1.55	84.41	47.61	12.17	7.05	9.67
	BR	.06	.43	.21	.02	3.54	2.45	125.45	72.05	18.34	10.73	14.62
2004	FR	.09	.14	.18	.15	1.97	1.59	80.16	41.13	11.30	6.15	8.78
	BR	4.00	.23	.31	.26	3.06	2.47	125.21	66.01	17.66	9.84	13.83

* FR: Frequentist Rate; †BR: Bayesian Rate

data consisting of the number of deaths due to cancer and non-cancer among residents of Hiroshima and Nagasaki, Japan, who were present during the atomic bombings in August of 1945 (12).

Our study indicated that up to 40% of mortality due to GC remains underreported and suggested a substantial undercount of GC mortality in Iranian population. So healthcare policy makers who determine research and treatment priorities on death rates as an indicator of public health priorities should notice this underreported data.

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