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ORIGINAL ARTICLE

Joint Disease Mapping of Two Digestive Cancers in Golestan Province, Iran Using a Shared Component Model

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Abstract

Objectives: Recent studies have suggested the occurrence patterns and related diet factor of esophagus cancer (EC) and gastric cancer (GC). Incidence of these cancers was mapped either in general and stratified by sex. The aim of this study was to model the geographical variation in incidence of these two related cancers jointly to explore the relative importance of an intended risk factor, diet low in fruit and vegetable intake, in Golestan, Iran.

Methods: Data on the incidence of EC and GC between 2004 and 2008 were extracted from Golestan Research Center of Gastroenterology and Hepatology, Hamadan, Iran. These data were registered as new observations in 11 counties of the province yearly. The Bayesian shared component model was used to analyze the spatial variation of incidence rates jointly and in this study we analyzed the data using this model. Joint modeling improved the precision of estimations of underlying diseases pattern, and thus strengthened the relevant results.

Results: From 2004 to 2008, the joint incidence rates of the two cancers studied were relatively high (0.8–1.2) in the Golestan area. The general map showed that the northern part of the province was at higher risk than the other parts. Thus the component representing diet low in fruit and vegetable intake had larger effect of EC and GC incidence rates in this part. This incidence risk pattern was retained for female but for male was a little different.

Conclusion: Using a shared component model for joint modeling of incidence rates leads to more precise estimates, so the common risk factor, a diet low in fruit and vegetables, is important in this area and needs more attention in the allocation and delivery of public health policies.

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1. Introduction

Cancer is the third leading cause of death and nearly 70,000 new cases of cancer occur annually in Iran [1,2]. About half of all cancers are related to the gastrointestinal cancers. In men, the three important cancers are gastric, esophagus, and colorectal; in women, after breast cancer, these three are the major cancers [3]. There is an evidence of sharp gradients in incidence rates of esophagus cancer (EC) and gastric cancer (GC) over proportionally short geographical distances in the Caspian region of Iran [4]. In this area, EC is the second highest cause of death after heart disease [2]. Also, among other tumors, GC had a strikingly similar incidence [5]. Some studies have highlighted a positive correlation between standardized incidence ratios of GC and EC which might be an evidence of these two cancer sites shared common risk factors such as diet low in fruit and vegetable intake, low socio-economic status, smoking, and gastric atrophy but in the Caspian sea region of Iran, the first two component were more influential [3].

In northeastern Iran, Golestan province is one of the very high-risk areas of EC in the world so that the rates are as high in women as in men in areas surrounding Gonbad, one of the major counties of Golestan province, Iran, and further to the East [6]. Recently in Iran, the age standardized incidence rate of EC and GC for men was about 17.6 per 100,000 person years and 26.1 per 100,000 person years and for women, were 14.4 and 11.1 [7,8].

In epidemiology, disease mapping has long been used in the statistical analysis of geographical variation of disease rate [9], which provides useful information such as describing areas of unusually high risk and assessment hypotheses, and producing a clean map of disease risk to allocate better resources and public health policies [10]. Mapping the population-based standardized mortality ratio or standardized incidence ratio, defined as the ratio of observed to expected count in the region under study, specified the situation of geographic dispersion of disease incidence and mortality rates [11]. Although these methods obtain unbiased estimators of relative risk (RR) but suffer from many problems: their variance is large in areas with a small population and small in areas with a large population; they do not differentiate between regions when there is no death; and they do not try to manifest any underlying structure in the data and are not parsimonious [10].

To remove these problems a variety of alternative models have been proposed. Among them, the Bayesian approach is suggested more because of the great flexibility in modeling options and a reliable output for inferential purposes. This approach considers spatial correlation of disease rates among neighboring areas to capture the geographical structure, so the estimates of the parameters in the model are more realistic [11].

Most of the studies in geographical modeling of diseases are based on a single disease, but because many diseases have common risk factors, recently joint disease mapping has appeared [12]. The definition of joint disease mapping is the spatial modeling of two or more diseases or the same disease in two or more subsets of the population at risk [11,13]. Joint modeling of different diseases has some advantages including the ability to assess shared and specific geographic patterns of risk among different diseases and improvement in the precision of estimation of underlying diseases pattern. Moreover, when interest is in a relatively rare disease, this model incorporates data from a more common, and related disease so strengthens the relevant results of the rare disease [13].

In recent decades, different methods have been proposed for joint disease mapping [14]. The first study that introduced joint spatial model analysis was done by Langford et al [15] and Leyland et al [16] whom used a multilevel model. Knorr-Held and Best [17] proposed a shared component model, then Held [18] extended a shared component model to analyze the spatial variation of several disease that allows the linear predictor to be decomposed into shared and disease-specific spatial variability components. In another study, joint modeling of two diseases applied using a proportional mortality model [13]. Moreover, in Manda et al's [19] study four joint modeling techniques were compared, including multivariate intrinsic conditional autoregressive model, multivariate multiple membership multiple classification model, shared-component, and proportional mortality models using EC and GC data. This article confirmed that the shared component model adds more versatility in answering more substantive epidemiological questions than the other three models [19].

Mohebbi et al [3,4] executed two studies in Caspian region of Iran included Golestan and Mazandaran provinces and presented the geographical patterns of EC and GC separately in this area. In both of them, Golestan was in high risk, especially for EC [3,4]. Therefore, the main object of the present paper is to apply a shared component model for joint modeling of EC and GC in Golestan province of Iran, for which diet low in fruit and vegetable intake is considered as a major risk factor, to explore the geographical variation of these two disease incidence rates. Also, we explore the differences of incidence rates between males and females by joint modeling of EC and GC separated by sex.

2. Materials and methods

Data on incident cases of EC and GC from 2004 and 2008 were extracted from Golestan Research Center of Gastroenterology and Hepatology. The cancers were