RESEARCH ARTICLE

Total and Partial Prevalence of Cancer Across Kerman Province, Iran, in 2014, Using an Adapted Generalized Network Scale-Up Method

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Abstract

Due to the lack of nationwide population-based cancer registration, the total cancer prevalence in Iran is unknown. Our previous work in which we used a basic network scale-up (NSU) method, failed to provide plausible estimates of total cancer prevalence in Kerman. The aim of the present study was to estimate total and partial prevalence of cancer in southeastern Iran using an adapted version of the generalized network scale-up method. A survey was conducted in 2014 using multi-stage cluster sampling. A total of 1995 face-to-face gender-matched interviews were performed based on an adapted version of the NSU questionnaire. Interviewees were asked about their family cancer history. Total and partial prevalence were estimated using a generalized NSU estimator. The Monte Carlo method was adopted for the estimation of upper/lower bounds of the uncertainty range of point estimates. One-yr, 2-3 yr, and 4-5 yr prevalence (per 100,000 people) was respectively estimated at 78 (95%CI, 66, 90), 128 (95%CI, 118, 147), and 59 (95%CI, 49, 70) for women, and 48 (95%CI, 38, 58), 78 (95%CI, 66, 91), and 42 (95%CI, 32, 52) for men. The 5-yr prevalence of all cancers was estimated at 0.18 percent for men, and 0.27 percent for women. This study showed that the generalized familial network scale-up method is capable of estimating cancer prevalence, with acceptable precision.

Keywords: Network Scale-Up - Cancer prevalence - family cancer history - Kerman - Iran

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Introduction

Cancer is one of the world's leading causes of morbidity and mortality (Jemal et al., 2011). Evidence shows that a considerable proportion of cancer morbidity and mortality occurs in the developing and less developed countries (Lawlor et al., 2013). While, due to epidemiological and demographic transition, besides failure in providing cancer prevention and control, it is estimated that the morbidity and mortality shares of these regions in 2030, will reach 60 and almost 70 percent of all morbidity and mortality cases of that year (Bray et al., 2012).

Cancer is among the most important causes of morbidity and the third leading cause of mortality in Iran (Mousavi et al., 2009). However, in lack of a proper population-based cancer registry, the exact figure of annual cancer incidence in Iran is unknown (Zendehdel et al., 2010; Zendehdel et al., 2011; Zendehdel, 2015); yet, based on available evidence, the annual age standardized incidence rate for cancer in Iran, has been estimated at 98 to 110 cases in 100,000 people (Mousavi et al., 2009). That being said, numerous studies have pointed out the rising trends for the morbidity and mortality of most cancers in Iran, which are expected to continue to rise (Mousavi et al., 2009; Taghavi et al., 2012; Moradpour and Fatemi, 2013). Evidence shows that breast, colorectal, prostate, gastric, and hematopoietic cancers are among the most prevalent in Iran (Mousavi et al., 2009).

The increasing burden of cancer in countries with low/moderate resources has called for critical and special attentions to the design and implementation of preventive and control programs across these regions(Lawlor et al., 2013). A critical component in cancer control planning and policy-making is the availability of authentic statistics (Sharp et al., 2014; Takiar et al., 2014), including population-based rates of incidence, prevalence, and survival of cancer patients. Absence of appropriate cancer registries in such regions has rendered all these criteria to be incalculable, especially for prevalence and survival rates, which require follow-up on cancer patients (Hadji et al., 2013). As a result, evidence-based policy-making is out of the question in these areas.

Numerous attempts have been made in Iran for the estimation of cancer prevalence based on incidence and survival data, yet they have failed to satisfy the expectations of researchers and policy-makers, due to defective initial data required for mortality-data based methods (Maracy et al., 2012; Rashidian et al., 2013).

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Moreover, to the best of our knowledge, there have been no reports on cancer prevalence in Kerman Province as of yet, except for our previous study in which the total prevalence of some cancer types was estimated in Kerman city, using basic network scale-up (NSU) method(Haghdoost et al., 2015). Still, the mentioned study failed to provide adequate prevalence estimates. Based on our former experience, we made some modifications to the NSU method, using which the present study was carried out. We speculate that the adapted method can estimate cancer prevalence with a desirable precision. This study attempted to estimate the total, 5-yr, 5-4 years 3-2 years, and 1-yr cancer prevalence in Kerman Province, the most populated province of southeastern Iran, using the familial generalized network scale-up method.

Materials and Methods

Generalized Network Scale-Up (NSU) Method (Bernard et al., 2010)

In the basic NSU method, a representative sample of the population is interviewed. The respondents answer the following questions: 1) How many people do you know? (How big is your social network size); and 2) How many of the people you know have the intended trait, e.g. cancer? The ratio of the respondent's social network members with the intended trait (m) to total network size (C) is, then, estimated. By replacing target population size (t) in the basic NSU estimator (m/C=e/t) the number of individuals with the intended trait in the target population (e) is estimated.

One of the basic assumptions in this method is that the respondent is fully aware of the presence or absence of the trait in question among his personal network members. In case of violation of this assumption, the transmission effect (TE) occurs, which leads to a biased e estimate. Therefore, a correction coefficient is required to rectify the e estimate.

In this study, in attempt to reduce the probability of TE, the respondent's personal network was confined to his/her familial networks. Also, a side study estimated TE sizes. To this end, 415 patients were interviewed according to the proposed method of Salganik et al(Salganik et al., 2011b), using standard interview forms (the details of which will be published separately). In short, patients were randomly selected from oncology centers across Kerman. Subsequent to declaring informed consent, they were interviewed by trained interviewers. They were asked to count out their relatives, divided by relation, and state whether or not they are aware of their condition. An average percentage of unaware relatives was defined as the TE.

Survey

Study area: Kerman is the most populated province of the southeastern Iran. According to the most recent census, the population of this province reaches 2,938,988 people, with a sex ratio of 1.02 and urbanization of 1.36. The province has an area of about 180,726 square kilometers, located in between 25º55' to 32º North Latitude and 53º26' to 59º29' East Longitude(kerman province presidental portal, 2011).

Sampling and data collection

A cross-sectional study was conducted within Kerman district in the second half of 2014. The population of Kerman forms 25 percent of the total population of Kerman Province. All individuals between 20 and 60 years old who were residing in Kerman and able to speak Persian were qualified to enter the study. Random sampling was designed and carried out proportional to size with 15 interviews in randomly selected clusters. For this, Kerman was, initially, divided to urban and rural strata and then substrata based on population size residing in towns and villages. For example, all villages with a population of less than 200 residents were categorized in one stratum, and those with 200 to 1000 residents were placed in another. A number of 130 clusters were defined and listed, with approximate populations of 5 to 6 thousand people per cluster. Then, proportional to the population size of each stratum, the number of clusters in that stratum, fit for sampling, was selected randomly. In each cluster, 8 males and 7 females, and on average, 9 individuals of 20 to 40, 4 individuals of 40 to 50, and two individuals of 50 to 60 years old. The age-gender ratio in the clusters was defined as per the population data of Kerman Province. Samplings in the clusters were conducted by 2 interviewers (a man and a woman), simultaneously.

Having produced their ID Card followed by an introduction, and upon receiving informed consent, trained interviewers interview the respondents, in a gender-matched, structured, face-to-face interview, based on an author-designed form. Besides the trainings the interviewers received, their interviewing capability was also evaluated in three role-playing interviews, and applicants with one mistake in the interviews were omitted. The present study was approved by the Ethics Committee of Kerman University of Medical Sciences (KMU/93/50).

Survey Questionnaire

The form's structure followed that of standard templates used in NSU studies along with an additional author-developed section, including three sections: 1) the demographic profile, containing age (20-29, 30-39, 40-49, and 50-60 years old), gender, marital status, and the residing town/village; 2) section two included the required data for the estimation of close relatives network size who resided in Kerman district. One column thereof enlisted all relationships by blood and marriage (those who usually maintain close relationships among Iranian families). Subsequent columns, respectively, recorded total number of relatives (dead/alive), number of living relatives, number of those who were/are with cancer (dead/alive), and the town/village of residence of each and every relative of the respondent in the past 7 years. Section Three recorded illness particulars of those who were reported to have cancer, including relationship to the respondent, gender, age, cancer type, year of diagnosis, vital status (if deceased, cause and year of death), and the patient's place of residence during the past 7 years. The basic network scale-up questionnaire does not have this last section. The form's validity was evaluated in three pilot studies and its reliability via a test-retest study (n=25) (R: mean, 0.81;

min, 0.77; max, 0.99).

Statistical methods

The estimation of the personal network size was conducted using summation method(McCarty et al., 2001), through which the reported number counted by the respondent's relatives, divided by relation, is summed and its average among all the respondents is calculated and considered as C estimate. Number of reported living patients was counted out, divided by sex and age group, for prevalent cancers, viz breast, colorectal, prostate, gastric, and hematopoietic cancers. Then, assuming uniform cancer prevalence across Kerman province, the number of reported living patients for Kerman was multiplied by 4 and the number of reportable cases was estimated for Kerman province, divided by the mentioned groups. Finally, to estimate total, 5-yr, 4-5-yr, 2-3-yr, and 1-yr cancer prevalence throughout Kerman province, this number was determined as per the diagnosis year (anytime, less than 5 years, 4-5 years, 2-3 years, and less than one year from the interview) and entered into the NSU estimator. The demographic data was collected from 2011 Census, via the website of Statistical Center of Iran.

Monte Carlo method was adopted for the estimation of upper/lower bounds of the uncertainty range of point estimates. To this end, assuming normal distribution for TEs, and Poisson distribution for the reported number of cancer cases, an initial 5000 estimates were calculated for e, and then, the 2.5 and 97.5 percentiles were designated as lower and upper bounds of uncertainty range of prevalence estimation. The modeling and sensitivity analysis was conducted using MS Excel.

Results

Out of 2300 interview applications, 1995 individuals participated in the study, consisting of 931 women and 1064 men. Of the respondents, 44 percent were 20 to 29 years old, 25 percent were 30 to 39, 16 percent, 40 to 50, and the remaining were 50 to 60. Thirty one percent of the respondents were single, and 69 percent, married.

The average personal family network size resident in Kerman was estimated at 68 persons. Out of 1304 respondent-reported cancer cases, 417 patients were reported alive, with 144 men (35%) and 273 women (65%) (Table 1). Mean age and time from diagnosis was 47.9 (16.2) and 4.11 (3.99) for female patients, and 48.7 (16.3) and 4.07 (4.45) for male patients, respectively.

Total prevalence of cancer was 483 (95%CI, 457-518) for women and 287(95%CI, 263-311) for men in 100,000 people. One-yr, 2-3 years, and 4-5 years prevalence (per 100,000 people) was respectively estimated at 78(95%CI, 66, 90), 128(95%CI, 118, 147), and 59(95%CI, 49, 70) for women, and 48(95%CI, 38, 58), 78(95%CI, 66, 91), and 42(95%CI, 32, 52) for men.

Breast (30 (95%CI, 23, 37)) and prostate (9.5 (95%CI, 5.5, 14)) cancers had the highest 4-5-yr prevalence in women and men, respectively (Table 2). One- years

Table 1. Reported and Estimated Total and Partial Prevalence of Cancer Cases in Kerman Province, 2014

Category		Females			Males		
		Reported*	TE$ mean(SD)	Estimated (95% CI)	Reported*	TE$ Mean(SD)	Estimated (95% CI)
Age group	0-39	288	71 (2.5)	2014 (1775, 2256)	172	64 (2.5)	1273 (1076, 1470)
	40-59	532	83 (1.5)	3374 (3075, 3380)	216	75 (1.5)	1845 (1623, 2075)
	60+	272	69 (.4.5)	1933 (1676, 2196)	188	62 (.4.5)	1407 (1186, 1633)
	Overall	1092	80 (1.5)	70101 (6710, 7616)	576	65(1.5)	4215 (3871, 4571)
Cancer type	Breast	528	88 (1.5)	3203 (2920, 3492)	-	-	-
	Prostate	-	-	-	88	70 (4)	617 (488, 760)
	Colorectal	40	75 (4.5)	272 (186, 365)	48	70(4.5)	338 (244, 439)
	Hematopoietic	140	78 (5)	927 (765, 1105)	104	71(5)	727 (592, 873)
	gastric	44	75 (5)	299 (213, 393)	60	68(5)	429 (321, 548)
	Lung	20	73 (3.5)	133 (81, 202)	60	69(3.5)	426 (320, 540)
Duration from diagnosis	Less than one	168	75 (1.5)	1138 (962, 1312)	92	60 (2)	698 (555, 845)
	2-3 Years	300	80 (1.5)	1948 (1730, 2170)	156	64 (1.5)	1150 (967, 1342)
	4-5 Years	140	85(2.5)	873 (728, 1026)	88	71(3.5)	613 (480, 755)
All sites 5-years prevalence		608	80 (1.5)	3959 (3521, 4347)	336	65 (1.5)	2461 (2220, 2701)

$ the transmission effect value used for the estimation; * the reported number for Kerman, times 4

Table 2. Estimated Partial Prevalence of Cancer Cases in Kerman Province, 2014 (Counts)

Category		4-5 years		2-3 Years		Less than one year	
		Reported*	Estimated (95% CI)	Reported*	Estimated (95% CI)	Reported*	Estimated (95% CI)
Male	Prostate	20	140 (78, 206)	24	169 (104, 240)	9	63 (27, 110)
	Colorectal	8	57 (21, 100)	12	85 (40, 135)	8	57 (20, 100)
	hematopoietic	12	83 (42, 134)	36	252 (174, 335)	8	56 (21, 99)
	gastric	4	29 (7, 54)	16	82 (22, 101)	8	58 (22, 101)
	Lung	4	27 (7, 57)	24	165 (102, 236)	10	69 (28, 115)
Female	Breast	72	436 -337,540	144	875 (736, 1022)	64	389 (297, 488)
	Colorectal	4	27 (6, 55)	12	81 (40, 128)	4	27 (7, 54)
	Hematopoietic	20	132 (78, 196)	24	159 (98, 226)	28	185 (118, 259)
	gastric	0	0	16	108 (57, 163)	4	26 (6, 56)
	Lung	8	55 (20, 97)	4	27 (7, 56)	4	27 (6, 57)

* the reported number for Kerman, times 4

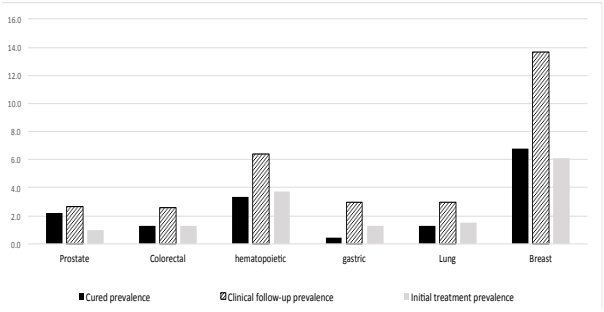

Figure 1. Contribution of the Most Prevalent Cancers in 5-yr Prevalence in Kerman Province, in 2014, Divided by Prevalence Type

(26.5 (95%CI, 20, 33)) and 2-3-yr (59.5 (95%CI, 50, 70)) prevalence of breast cancer were the highest prevalence among women (Table 2).

Breast and hematopoietic cancers dedicated to themselves, approximately 26.5 and 13.5 percent of the overall cases of 5-yr cancer prevalence, respectively. Gastric cancer, with 4.7 percent, had the least share. Respective proportions of cured patients, patients requiring clinical follow-up, and patients requiring initial treatment were respectively, 15.4, 31.2, and 14.9 percent. In total, 61.5 percent of the overall 5-year prevalence was pertinent to breast, prostate, colorectal, hematopoietic, lung, and gastric cancers (Figure 1).

Discussion

This study examined the prevalence of cancer in southeastern Iran in 2014. In light of the fact that the coverage of cancer registry in Iran is seriously defective, any prevalence estimation based on the incidence and survival rates retrieved from this data will, inevitably, be biased(Mohagheghi and Mosavi-Jarrahi, 2010; Zendehdel et al., 2010; Zendehdel et al., 2011; Ghojazadeh et al., 2013; Zendehdel, 2015). As a result, this study adopted a common method used for the estimations of different sub-populations(Salganik et al., 2011a).

The 5-yr prevalence of all cancers was estimated at 0.18 percent for men, and 0.27 percent for women. Our estimates match the results of the study by Bray et al(Bray et al., 2013). And since the most credible cancer prevalence figures in Iran and the world are presented by Bray et al(Bray et al., 2013), according to cancer incidence in five continents(Forman et al., 2013), we claim that this agreement can represent the equal efficiencies of these two prevalence estimation methods for application in developing countries. Although in our previous study it was shown that the basic network scale-up method cannot provide desirable prevalence figures(Haghdoost et al., 2015), the proposed method in this study, familial network scale-up method, with a correction for TE, seems to enable prevalence estimation with an adequate accuracy.

The prevalence of (4-5-yr) cured cancer was 0.05 percent for women and 0.04 percent for men. Accordingly, the ratio of cured prevalence of women to men was 1.25. Comparing this ratio to the cancer incidence ratio of women to men, indicates men's higher mortality due to cancer (Hasanzadeh et al., 2013). The prevalence of patients requiring clinical follow-up (2-3 year prevalence) was estimated at 0.11 percent. Ratio of female patients requiring clinical follow-up to male patients was 1.6. A comparison of this ratio to the ratio of cured patients indicates higher mortality rates for women in this regard.

The prevalence of female patients requiring initial treatment (1-yr prevalence) was 60 percent higher than that of males. The ratio of 1-yr prevalence of females to males, reported by Mehrabian et al(Mehrabian et al., 2010) roughly matched our ratio. However, the absolute figures of the prevalence rates of the mentioned study were less than ours. The resulted difference may be due to their

reliance on Iranian cancer registry data, which, based on evidence, suffers from a significant underestimation.

The prevalence of colorectal cancer estimated by this study was lower than that of Esna-Ashari et al(Esna-Ashari et al., 2012), which can be accounted for by the overestimation of survival rates, based on data from Iranian Cancer Registry, lower incidence of colorectal cancer in southeastern Iran than its country-side value, or otherwise, the time difference of the two studies(Haghdoost et al., 2011; Esna-Ashari et al., 2012; Hassanzade et al., 2012; Nikbakht and Bahrampour, 2013).

A major part of female patients in different phases of cancer, were breast cancer patients, which conforms to the results from incidence and survival rates of cancer patients in Iran(Sadjadi et al., 2009). Hematopoietic cancers was the second most prevalent cancer type in the clinical follow-up phase for both sexes. This cancer type was also the second most prevalent in women requiring initial treatment. As for men, prostate and lung cancer were the second and third most prevalent cancers in the clinical follow-up phase, after hematopoietic cancers.

This study observed cancer as most prevalent in the middle-aged, followed by the elderly patients. Prevalence was least among patients under 40. These findings contradict the previously reported incidence rates(Mousavi et al., 2009). This may be due to the different survival schemes of different age groups, as well as defective incidence data based on pathological reports.

With regard to the approximate similarity of cancer incidence and access to diagnostic and therapeutic service in southern, and especially southeastern Iran, it may be reasonable enough to generalize the estimated prevalence herein to other southern regions in Iran(Hassanzade et al., 2012).

According to the present study, over 11200 cancer patients, currently, live throughout Kerman province. The 5-yr prevalence for this province was more than 6400 people. Most of these patients were in the clinical follow-up phase, a considerable part, at the initial treatment phase, and a lesser fraction were cured. This study showed that the familial network scale-up method is capable of estimating prevalence of cancer in regions without population-based cancer registry, with acceptable accuracy.

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