ORIGINAL REPORT

Prevalence of Smoking in 15-64 Years Old Population of North of Iran: Meta-Analysis of the Results of Non-Communicable Diseases Risk Factors Surveillance System

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Abstract- Smoking is known as a major cause of chronic obstructive pulmonary disease (COPD) and hence immediate and effective interventions are required for its elimination. This study aimed to collect valid data with regard to cigarette smoking in adult population of north of Iran for policy making by a meta-analysis of the documents of national non-communicable disease risk factors surveillance system. We investigated relevant evidences by searching in published and non-electronic databases. Data were extracted based on variables such as year of the study, sex, age group and prevalence of smoking habit. Based on results of heterogeneity, we applied fixed or random effects model to estimate the overall prevalence of cigarette smoking. All analyses were performed using STATA 11 software. A total of 20747 subjects (10381 males and 10366 females) in five age groups 15-24, 25-34, 35-44, 45-54 and 55-64 years were interviewed. Meta-analysis in men and women showed prevalence of 19.2% (15.8-22.6%) and 0.3% (0.2-0.5%) respectively. Results of the present meta-analysis showed as much as one fifth of male population of north of Iran are smoker. Subgroup analysis also revealed that the rate of smoking was higher among the middle-aged men.

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Keywords: Cigarette; Iran; Meta-analysis; Prevalence; Smoking

Introduction

Cigarette smoking is one of the main risk factors for increasing the total burden of diseases throughout the world, particularly chronic and non-communicable diseases such as cardiovascular, cerebrovascular and respiratory diseases. Moreover, cigarette smoking is considered as the main etiology for malignancies in mouth, throat, lung, larynx, esophagus, bladder, pancreas, liver and cervix. Based on the reports of the United States Center for Disease Control, mortality rate due to lung cancer in men and women is 22 and 12 fold greater than that of non-smokers respectively. Many studies have found smoking as the most common cause of preventable deaths in the world (1-4).

In a 50-year study by Dol *et al.* life expectancy for the smokers was 10 years shorter than those of non-smokers (5). Scientific evidences have shown that smoking is harmful not only for smokers but also for ones who are passively exposed to the smoke (6).

Current data suggests that smoking is going to became more important in developing countries. Based on the world health organization (WHO) estimates, smoking related deaths will be decreased about 9% in developed countries between 2002 and 2030 while it will be doubled in developing countries (7). It is also estimated that during the previous decade, annually 3 millions deaths have occurred due to cigarette smoking. Two millions of these deaths were in developed countries but it is estimated that in 2020 and early 2030

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decades, this indicator will increase to 10 millions with 7 millions deaths in developing countries. This report indicates that there is one cigarette related death per 10 seconds and this rate will reaches to one death per 3 seconds in the next 30-40 years (4,7).

It seems a same trend of increasing smoking importance could be encountered in Iran as a developing country. Results of a national study in Iran have shown that as much as 14 percent of Iranian population is tobacco consumers and the male-female ratio is showed to be six. As far as the geographical distribution is concerned, it is estimated that the lowest prevalence of smoking is in Ilam (7.6%), Yazd (8.6%) and Golestan (9.1%) province, whereas Sistan-Baloochistan (20.3%) and Booshehr (21.2%) where provinces with the highest rates of smoking (8). In addition, a recent report of WHO has announced that the burden of smoking in developing countries such as Iran shows an increasing trend (9).

Considering the abovementioned concerns and high prevalence of smoking-related diseases, it is necessary to estimate a precise rate of smoking in the community using a valid data to be able to reduce the rate of cigarette smoking and its adverse outcomes. The national surveillance of non-communicable disease risk factors, which has been conducted in all provinces of Iran in recent years, enabled researchers to publish several reports with regard to current status of smoking in Iran. It seems collection and pooling of these results via a meta-analysis gives the health policy makers an invaluable opportunity to make evidence based decisions. This study aims to estimate the prevalence of cigarette smoking in 15-64 year-old adults by conducting a meta-analysis of the published results of a 5-years national non-communicable disease risk factors surveillance project in north provinces of Iran (Mazandaran, Golestan and Gilan).

Materials and Methods

This study is meta-analysis of 5-year documents of national non-communicable disease risk factors surveillance system (first step) with regard to prevalence of smoking among adult population of north of Iran.

Selection of evidences

To access the results of the first step of non-communicable disease risk factors surveillance system in different provinces, we used published reports of the relevant studies in 2007-2009. Documents of surveillance system in 2004 and 2006 (which were not in paper or electronically available) were collected in coordination with the center for disease control of the Ministry of Health (Iran).

The national non-communicable disease risk factors surveillance system in Iran

These studies were carried out from 2004 using relevant protocols of WHO to obtain valid and comparable information at the national and international levels. The first step of these surveillance studies was finished after five national projects. These cross-sectional studies have been conducted by means of questionnaires. General information was collected through face-to-face interviews at the participants' residential areas. In each selected cluster, eligible subjects of the first household were asked by the interviewers and then other households were approached until required sample sizes in each age and sex groups were completed. In the case of any household being absent for twice, other neighborhood household from the right direction of the seed was approached systematically and with the same method, eligible people were asked to participate in the study.

Sample selection in this surveillance project was carried out using information of post office of Islamic Republic of Iran with a systematic approach and multi stage cluster sampling method in all provinces. It should be noted that these studies did not addressed military personnel and populations living in areas such as prisons and old people houses. Sample size selection was equal in different age groups (15-24, 25-34, 35-44, 45-54, 55-64 years).

Based on the WHO's definition (11), study subjects were considered current smoker if they smoked at least one cigarette per day in the time of interview.

Quality assessment

All of the articles selected for this meta-analysis had conducted and published based on the standards of WHO with a similar methodology in all provinces of Iran and hence no quality assessment was necessary.

Data extraction

We extracted required data based on the year of study, total sample size, and sample size in sex and age groups and finally, prevalence of cigarette smoking in men and women.

Inclusion and exclusion criteria

Only results of 5 years of the national non-communicable disease risk factors surveillance system

(first step) in the north-west of Iran were included in the study. Other studies whose results did not hold those criteria excluded from the data entry.

Statistical analysis

Stata V.11 software was used for the analysis. Standard error for prevalence of smoking in each study was calculated based on the binary distribution formula. Test of heterogeneity among the studies was calculated by means of Cochran test. Based on the results of the heterogeneity test, fixed effect model (where *P*-value>0.05) or random effects model (where *P*-value<0.05) was used to estimate the pooled prevalence of cigarette smoking in total population and within age-sex groups. In addition, to reduce the effect of random variation, we used Bayesian techniques to estimate the pooled prevalence of smoking. Finally, using meta-regression technique, the effect of variables potentially make heterogeneity among the studies was investigated. Ninety-five confidence interval of prevalence was estimated and demonstrated in forest plot. Size of the square was used to indicate the weight or sample size and the horizontal line indicated the 95% confidence interval (CI) for prevalence of smoking in each study and pooled prevalence.

Results

Based on the national census of 2006, total population of north of Iran was 6942518 (Mazandaran: 2920657, Golestan: 1617000, Gilan: 2404861) which comprised about 9.9% of total population of Iran. Of this population, 20747 persons (10381 males and 10366 females) who were Iranian in five age groups (15-24, 25-34, 35-44, 45-54 and 55-64 years) were interviewed (Table 1). Sample size in 2004 was 8747 and in the next four years annually 3000 subjects were recruited in the study.

Based on the results of the first step of the national non-communicable disease risk factors surveillance, prevalence of cigarette smoking in men varied from 12.3% (Golestan, 2009) to 26.2% (Gilan, 2004). Pooled prevalence of smoking in men in this meta-analysis was estimated to be 19.2% (CI=15.8-22.6). The range for the smoking prevalence in 15-24-year old males varied from 1% (Golestan, 2006) to 11.2% (Golestan, 2004). This ratio for 25-34-year old men showed to be 11% (Golestan, 2007) to 36.3% (Golestan, 2004). For middle age males (35-44-year olds) the prevalence of smoking was reported from 20.8% (Golestan, 2009) to 46.1% (Golestan, 2004). The smoking prevalence in 45-54 years old men was reported between 14.9% (Mazandaran, 2004) and 43.9% (Gilan, 2008), while this range for 55-64 years old men was 13.5% (Golestan, 2007) to 40.2% (Gilan, 2009). These results are presented in figure 1. Moreover, table 1 summarizes the total estimates of smoking prevalence by gender.

Table 1. Description of the studies according to year of publication, sex, age group and result of meta-analysis.

Province		**15-24**		**25-34**		**35-44**	
(Publication year)		**M**	**F**	**M**	**F**	**M**	**F**
Golestan2004		11.2	1.2	36.3	1	46.1	3.1
Golestan2006		1	0	12.9	0	28	0
Golestan2007		3	0	11	3.2	24.8	0
Golestan2008		1.01	0	19.8	0.98	29	0
Golestan2009		2.97	0	13	0	20.79	0
Gilan2004		6.8	0.4	27.8	1.3	41.8	4.7
Gilan2006		7	1	30.1	0	36.6	0
Gilan2007		10	0	34.4	0	39.2	1
Gilan2008		4.12	0	25.47	0	34.47	0
Gilan2009		8.08	0	33	0	34.34	0
Mazandaran2004		4.2	0	18.1	0	23	0.8
Mazandaran2006		7	0	29.6	0	32.7	2.1
Mazandaran2007		10	0	16.2	1	29.4	1
Mazandaran2008		5.82	0	28.57	0	30	0
Mazandaran2009		5.94	0	26.53	0.98	33.01	0
Pooled estimate	%	5.3 (3.6-7.02)	0.2 (-0.2-0.5)	23.8 (19.5-28.2)	0.3 (-0.05-0.7)	32.2 (27.9-36.5)	0.7 (0.2-1.1)
	Q (Heterogeneity)	49.1	4	81.4	9.3	63.5	19.2
	P	0.0001	0.9	0.0001	0.8	0.0001	0.1
	Sample size	2067	2075	2060	2064	2092	2077

Table 1. (Continue) Description of the studies according to year of publication, sex, age group and result of meta-analysis.

Province(Publication year)		45-54		55-64		Total	
		M	F	M	F	M	F
Golestan2004		41.2	3.2	38.4	5.2	-	-
Golestan2006		28.6	0	16.3	0	-	-
Golestan2007		25.7	0	13.5	1	12.7	0.9
Golestan2008		23.76	1.04	14.43	3.33	14.89	0.62
Golestan2009		23.23	1.01	15.15	1.03	12.28	0.2
Gilan2004		40.2	4.2	35.9	2.9	-	-
Gilan2006		33	1	31.3	3	-	-
Gilan2007		33	3.9	32.7	3.1	26.2	0.9
Gilan2008		43.88	3.12	30.53	0	22.18	0.4
Gilan2009		41.18	1	40.21	2.08	25.8	0.27
Mazandaran2004		14.9	1.6	17.7	2.6	-	-
Mazandaran2006		33.7	0	28.3	1.9	-	-
Mazandaran2007		32.7	1	27.7	0	19.3	0.6
Mazandaran2008		23	1.01	21.57	0.99	19.47	0.2
Mazandaran2009		30.61	0	28.28	0	20.95	0.25
Pooled estimate	%	31.1 (25.6-36.6)	1.2 (0.7-1.7)	25.9 (21.01-30.8)	1.4 (0.9-2)	19.2 (15.8-22.6)	0.3 (0.2-0.5)
	Q (Heterogeneity)	110.9	18.4	96.9	23.1	73.6	5.9
	P	0.0001	0.2	0.0001	0.06	0.0001	0.6
	Sample size	2079	2080	2083	2070	10381	10366

In women, the prevalence of cigarette smoking varied from 0.2 % (Golestan, 2009 and Mazandaran, 2008) to 0.9% (Gilan and Mazandaran, 2007). Pooled prevalence of smoking in women in this meta-analysis was estimated about 0.3% (CI= 0.2-0.5). In this study, prevalence of smoking varied from 0-1.2% in 15-24 years old women, 0-3.2% in 25-34 years old women, 0-4.7% in 35-44 years old women, 0-4.2% in 45-54 years old women and 0-5.2% in 55-64 years old women (Figure 2 and Table 1).

We added the variable year of the study in the meta-regression model where the heterogeneity of the studies based on the heterogeneity test (Q) was significant and found no significant effect of this variable on the heterogeneity in the results (P>0.05).

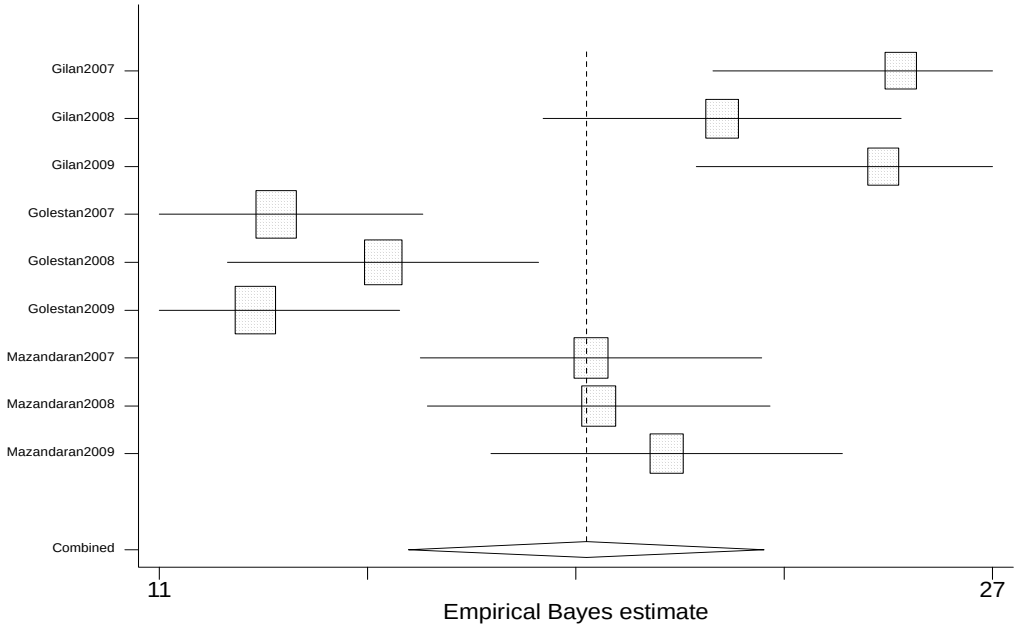

Figure 1. The estimated prevalence of smoking among men in the included studies and the overall view. The chart shows that the prevalence of smoking among males is 12.84-25.24 % (Based on Bayes estimate).

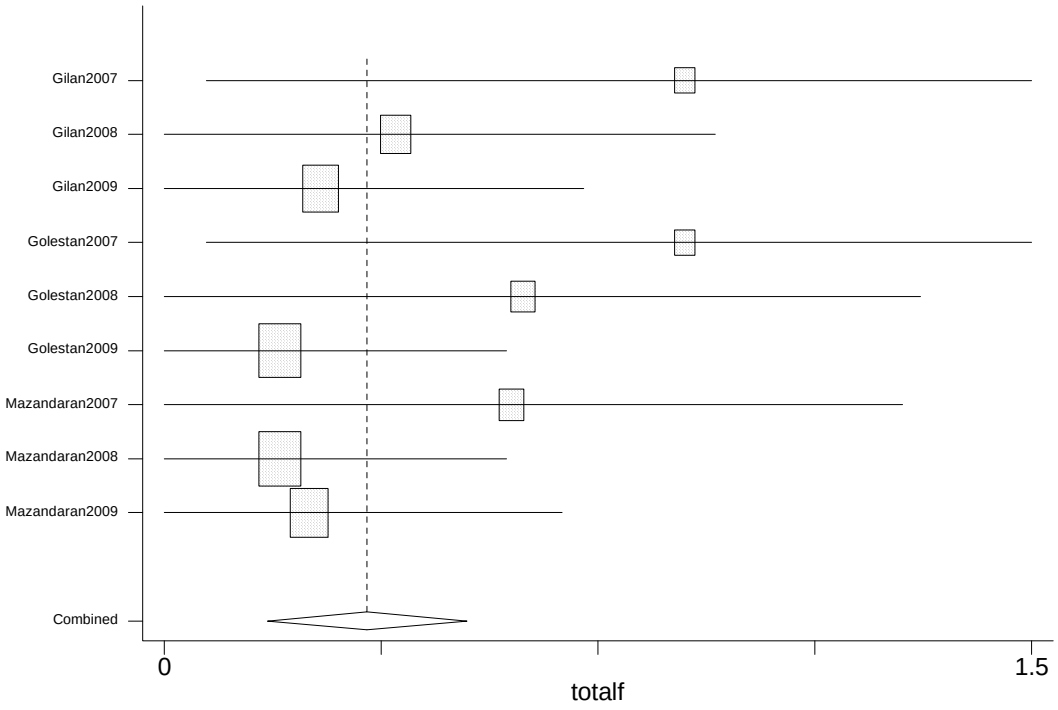

Figure 2. Difference in the estimated prevalence of smoking among female in the included studies and the overall view. This chart shows that the range for the prevalence of smoking among females is 0.2-0.9 %.

Discussion

The findings in this meta-analysis showed that about one fifth of male residents in north of Iran are current cigarette smokers. This high prevalence could be higher if other usage of other smoking products would be added to this rate. A dreadful scenario of the confrontational effects of smoking could be anticipated for the people of this area. This proportion of tobacco usage in the North of Iran is comparable and even higher in comparison with certain provinces. In a study conducted by Sarrafzadegan *et al*. in Isfahan (central province of Iran), of a total of 2626 male subjects who were older than 19-yeasr of age, prevalence of self-reported cigarette smoking was 18.7% (12). Results of two other studies in Tehran (capital city of Iran) demonstrated this prevalence to be 20.6% and 22% in men (13,14). In Mashhad (north-east Iran) 17.2% of men (172 of 999) were current smokers with higher rates in men with low income and low levels of education (15). About 26% of men in Shiraz (south of Iran) were also smoker in a study reported by Ahmadi *et al*, (16).

Our findings in the present study also showed that the prevalence of cigarette smoking among people aged 15-24 years, is lower than the this ratio for other countries (USA: 43.7%, Brazil: 14.7% and Malaysia: 29.7%) (17). This observed difference could be attributed to cultural and social factors in different populations.

Most of male smokers were in 35-44 and 45-54 age groups respectively. Table 1 shows that there is a significant difference in smoking prevalence among men aged 15-24 with the other age groups. It also shows that this prevalence increases from 15-24 to 35-44 age groups and then decreases. This finding is in accordance with the results of most of previous studies (14). This reduction might be due to appearance of cigarette related diseases and mortality and better perception of its risks in the older age groups.

Estimated pooled prevalence of cigarette smoking in female residents of north of Iran was 0.5% with an increasing trend by age, so women aged 55-64 years smoked more than the other age groups. The rates in first two age groups were significantly different from those in older age groups (Table 1). Only some of the studies in different parts of Iran presented similar findings. Fotouhi *et al*. (14) and Ebadi *et al.* (18) reported 2.9% and 2.1% prevalence of cigarette smoking

respectively for women. This prevalence for 30-70 years old women in Semnan (northern Iran) was 0.5% (19) while Mehrabi *et al.* found that 5.9% of women aged 15-64 years were smoker (20). In Mashhad (north-east Iran), 2.5% (15) and in Shiraz (southern Iran) 3.6% of women smoked cigarette (16). It seems that various definitions in different studies are the main causes of the heterogeneity in the results. The prevalence of cigarette smoking in the other countries is also different. For instance, a study in Pakistan showed that 5% of women aged 25-44 years and 7.8% women aged 45-64 years are smokers (21). In Egypt, 1.5% of 15-80 years old women (22) and in Kuwait 1.9% of adult women (23) were current smokers. On the other hand, the prevalence of cigarette smoking in adult women in Italy was showed to be 22.5% (24) and in the USA this ratio was 17.4% (25). Most of these findings were more than the estimates of the present meta-analysis.

We also found that the prevalence of cigarette smoking in men was considerably more than that of women in all age groups. This pattern was similar to the results of all studies in Iran and other countries such as China, Korea, European countries and USA (26).

Pattern of cigarette smoking depends on different factors such as age, sex, level of education and the socio-economic status (13). Ebadi *et al.* (18) showed that each year increase in age, increases the prevalence of smoking about 2% whereas each level of education decreases that prevalence about 5%. That study also revealed that males smoke 5 folds more than women, people with current job smoke 1.4 folds more than retired people and jobless subjects smoke twice the people with a current job. Among social determinants, the study showed that divorced subjects had the most prevalence of smoking.

One of the main causes of variations in the results of different studies is due to various definitions of smoking. Another source of heterogeneity roots in determination of prevalence based on self-report data gathering. This may leads to recall bias as a critical systematic error. The magnitude of this bias is different in populations based on socio-cultural situation and level of acceptance of smoking and stigma. Although validity of non-communicable disease risk factor surveillance system has been previously addressed (10), data gathering by means of self-report questionnaires in the included studies is one of the main limitations to our study. In other words, socio-cultural situation and lack of social acceptance of smoking, increases the probability of underreporting of prevalence of smoking in both genders (especially in women) more than the other countries. For example in Sarrafzadegan *et al*. study, prevalence of smoking based on self-reports showed to be 18.7 and 1.3 in men and women respectively. This is while laboratory tests showed these rates to be 21.2% and 6.7% respectively (12). Considering this issue, we can expect that the true prevalence of smoking in both genders living in the studied areas in the present study might be more than the reported prevalence.

Increasing trends in prevalence of cigarette smoking indicate that strategies for controlling cigarette smoking in Iran and especially in Northern provinces have not been efficiently implemented. For instance, since US Health Center has implemented programs for smoking reduction to less than 12% in 2010, the prevalence of cigarette smoking in adults had a significant decreasing trend from 22.5% in 2002 to 20.9% in 2004 .

Our results imply that it is necessary to design and conduct strategies with regard to control of smoking such as general and political supports, increasing social pressures toward smoking prohibition, systematic training of population to understand risks of smoking and converting the control programs to a social demand in addition to accessibility of giving up facilities (consultation and drug treatment). These activities should be implemented and closely monitored to accelerate reduction in prevalence of smoking in adult population and burden of diseases related to cigarette smoking.

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