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Original Article

The Prevalence and 5-Year Incidence Rate of Cigarette Smoking and Water-Pipe Tobacco Smoking and Their Associated Factors among 15 to 80 Years Old Urban Population in Southeast Iran: Results from KERCADR Study

Hamid Najafipour[1], Amin Mahdavi[2*], Zeinab Kordestani[3], Zahra Zamaninasab[4], Mitra Shadkam Farokhi[5], Atefeh Shamsadini[6], Elnaz Azizi[6]

[1]Physiology Research Center, Institute of Neuropharmacology, and Department of Physiology and Pharmacology, Kerman University of Medical Sciences, Kerman, Iran
[2]Cardiovascular Research Center, Institute of Basic and Clinical Physiology Sciences and Department of Cardiology, Kerman University of Medical Sciences, Kerman, Iran
[3]Endocrinology and Metabolism Research Center, Institute of Basic and Clinical Physiology Sciences, Kerman University of Medical Sciences, Kerman, Iran
[4]Department of Biostatistics, Faculty of Health, and Gastroenterology and Hepatology Research Center, Kerman University of Medical Sciences, Kerman, Iran
[5]Physiology Research Center, Kerman University of Medical Sciences, Kerman, Iran
[6]Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran

Abstract

Background: Cigarette and tobacco smoking are closely associated with chronic cardiovascular disease and lung cancer. We aimed to assess the prevalence and 5-year incidence rate (IR) of these two risk factors for cardiovascular diseases in Kerman, southeastern of Iran.

Methods: 10015 individuals aged 15-80 were recruited to the study between 2014 and 2018 (Kerman coronary artery disease (CAD) risk factors study, KERCADRS) of which 2820 had also participated in the first phase (5 years earlier). We took fasting blood samples and collected demographic information and data on cigarette and water-pipe tobacco smoking (WPTS) through interviews.

Findings: The overall prevalence of cigarette smoking increased from 8.1% in phase1 to 8.8% in phase 2. During the same period, the prevalence of WPTS increased from 10% to 14%, especially in the age groups of 15-45 years. The prevalence of opium dependance was higher among cigarette smokers compared to WPT users. The overall 5-year IR of cigarette and WPTS was 3.6 and 4.65 per 1000 person-years respectively. The highest IRs of cigarette smoking and WPTS were reported in the age group of 15-39 years, and IR of WPTS was higher among women. Obesity, diabetes, and hypertension associated with a reduced IRs of cigarette and WPTS.

Conclusion: Over the past five years, the prevalence of cigarette smoking has increased slightly, but WPTS has increased more rapidly, especially among women. The highest prevalence of cigarette and WPT smoking was in the age groups of 15-39 years. Smoking is shifting from cigarette smoking to WPTS. Age- and gender-oriented interventions would help correct the unhealthy life style in the community and prevent further smoking-related morbidities and mortalities.

Keywords: Cigarette smoking; Tobacco smoking; Prevalence; Incidence; Kerman; Iran

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Introduction

Coronary artery disease (CAD) is one of the leading causes of mortality and disability worldwide, especially in Iran. According to the Global Burden of Disease study in 2010 (GBD 2010), the leading causes of death in the United States were poor diet (14%), cigarette smoking (11%), obesity (11%), and high blood pressure (8%).[1] Cigarette smoking, with 11%, is associated with chronic obstructive pulmonary diseases (COPD), CAD, peripheral vascular disease, and lung cancer. According to GBD study opioid use disorders moved) from 11th ranked cause of disability-adjusted life years in 1990 to 7th

***Corresponding Author:** Amin Mahdavi , MD, Cardiovascular Research Center and Department of Cardiology, Afzalipour Medical Faculty, Shafa Hospital, Shafa Street, Kerman, Iran. Tel: +983412264071, Fax: +983412264097, Emails: mahdaviamin@yahoo.com, kerman.physiology@gmail.com

in 2016, and cigarette smoking accounted for more than 5% of disability-adjusted life years.[1-3] Cigarette smokers have a high mortality rate with cigarette smoking-related deaths estimated to increase from 4.8 million to 8.3 million between 2006 and 2030.[4-6] Based on international reports in 2015, overall daily smoking prevalence in Iran was 10.7% with the rage of 8.9%-12.8% in subgroups.[7] Cigarette smoking is not only harmful to smokers but also threatens the health of people exposed to secondhand smoke. Tobacco, as the main ingredient in cigarettes, produces a large amount of toxic substances and carcinogens such as polycyclic aromatic hydrocarbons and nitrosamines through incomplete combustion under high heat.[8] Chronic inflammation is caused by cigarette smoking due to the release of numerous inflammatory mediators such as interleukin 6 (IL-6), IL-1, tumour necrosis factor α, CXCL8, and CXCL1. The inflammation inhibits the secretion of mucus into the intestinal mucosa, which in turn causes the tumor to grow and spread in this area. Therefore, cigarette smoking increases the incidence and recurrence of peptic ulcer disease, inflammatory bowel disease, and colon, esophageal, and pancreatic cancers.[9] The onset of cigarette smoking at an early age increases the risk of psychiatric disorders at older ages. The complications such as social incompatibility, anxiety, depression, and sadness are more common in cigarette smokers than non-smokers.[10, 11]

The World Health Organization (WHO) report shows that the geography of cigarette smoking is shifting from developed countries to developing countries, and the problem is more serious in Asia.[12] According to the WHO report in 2010, the prevalence of cigarette smoking in Iran was 10.8% (20.4% in men and 1% in women). According to the results of STEPS study in 30 065 individuals aged 18 years and older in 2016, the overall prevalence of cigarette smoking in Iran was 10.1% (20.1% in men and 0.9% in women) and the overall prevalence of tobacco smoking was 14.2% (25.2% in men and 4% in women).[13,14] The highest prevalence of cigarette smoking was observed in the age groups of 35 to 64. Geographically, the highest prevalence of cigarette and tobacco smoking was reported in the northwestern and southern regions of the country respectively.[14,15] Kerman was among the provinces with low to intermediate prevalence accounting for approximately 1000 participants in a total sample size of 30 065 across the country.

In the first phase of the KERCADR study in Kerman (2011), the overall prevalence of cigarette smoking among 5716 individuals aged 15 to 75 years was reported 10% (15.5% in men and 0.8% in women).[16] However the prevalence of water-pipe tobacco smoking (WPTS) was not investigated in the study population. It seems that tobacco use, mainly in the form of WPTS, has recently increased due to its lower social stigma, but there is no precise information on its current prevalence in this region. In the present study, which was the second phase of the KERCADR study conducted 5 years after the first phase, in addition to increasing the sample size to 10 015, of which 2820 participants were in the first phase, the prevalence of cigarette smoking and tobacco use (WPTS), and their incidence rate (IR) between two phases (5-year period) were investigated. This determines the current status of risk factors for these non-communicable diseases, the changes in their prevalence and incidence over the last five years, and their relationship to other risk factors for CAD in this region. Larger sample size and wider age range (15-80 years) give a better picture of the current status of the overall and gender and age subgroups in relation to the prevalence and incidence of both cigarette and WPTS in the area.

Methods

This study used the data from the second phase of KERCADRS study on risk factors for CADs conducted between 2014-2018. The Ethics committee of Kerman University of Medical Sciences approved the study protocols (Ethical code: IR.KMU.REC.1401.286).

Study design and variables

This was a cross-sectional study with 10 015 participants who were included by cluster sampling method. Written informed consent was obtained from all subjects. The methodology and more detailed description of the selected variables have been described in the article which was previously published from the results of the first phase.[16]

Participants

The subjects of the survey were people aged 15 to 80 who were residents of Kerman. Of the participants, 2820 were also participants in the first phase of the study. The first phase of the study was conducted from 2009 to 2012 with 5,895 people.[16] In the present study, 420 zip codes were randomly selected from the zip codes of Kerman city with allocation of the proportion of people in each of the four city areas obtained from the Central Post Office. The research team invited all eligible family members (aged 15-80 years) who were living in the selected locations and their neighbors on the right side of the alley to reach 24 people (12 men and 12 women). Informed consent forms were collected from participants, then, the participants were referred to a research clinic located in city downtown.

Data collection

Fasting blood samples were collected on the day of the visit after the fast for 10-12 hours. Participants then received breakfast and completed a demographic questionnaire consisting of personal characteristics, education level, occupational, and tobacco and cigarette smoking status. Participants in the first phase of the study were associated

with 250 zip codes and were recalled in the second phase five years later. Despite great efforts, the relocation of some participants who were primarily renters and the fact that mobile phones were not widespread in 2008, or death of some participants during this period, it was not possible to recruit all participants. If the researchers could not find a participant, a new person from the same zip code was invited and included in the study. The remaining individuals up to the sample size of 10000 were recruited from 170 new zip codes using the same protocol. The details of the laboratory tests, definitions of underlying risk factors such as diabetes, hypertension, obesity, mental disorders (anxiety and depression), and the levels of physical activity have been described in the previous publication.[17]

We collected demographics and tobacco and cigarette smoking information using standard questionnaires and personal interviews and divided the participants into two groups of non-smokers (people who have never smoked) and daily smokers (people who smoked at least one cigarette a day or water-pipe at least once a week). Almost all tobacco users use it in the form of water-pipe smoking, so in the present study, the word "water-pipe tobacco smoking" was used instead of tobacco use.

In the present study, the completed data of 2807 out of 2820 people who participated in both phases of the study were used to determine the IR of cigarette and tobacco smoking at 5-year intervals between the two phases.

Incidence rate of cigarette/tobacco smoking

In the present study, the IR of cigarette and tobacco smoking were calculated by a similar method. So, only the method for calculating the IR of cigarette smoking is presented here. To calculate the IR of cigarette smoking, the data obtained from those who participated in both phases, did not smoke cigarette in phase 1, and therefore, were at the risk of becoming smoker during the follow-up period (5 years) were used (Figure S1). Therefore, 10% of 5895 participants (n = 590) in phase 1 who were already cigarette smokers, were excluded from the incidence calculation. Of the remaining participants (n = 5305) who were at risk of becoming smoker, 2485 (42%) were untraceable (were not found/died during 5 years). The number of new smoking cases identified during the follow-up period (out of 5305 cases) was considered as numerator. For those who were non-smokers in phase 1, the time difference (years) between phase 1 and phase 2 visits were calculated as person-years at risk. Therefore, the denominator was the total follow up time (person-years for each subject which was totaled for all 5305 subjects at risk of becoming smoker. For those who were untraceable, it was assumed that they had been followed up for an average of 2.5 years (half of the overall follow-up time between phase 1 and 2), and then, lost to follow up. The IR (expressed as person per 1000 person-years) was then calculated by the following formula.[18]

$$\text{Incidence rate} = \frac{\text{Number of new cases of smoker during follow-up period}}{\text{Total person-years for all persons at risk}} \times 1000$$

Statistical analysis

The statistical software STATA version 15 was used for statistical analysis. For age-sex direct standardization, Kerman population reported in the census 2016 was used. All prevalence rates were weighted according to the sampling weight (reciprocal of the probability of selection) and individual response rate. Univariate and multivariate logistic regression models were used to determine the potential predictors of cigarette/tobacco smoking. The prevalence of cigarette/tobacco smoking between phase 1 and 2 was compared using Z-test and chi-square test.

Results

In the present study, 10,015 people participated, of whom 5,952 (59%) were women. The age and sex distribution of participants are shown in Table 1. Of 5895 participants in phase 1, the data of 5716 persons were complete and analyzed. The overall and sex and age-related prevalence of cigarette smoking are shown in Figure 1 and Table S1. The overall prevalence of cigarette smoking increased from 8.1% in phase 1 to 8.8% in phase 2. In men cigarette

Table 1. Age-sex distribution [n (%)] of participants in the two phases of the KERCADRS study, Kerman, Iran (n = 5716 in phase 1, 2009-2012 and n = 10015 in phase 2, 2014-2018)

Category		Phase I			Phase II		
		Female	Male	Total	Female	Male	Total
Total		3160	2556	5716	5952	4063	10015
Age group (y)	15-24	432 (13.7)	384 (15.0)	816 (14.3)	370 (6.2)	325 (8)	695 (6.9)
	25-34	603 (19.1)	473 (18.5)	1076 (18.8)	942 (15.8)	608 (14.9)	1550 (15.5)
	35-44	611 (19.3)	442 (17.3)	1053 (18.4)	1272 (21.4)	753 (18.5)	2025 (20.2)
	45-54	716 (22.7)	487 (19.0)	1203 (21.0)	1253 (21.0)	739 (18.2)	1992 (19.9)
	55-64	536 (19.9)	485 (19.1)	1021 (17.9)	1298 (21.8)	820 (20.2)	2118 (21.1)
	65-75	262 (8.3)	285 (11.1)	547 (9.6)	620 (10.4)	548 (13.5)	1168 (11.7)
	≥75	-	-	-	197 (3.3)	270 (6.6)	467 (4.7)

Note: The data of phase 1 were extracted from the previous publication and presented here for comparison.[15]

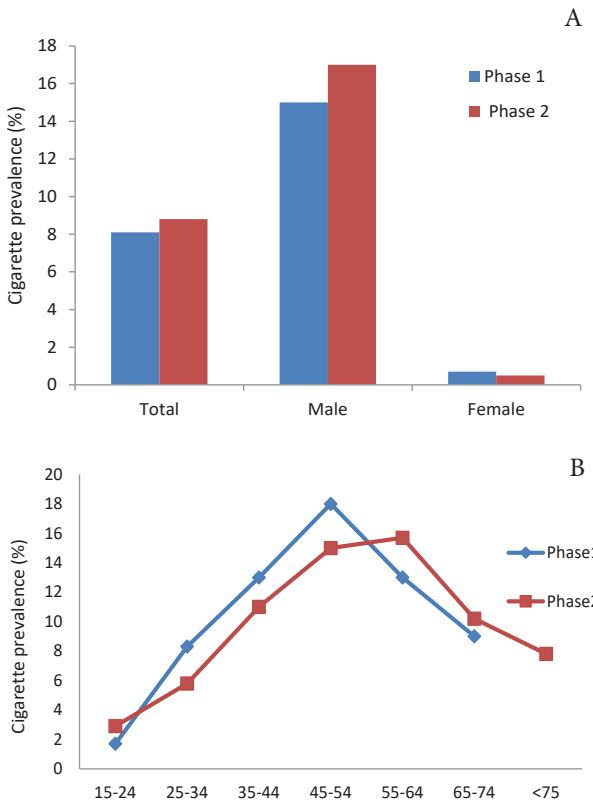

Figure 1. The prevalence of cigarette smoking in two phases of the KERCADR study (phase 1, 2009-2012 and phase 2, 2014-2018), based on sex (A) and age group (B). The data of phase 1 were extracted from the article that was published previously and presented here for comparison.[15]

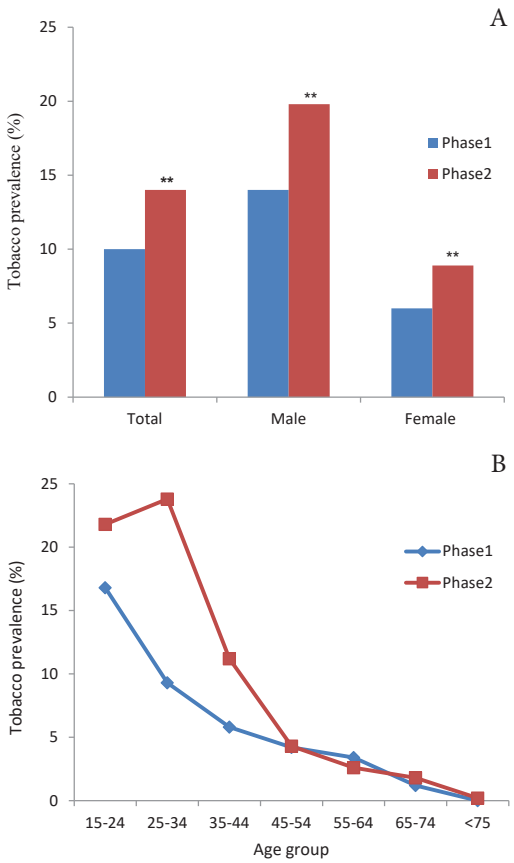

Figure 2. The prevalence of water-pipe tobacco smoking in the two phases of the KERCADRS study (phase 1, 2009-2012 and phase 2, 2014-2018), based on sex (A) and age groups (B). The data of phase 1 were extracted from the article published previously and presented here for comparison.[15] ** $P<0.01$ compared to phase 1.

smoking prevalence increased from 15% in phase 1 to 17% in phase 2 ($P<0.05$ for men). The prevalence decreased in women from 0.8% to 0.5% over the 5-year period ($P>0.05$). The prevalence of cigarette smoking in both phases and in both genders increased with age up to 55 years.

The prevalence of WPTS in the study population in the two phases of the study is shown in Table 2. The overall prevalence of WPTS significantly increased from 10% in the first phase to 14% in the second phase ($P<0.01$). The highest prevalence (16.8%) in phase 1 was in the age group of 15 to 24 years and in phase 2 (23.8%) in the age group of 25 to 34 years. The highest prevalence of WPTS in both men (33%) and in women (14%) was in the age group of 25-34. Figure 2 shows the overall prevalence by gender and age. The prevalence of WPTS in both genders increased significantly over the 5-year period between the two phases ($P<0.01$ for both). The prevalence of WPTS in all age groups up to the age of 45 was significantly higher in phase 2 than in phase 1.

Co-morbidities associated with cigarette and WPTS

The prevalence of co-morbidities associated with cigarette and WPTS is presented in Table 3. In cigarette smokers, the prevalence of dependent opium use was significantly higher in smokers than in non-smokers, while the prevalence of hypertension and occasional opium use was lower in non-smokers. In WPTS, the prevalence of dependent opium use was low and the prevalence of occasional opium use, anxiety, and obesity was high. Low physical activity, depression, and dyslipidemia were not significantly associated with cigarette and WPT smoking (Table 3).

The incidence of cigarette and WPTS

Table 4 shows the IR of cigarettes and WPT smoking in the study population over a 5 years period. A Total of, 2807 people who participated in both phases of the study and completed the information, were included in the calculation of IR of cigarette and WPT smoking. The overall IR of cigarette and WPT smoking was 3.6 and 4.64 person per 1000 person-years, respectively. The highest IR of cigarette smoking and WPTS was reported in the age group of 15-39. The IRs of WPTS and cigarette smoking were both higher in men ($P<0.001$ and $P<0.04$ respectively). With aging, the IR of cigarette and WPT smoking declined, but this reduction was only significant for WPTS ($P<0.01$). Obesity, diabetes, and high blood pressure were significantly associated with a reduced incidence of cigarette and WPT smoking ($P<0.001$ for

Table 2. The prevalence of tobacco smoking, n (%) in phases 1 and 2 of the KERCADR study, Kerman, Iran (n = 5716 in phase 1, 2009-2012 and n=10015 in phase 2, 2014-2018)

Subgroup	Phase 1	Phase 2	*P* value
Overall	10 (9-11)	14 (13-15)	0.00
Male	14 (13-16)	19.8 (8-21)	0.00
Female	6 (5-7)	8.9 (79-9.9)	0.00
15-24 years	16.8 (14.1-19.8)	21.8 (18.8-25)	0.026
Male	24 (20-29)	31 (26-36)	0.057
Female	9 (6-11)	12 (9-15)	0.193
25-34 years	9.3 (7.4-11.5)	23.8 (21.7-26.1)	0.00
Male	14 (11-17)	33 (29-37)	0.00
Female	4 (3-6)	14 (12-17)	0.00
35-44 years	5.8 (4.4-7.4)	11.2 (9.8-12.8)	0.00
Male	7 (5-1)	16 (13-18)	0.00
Female	4 (2.7-5.9)	7 (5-8)	0.012
45-54 years	4.2 (3-5.7)	4.3 (3.5-5.3)	0.493
Male	4 (3-7)	3 (2-5)	0.266
Female	4 (3-6)	5 (4-7)	0.10
55-64 years	3.4 (2.3-4.9)	2.6 (2-3.4)	0.266
Male	3 (2-5)	2 (1.4-4)	0.378
Female	3.5 (2.1-5.8)	3 (2-4)	0.442
65-74 years	1.2 (0.6-2.6)	1.8 (1.1-2.7)	0.403
Male	0.7 (0.2-2.7)	1.8 (0.9-3.3)	0.137
Female	1.9 (0.8-4.5)	1.7 (1-3)	0.89
>75 years	-	0.2 (0-1.7)	-
Male	-	0	-
Female	-	0.5 (0.07-0.3)	-

obesity and hypertension, and $P<0.02$ for diabetes) (Table 4).

Discussion

Our findings showed that in the recent 5 years the overall prevalence of cigarette smoking in the population aged 15 to 80 has increased from 8.1% to 8.8% (individually 0.8% to 0.5% in females and 15% to 17% in males) in Kerman, as the largest city in the southeast of the country. Additionally, the prevalence of WPTS has increased from %10 to 14% (6% to 8.9% in females and 14% to 19.8% in males). The prevalence of WPTS increased in both men and women, especially in the group aged 15-44. In cigarette smokers, the prevalence of dependent opium use was higher. Over the 5-year period, the IR of cigarette and WPTS was 3.6 and 4.65 per 1000 person-years respectively, with the highest rates reported in the group aged 15-39. Obesity, diabetes, and high blood pressure were significantly associated with a reduced incidence of WPT smoking. The burden of smoking in developing countries is increasing.[1,2] With a cigarette smoking prevalence of 17% in men and 0.5 % in women, the estimate of the present study was lower than the national estimate for Iran (20.1% in men, 0.9% in women) in 2016.[13] Recent meta-analyses have reported the prevalence of cigarette smoking among women 0.3% to 0.9% in different regions of Iran[19-21] which is comparable to the estimates of the present study. In men, our estimates are considerably lower than those reported (19.2% to 22.9%).[19-21] It is well documented that women smoke less than men in Iran.[19,21,22] Stigma related to cigarette smoking among women persists in Iran and as a result, women shift to use less-stigmatized types of tobacco smoking like WPTS, or report cigarette smoking less frequently. [22] Accordingly, the results showed that the prevalence and IR of WPTS over the past five years increased more strongly in women than in men. The popular belief that WPTS is less harmful than cigarette smoking has proven false. Moreover, consumers believe

Table 3. The standardized prevalence, % (95% CI) of associated co-morbidities among people smoking cigarette or tobacco (total participants=9978, KERCADRS, 2nd phase, Kerman, Iran, 2014-2018)

Risk factor	No cigarette smoking % (95% CI)	Cigarette smoking % (95% CI)	*P* value	No tobacco smoking % (95% CI)	Tobacco smoking % (95% CI)	*P* value
Hypertension (n=2790)	18.4 (17.7, 19.1)	14.6 (12.0, 17.6)	0.005	17.7 (17.1, 18.4)	18.8 (16.1, 21.9)	0.41
Obesity (n=2587)	21.4 (20.6, 22.4)	20.0 (14.1, 27.6)	0.34	20.8 (19.9, 21.8)	23.9 (20.9, 27.1)	0.04
Low physical activity (n=4775)	47.0 (45.8, 48.2)	49.1 (41.6, 56.7)	0.21	47.4 (46.1, 48.7)	48.2 (44.6, 51.9)	0.66
Anxiety (n=1643)	14.5 (13.7, 15.3)	13.2 (10.2, 17.0)	0.28	14.2 (13.4, 15.0)	19.2 (16.7, 22.0)	<0.001
Depression (n=134)	1.1 (0.9, 1.40)	1.7 (0.7, 4.1)	0.13	1.1 (0.9, 1.40)	1.8 (1.10, 2.90)	0.08
Triglyceride>200 mg/dL (n=3884)	32.0 (31.0, 33.1)	33.80 (26.8, 41.6)	0.27	31.4 (30.3, 32.5)	34.5 (31.2, 37.9)	0.06
Cholesterol>200 mg/dL (n=2233)	14.5 (13.8, 15.1)	13.8 (11.0, 17.3)	0.59	14.4 (13.7, 15.0)	14.7 (12.2, 17.5)	0.79
Dependent opium use (n=715)	27.6 (23.7, 31.9)	39.7 (31.7, 48.4)	<0.001	32.8 (27.8, 38.2)	18.2 (13.0, 24.9)	<0.001
Occasional opium use (n=502)	46.2 (41.3, 51.2)	31.6 (24.3, 39.9)	<0.001	38.2 (32.3, 44.4)	58.0 (50.9, 64.8)	<0.001
Water-pipe tobacco smoking (n=855)	13.7 (12.8, 14.7)	19.1 (13.0, 27.3)	0.003	-	-	-
Cigarette smoking (n=903)	-	-	-	8.9 (6.9, 11.4)	9.0 (8.4, 9.7)	0.93

Table 4. Overall and subgroup incidence rates (person/1000 person-years) of cigarette/water-pipe tobacco smoking (Community-based cohort study, KERCADRS, between phase 1 (2009-2012) and phase 2 (2014-2018) (n=2807 match cases), Kerman, Iran

	Cigarette (n)	Incidence rate (95% CI)	*P* value	Tobacco (n)	Incidence rate (95% CI)	*P* value
Overall	70	3.6 (2.8, 45)	-	96	4.6 (3.8, 5.7)	-
Gender						
Male	62	7.8 (6.0, 10.0)	<0.001	53	5.7 (4.3, 7.5)	0.04
Female	8	0.7 (0.3, 1.4)		43	3.8 (2.7, 5.1)	
Age group (year)						
15-39	31	4.4 (3.0, 6.2)		67	9.7 (7.5, 12.2)	
40-59	27	3.2 (2.1, 4.6)	0.29	23	2.4 (1.6, 3.7)	<0.001
+60	12	3.1 (1.6, 5.5)		2	0.5 (0.1, 1.7)	
Opium addiction						
No	45	2.5 (1.9, 3.4)	<0.001	85	4.50 (3.6, 5.6)	0.7
Yes	25	12.8 (8.3, 18.9)		11	4.0 (2.0, 7.2)	
Depression						
No	48	3.9 (2.9, 5.2)	0.33	65	4.9 (3.8, 6.3)	0.33
Yes	22	3.1 (1.9, 4.6)		30	4.0 (2.7, 5.7)	
Anxiety						
No	17	3.6 (2.1, 5.7)	0.99	21	4.0 (2.5, 6.2)	0.44
Yes	53	3.6 (2.7, 4.7)		75	4.8 (3.8, 6.1)	
Obesity						
No	62	4.1 (3.1, 5.2)	0.003	83	4.7 (3.7 , 5.8)	<0.001
Yes	7	1.7 (0.7, 3.5)		12	1.4 (0.7, 2.5)	
Diabetes						
No	63	3.8 (2.9, 4.8)	0.26	89	4.7 (3.8, 5.8)	0.02
Yes	7	2.6 (1.0, 5.3)		7	2.4 (0.9, 4.9)	
Hypertension						
No	57	3.8 (2.9, 5.0)	0.21	90	5.2 (4.2, 6.4)	<0.001
Yes	13	2.7 (1.4, 4.7)		6	1.2 (0.4, 2.6)	
Low physical activity						
No	39	3.5 (2.5, 4.7)	0.73	52	4.4 (3.3, 5.7)	0.54
Yes	31	3.8 (2.6, 5.3)		44	4.9 (3.6, 6.7)	

that water pipe is not addictive and this belief is also one of the major contributing factors to water pipe consumption.[23,24]

Although the frequency of first-hand (active) smoking was much less in women, differences in lung function associated with secondhand smoke were more detected in women.[25] In the Eastern Mediterranean, and South-East Asia, women are at least %50 more likely to be exposed to passive cigarette smoke compared to men.[26] High exposure to smoke is associated with an increasing trend of morbidities and mortality of non-communicable diseases and malignancies in Iran.[27] Implementing effective community-based interventions are needed to change this unhealthy pattern.[28,29] The prevalence of opioid dependence, another risk factor for CVD in the area,[30] was significantly higher among cigarette smokers (Table 3), requiring immediate educational intervention by the health services.

Smoking prevalence has been shown to be more in middle-aged men and in those with lower socio-economic and educational status.[31] Our results showed the same pattern regarding gender and age and are consistent with the results of other studies in Iran,[32] and other countries such as European countries, China, Korea, and the United States.[33] Also we found that the prevalence of cigarette smoking was lower in the age groups up to 45 years in phase 2 compared to phase 1 (Figure 1B). Conversely, the prevalence of WPTS was higher in the same age groups in phase 2 compared to phase 1 (Figure 2B). This may imply the shift from cigarette smoking to WPTS in the young to middle-aged population over the last five years. In a recent experimental study a heart dysfunction effect of WPTS, which was shown to be largely compensated by exercise training was demonstrated.[34] On the other hand,

our recent findings in Kerman population showed that the level of physical activity has decreased in young to middle-aged people in recent years.[35] Both of these risky behaviors are likely to have negative health consequences in these age groups in a near future. Moreover, the steeper upward trend in the prevalence of WPTS in women highlights the fact that many non-smoker women (about 40% of the population) would join the current (14%) tobacco smokers. As mother–adolescent behavior probably is affected by ongoing characteristics of the mothers, it will have a double adverse effect on society, both for the health of the women themselves and for the health of future generations.

Based on the available evidence, it can be concluded that legislative bans[36] and educational programming in media (radio and television) may have led to a decline in the growth of cigarette smoking in the society over the past five years. However, these hypotheses were not investigated in this study. Meanwhile, since shifting to WPTS is currently accepted by public, implementing effective programs to prevent or eliminate this misleading and unsafe behavior should be a priority in the society.

Consistent with the results of previous reports,[32] we observed that the prevalence of cigarette smoking decreased after the age of 65 years, in both men and women (Table S1 and Figure 1). This may be, at least in part, the result of increased mortality from smoke-induced non-communicable diseases (e.g., CVD and COPD). In fact, such smokers are not able to smoke cigarettes as they did before. The IR of cigarette and WPTS was less in people with obesity, diabetes, and hypertension, the three age-dependent non-communicable diseases (Table 4). The present study has some limitations. First, the study was conducted in urban areas. Due to differences in socio-economic status, levels of education, and available health services between rural and urban populations, it is recommended to evaluate the status of cigarette and WPT smoking in rural areas of the region as well. Second, the researchers were able to recruit only 48% of the participants in phase 1. Although those lost to follow up share very similar demographic characteristics with those remained in the cohort, the actual effect of such losses on IR calculation is unknown. It should be considered that loss of follow-up does not affect the prevalence data presented in this article, as these data were obtained only from the participants in each phase and were not related to follow up. The other limitation is that passive smoking status in the region was not reported, as the health consequences of passive smoking have been shown to be no less than those of active smoking.[37]

Conclusion

According to the results, cigarette and WPT smoking are very common among young and middle-aged populations. Smoking is shifting from cigarette smoking to WPTS and this shift pattern is steeper in women. Age- and gender-oriented interventions are required to change this risk pattern in the community to prevent further smoking-related morbidities and mortalities.

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Author Contributions

HN and AM designed the study. ZZ developed the analytic approach. ZK and MSF collected data. HN, ZZ and ZK wrote the first draft of the paper. AS and EA performed Physical examination of the participants and helped data acquisition and interpreting of the results. All authors contributed to finalizing the paper.

Conflict of Interests

The authors declare that they have no competing interests.

Supplementary Files

Supplementary file 1 contains Table S1 and Figure S1.

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