Review Article

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TANAFFOS

Prevalence of Cigarette Smoking and its Related Factors among Students in Iran: A Meta-Analysis

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Background: Smoking is a preventable cause of morbidity and mortality with an increasing prevalence in developing countries. The present systematic review and meta-analysis aimed to estimate the prevalence of smoking among college and high school students in Iran.

Materials and Methods: Databases of Scopus, PubMed, Web of Science, Google Scholar, SID, and MagIran were searched with no time limitation. Observational studies published in Persian or English were included in the analysis. Time frame of the searches was from inception until 1 January 2021. The data was analyzed using random effects model, subgroup analysis, and meta-regression analysis. Heterogeneity among studies was examined using Cochran's Q test and I^2 statistic.

Results: A total of 63 articles with a sample size of 58742 were analyzed. The pooled smoking prevalence was found to be 13.56% (95% CI: 11.65-15.47). There was a significant increase in the prevalence of smoking among female students between 1998 and 2020. Regions 1 of Iran had the highest prevalence rates of smoking (Provinces of Alborz, Tehran, Qazvin, Mazandaran, Semnan, Golestan, and Qom). Smoking was more prevalent among college students (15.62%, 95% CI: 13.14-18.10) than in high school students (9.77%, 95% CI: 7.19-12.35).

Conclusion: Given the relatively high prevalence of smoking among Iranian college and high school students, it is necessary to inform them about the harmful effects of smoking through training programs.

Key words: Meta-Analysis; Cigarette Smoking; Prevalence; Students

INTRODUCTION

Smoking is a public health problem and a preventable cause of morbidity and mortality in the world (1) that leads to the death of 5-10 million people every year (2). It is the cause of 90% of lung cancers, 40% of other cancers, 75% of respiratory problems, 50% of cardiovascular problems, and 12% of total deaths (3). It is projected that smoking will lead to more deaths than AIDS, malaria, tuberculosis, maternal death, and accidents (4). One-third of the world's population is smokers, of which about 80% live in developing countries (5). On average, every Iranian smoke 13.7 cigarettes per day, and every year, 30 billion cigarette sticks are smoked in Iran (6, 7).

The past few decades in the US have seen a steady decline in smoking rates in adults, but during the same period, smoking prevalence in students has heavily increased (8). In Iran, the smoking prevalence has been on the rise in the recent decades so that in 1990, about 10.7% of people aged 15-24 years (the high school and college age range) were smokers, and this increased to 17.1% by 2000 (9). A previous study showed that 22.9% and 19.8% of college students in Western and Eastern Europe were smokers, respectively (10). Results of a meta-analysis showed prevalence rates of 19.8 and 2.2% for smoking in Iranian male and female college students, respectively (11), while the prevalence of smoking in Iran's general population is 11.9% (12). The high prevalence of smoking among students compared to that in other groups of adults is alarming, especially considering the fact that most of them do not pay enough attention to smoking-related health warnings (13). Many active smokers around the word develop this habit in their adolescence. Given that most smokers smoke their first cigarettes in high school years and after that, students should be the primary target population of smoking prevention programs. Various studies in Iran conducted on the prevalence of smoking in students have led to mixed results, reporting prevalence rates ranging from 2.2 to 34.9% (14, 15). Given the fact that the first step in understanding any problem is to know the current situation, estimation of the prevalence of smoking in Iranian students can help health authorities better manage this problem. Therefore, the goal of the present study is to estimate the prevalence of smoking in Iranian high school and college students and examine the related factors.

MATERIALS AND METHODS

The aim of the present systematic review and meta-analysis is to estimate the prevalence of smoking in Iranian high school and college students and the related factors based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines (16). The current study did not register in PROSPERO.

Inclusion and exclusion criteria

All the observational studies published in Persian or English focused on the prevalence of smoking in Iranian high school and college students were included in the study with no time limitation. The exclusion criteria were as follows: unavailable full texts, duplicated articles, and articles that did not provide the required information in the text.

Search strategy

Search for articles was conducted in Web of Science, PubMed, Scopus, Scientific Information Databases (SID), MagIran using the following keywords and their potential combinations: Student, Smoking, Cigarette, and Iran. Time frame of the searches was from inception until 1 January 2021. In addition, the article references were reviewed to find more related studies (Table 1).

Table 1. Search strategy results in international databases

Scopus	(TITLE-ABS(tobacco*) OR TITLE-ABS("tobacco smoking") OR TITLE-ABS(smoking) OR TITLE-ABS("tobacco use*")) AND AFFILCOUNTRY(IRAN)	4161
	(TITLE(tobacco*) OR TITLE("tobacco smoking") OR TITLE(smoking) OR TITLE("tobacco use*")) AND AFFILCOUNTRY(IRAN)	955
PubMed	(((tobacco[MeSH Terms]) OR (tobacco smoking*[MeSH Terms]) OR (smoking[MeSH Terms]) OR (tobacco use*[MeSH Terms]))) AND (iran)	922
	(((tobacco[Title]) OR (tobacco smoking*[Title]) OR (smoking[Title]) OR (tobacco use*[Title]))) AND (iran)	726
WOS	TI=(tobacco OR "tobacco smoking" OR smoking OR "tobacco use*") AND CU=IRAN	1003
	Refined by: Document type: (Article)	779

Article selection

The results of the aforementioned databases were imported and managed using EndNote X9 (Thomson Reuters, New York, USA). Duplicate studies were excluded. In the next step, two researchers independently screened the studies by reviewing their titles and abstracts. Any disagreement in this step was resolved through discussion among the members of the research team

Data extraction

Article necessary intimation, including first author, year of publication, sample size (total, women, men), mean

age of participants, education level (high school student or college student), study environment, prevalence of previous experience of smoking, prevalence of current smoking (total, women, men), and methodological quality were extracted by two researchers independently from each other. In order to examine the data extraction rigor, the correspondent author examined the data extraction for the first 20 articles.

Quality assessment

A modified Newcastle-Ottawa Scale (NOS) was used to assess the methodological quality of each article (Lo et This scale evaluates the quality of an article through three criteria: Selection, comparability and exposure. High-quality articles were defined as ≥4 stars (17).

Statistical analysis

In the present study, the point estimate and a 95% confidence interval were calculated for each selected study focused on the prevalence of smoking in high school and college students (18). In addition, the prevalence of smoking by gender was examined. Heterogeneity and inconsistency between studies were assessed using Cochran's Q Test and I^2 statistic (19). Given the high heterogeneity among the studies, random effects model was used to combine them. In terms of heterogeneity, the studies were divided in three categories, including low (I^2 value below 25%), average (I^2 value between 25% and 75%), and high (I^2 value above 75%) (19,20). For Cochran's Q test, $P<0.1$ indicated a significant level of heterogeneity (21). Sensitivity analysis was used to ensure the consistency of the results. In this study, subgroup analysis and meta-regression test were used to investigate the potential source of changes affecting the prevalence of smoking. Subgroup analysis was used to identify the source of heterogeneity by region (Iran's five administrative regions), education level (high school or college) and language (Farsi or English) (22). Prevalence is presented in two ways in this article: current smoker and experimental smoker. Experimental smoker refers to people who have experienced smoking even once in their lifetime. In 2014, the provinces of Iran were included in a new classification by the Ministry of Interior of the Islamic Republic of Iran in the form of 5 regions according to the factors of proximity, geographical location and commonalities. Meta-regression analysis was employed to assess the relationship of smoking prevalence with article year of publication and mean age of participants. Publication bias was examined using a funnel plot and Egger's regression test. All the statistical analyses were performed using R, v.4.3.2.

RESULTS

In the primary search a total of 395 articles (73 from international databases and 320 from Iranian ones) were extracted. After excluding duplicate studies, titles and abstracts of 362 remaining articles were examined, and another 275 articles were excluded. The full texts of the 87 remaining articles were reviewed. In this step, articles not providing enough intimation were excluded, and 63 articles were included in the final analysis. The flowchart provided in Figure 1 shows the article search and screening process based on the PRISMA guidelines.

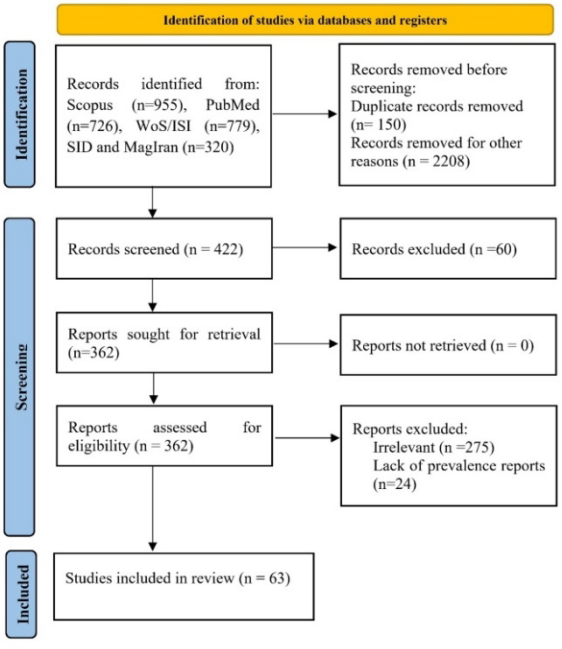

Figure 1. The process of searching, screening and selecting articles

Study Characteristics

A total of 63 studies with a total sample size of 58742 were systematically reviewed. The lowest and highest

sample sizes were for the studies conducted by Rahmanian (n=174) (23) and Habib (n=4591) (24), respectively. Among the studies, 48 were in Persian and 15 were in English. In addition, 28 studies had school students and 35 had college students as their participants. All selected studies were cross-sectional. Further details are reported in Table 2.

Prevalence of Current Cigarette Smoking

The prevalence of current cigarette smoking was reported in studies, and the pooled prevalence of smoking was found to be 13.56% (95% CI: 11.65-15.47) (I2 = 97.9%, P<0.001). The prevalence of smoking was higher in boys (20.35%, 95% CI: 16.74-23.96) than in girls (4.60%, 95% CI: 3.53-5.66) (p<0.0001) (Figure 2).

Regions 1 and 2 of Iran had the highest and lowest prevalence rates of smoking, respectively. In addition, there were significant differences between different regions of Iran in terms of smoking prevalence (Q=10.92, df=4, p-value=0.0275). Smoking was more prevalent among college students (15.62%, 95% CI: 13.14-18.10) than in high school students (9.77%, 95% CI: 7.19-12.35). There was no significant difference between regions of Iran in terms of smoking prevalence in boys (P-value: 0.0824), but smoking prevalence in girls was significantly different in various regions of Iran (P=0.0004) (Table 3).

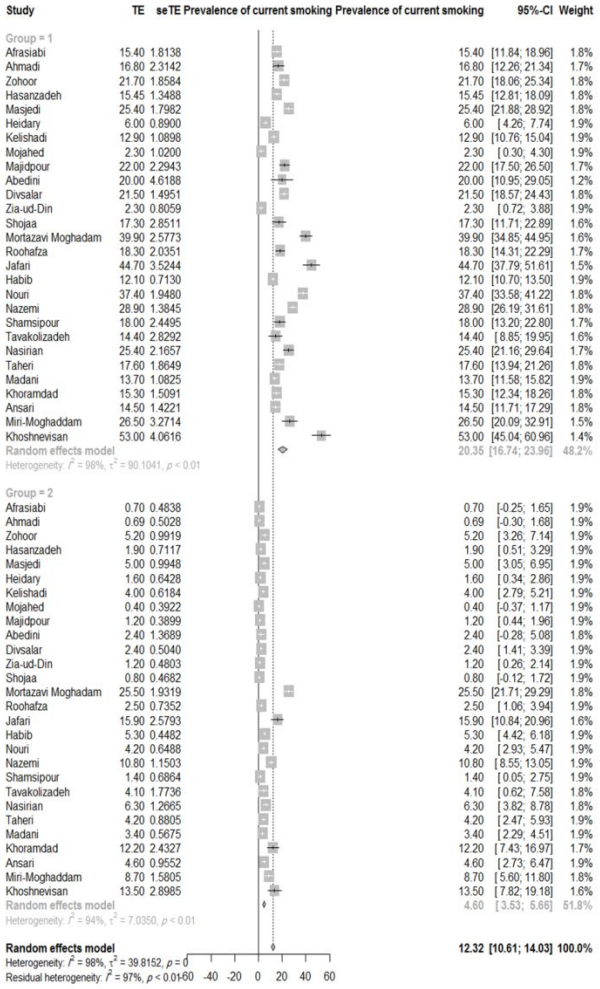

Figure 2. The prevalence of smoking by gender (1: male and 2: female).

Table 2. Article search and screening process

First Author	Year	Sample	Place	Prevalence			
				Total		Male	Female
				Current smoker	Experimental smoker		
Masjedi (25)	2020	1075	Varamin	-	9.2	-	-
Khoshnevisan (14)	2020	290	Tehran	34.4	51.4	53	13.5
Miri-Moghaddam (26)	2019	500	Zahedan	15.2	-	26.5	8.7
Ansari (27)	2019	1094	Zahedan	10.1	22.6	14.5	4.6
Cheraghi (28)	2018	899	Ahvaz	-	5.4	-	-
Panahi (29)	2017	340	Tehran	23.8	17.1	-	-
Karimi (30)	2017	842	Shiraz	-	19.7	-	-
Sahebihagh (15)	2017	476	Yazd	2.2	6.7	-	-
Khoramdad (31)	2016	750	Shiraz	-	15	15.3	12.2
Madani (3)	2016	2029	Bandar Abbas	8.5	23.2	13.7	3.4
Fazeli (32)	2016	361	Andimeshk	29.9	-	-	-
Attari (33)	2015	305	Esfahan	4.6	13.4	-	-
Taheri (34)	2015	936	Mashhad	9.8	18.3	17.6	4.2
Jalilian (35)	2015	425	Kermanshah-Isfahan	-	19.4	-	-
Reisi (36)	2014	382	Isfahan	7.2	32.7	-	-
Mohammadi (37)	2014	450	Babolsar	17.2	-	-	-
Bidel (38)	2014	1000	Ilam	1.3	11.4	-	-
Barati (39)	2014	810	Hamedan	2.7	17.2	-	-
Pirdehghan(40)	2014	460	Yazd	7	16.5	-	-
Nazarzadeh (41)	2013	1064	Zanjan	10.8	23.4	-	-
Shafiie (42)	2013	760	Bam	5.7	-	-	-
Nasirian (43)	2013	772	Kerman	15.8	-	25.4	6.3
Rezakhani Mogaddam (44)	2013	720	Tehran	22	-	-	-
Shahnazi (45)	2013	382	Isfahan	7.2	32.7	-	-
Heydari (46)	2013	1271	Tehran	17	31.1	-	-
Mokhtari (47)	2012	222	Guilan	23	-	-	-
Nazemi (48)	2012	1800	Shahrood	21.6	-	28.9	10.8
Nouri (49)	2012	1573	Tehran	17.2	-	37.4	4.2
Habib (24)	2012	4591	Tehran	-	-	12.1	5.3
Shamsipour (50)	2012	523	Tabriz	8.9	-	18	1.4
Aminoroaia (51)	2012	537	Isfahan	18.6	-	-	-
Tavakolizadeh (52)	2012	279	Gonabad	9.8	-	14.4	4.1
Morowatisharifabad (53)	2012	240	Maragheh	-	15.4	-	-
Ghodsi (54)	2012	222	Guilan	23	-	-	-
Roohafza (55)	2011	812	Isfahan	9.5	-	18.3	2.5
Jafari (56)	2011	400	Tehran	30.3	-	44.7	15.9
Moeini (57)	2011	900	Malayer	-	14	-	-
Kathiri (58)	2011	745	Ahvaz	19.1	44.1	-	-
Ramezani (59)	2011	460	Kerman	12.1	52.8	-	-
Heydari (60)	2010	1271	Tehran	-	61.5	-	-
Nazary (61)	2010	320	Semnan	14.4	29.4	-	-
Ramezankhani (62)	2010	4523	Tehran	-	25.5	-	-
Rahmanian (23)	2010	971	Jahrom	9.7	21.3	14.2	3.3
Rahmanian (23)	2010	174	Jahrom	12.6	25.3	18.1	1.8
Moghadam (63)	2009	870	Birjand	31.5	-	39.9	25.5
Divsalar (64)	2008	1677	Kerman	11	-	21.5	2.4

Namakin (65)	2008	1233	Birjand	3.9	21.3	-	-
Shoja (66)	2008	538	Golestan	6.2	83.5	17.3	0.8
Zia-ud-Din (67)	2008	860	Kerman	-	-	2.3	1.2
Divsalar (68)	2007	833	Kerman	21.5	-	-	-
Pasharavesh (69)	2007	3150	Kermanshah	-	15	-	-
Mohtasham Amiri (70)	2007	1297	Rasht	15	28.2	-	-
Abedini (71)	2007	200	Bandar Abbas	-	9	20	2.4
Majidpour(72)	2005	1106	Bandar Abbas	7.4	13.9	22	1.2
Kelishadi (73)	2004	1950	Isfahan	8.7	-	12.9	4
Mojahed (74)	2004	475	Zahedan	-	15.5	2.3	0.4
Heidari (75)	2003	1095	Tehran	4.4	28.9	6	1.6
Masjedi (76)	2003	1066	Tehran	16.3	-	25.4	5
Zohoor (9)	2002	993	Kerman	13.4	-	21.7	5.2
Ayatollahi (77)	2002	1132	Shiraz	25.5	16.9	-	-
Hasanzadeh (78)	2002	1086	Mashhad	10.9	-	15.45	1.9
Ahmadi (79)	2001	532	Shiraz	8.7	-	16.8	0.69
Afrasiabifar (80)	1998	693	Shiraz	9.1	-	15.4	0.7

C: Current smoker; E: Experimental smoker

Table 3. The results of subgroup analysis

Category			Number of studies	Pooled prevalence (% [95% CI])	I^2
		Total	12	18.53 (13.74-23.32)	97.9%
	1	Men	8	27.71 (18.74-36.68)	98.7%
		Women	8	6.24 (3.86-8.62)	94.9%
		Total	13	10.44 (8.06-12.83)	64.5%
	2	Men	8	16 (13.99-18.01)	63.1%
		Women	8	2.55 (1.33-3.77)	86.6%
Region*		Total	5	15.39 (11.20-19.58)	91.2%
	3	Men	1	18 (13.19-22.80)	-
		Women	1	1.4 (0.05-2.74)	-
	4	Total	4	12.76 (5.71-19.80)	98.9%
		Total	15	11.90 (8.73-15.6)	97.5%
	5	Men	11	18.16 (11.78-24.53)	98%
		Women	11	5.43 (3.30-7.56)	95.4%
		Total	32	15.62 (13.14-18.10)	97.2%
	University	Men	19	24.69 (20.76-28.63)	94%
		Women	19	5.18 (3.70-6.66)	94.6%
Type		Total	17	9.77 (7.19-12.35)	97.9%
	High school	Men	9	11.49 (7.40-15.58)	97.2%
		Women	9	3.64 (2.12-5.17)	92.8%
		Total	40	13.53 (11.39-15.67)	98%
	Farsi	Men	21	19.56 (14.99-24.13)	97.9%
		Women	21	3.84 (2.71-4.97)	94%
Language		Total	9	13.70 (9.11-18.30)	97.3%
	English	Men	7	22.54 (16.61-28.47)	95.8%
		Women	7	6.61 (4.95-8.28)	73.9%

*** Region 1:** Alborz, Tehran, Qazvin, Mazandaran, Semnan, Golestan, and Qom. **Region 2:** Isfahan, Fars, Bushehr, Hormozgan, Kohgiluyeh and Boyer-Ahmad, and Chaharmahal and Bakhtiari **Region 3:** West Azerbaijan, East Azerbaijan, Ardabil, Zanjan, Guilan, and Kurdistan. **Region 4:** Kermanshah, Ilam, Lorestan, Hamedan, Markazi, and Khuzestan. **Region 5:** Razavi Khorasan, North Khorasan, South Khorasan, Kerman, Yazd, and Sistan and Baluchestan.

Prevalence of Experimental Cigarette Smoking

In addition, the total prevalence of smoking in 37 studies was found to be 24.48% (95% CI: 20.06-28.89). Moreover, previous experience of smoking was higher in college students (19.82%, 95% CI: 1982-44.66) than in high school students (19.71, 95% CI, 16.73-22.69).

Meta-regression results

According to the results of univariate regression analysis, there was a significant relationship between total smoking prevalence and mean age of participants (P=0.039), and also a significant association between smoking prevalence in girls and article year of publication (P=0.032). In addition, publication bias was significant (P=0.001) (Figure 3).

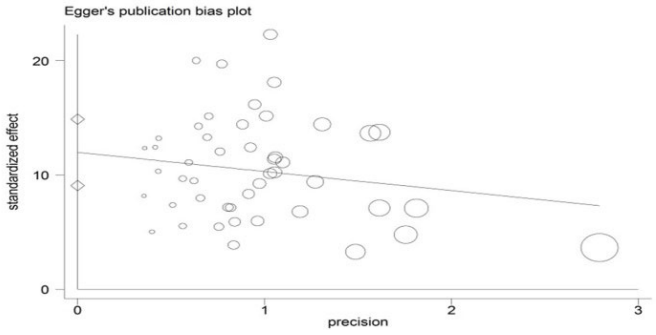

Figure 3. Publication bias

DISCUSSION

The study results showed that 13.56% of high school and college students were smokers, and 24.48% of them had previously smoked cigarettes. The prevalence of smoking in Iranian high school and college students was 9.77 and 15.62%, respectively. A review of the literature showed that the prevalence of smoking in high school students was higher in Iraq (15.3%) (81) and Nigeria (17.1%) (82) than in Iran. This finding can be attributed to the strict rules in Iranian schools in terms of smoking. The prevalence of smoking in Iranian college students is similar to that in Saudi Arabian (17.6%) (83), lower than that in Pakistani (23%) (84), and higher than that in Syrian students (10.9%) (85).

The prevalence of smoking was higher in college students than in high school students, perhaps due to the fact that compared to high school students, college students are more likely to move away from home for college; therefore, they are less controlled by their families and may feel more freedom to do what they want. In addition, consistent with the findings of previous studies, we found that the prevalence of smoking in female high school and college students was lower than that in male students (86). The lower prevalence of smoking in female students can be attributed to the fact that smoking is considered a stigma for women in Iran.

There was an increase in the prevalence of smoking in Iran between 1998 and 2020 (according publication years), including a 0.36% increase in its prevalence in girls. One possible reason for this increased prevalence is that girls may use smoking as a way of being accepted by their peers and others (87). In addition, some use smoking to control their weight (88). Smoking affects weight through increasing metabolism and reducing caloric absorption (89), and smoking cessation is associated with a 10-pound increase in weight after one year (90). There was also a relationship between participant age and prevalence of smoking, so that one year increase in age was associated with 1.02% increase in the chance of smoking cigarettes. It appears that smoking can induce a sense of independence in college students and make them believe that they are not being controlled by their parents anymore.

One of the strengths of this study is its novelty and comprehensiveness, which has provided the most up-to-date findings. The limitation of this study was that some studies did not fully report all the findings, so further analysis was not possible.

CONCLUSION

The prevalence of smoking in Iranian high school and college students is relatively high. Starting to smoke at this critical stage of life can make them increasingly dependent on nicotine and even vulnerable to drug abuse. Therefore, it is necessary to provide this age group with training programs on the harmful effects of smoking.

Abbreviations

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SID: Scientific Information Databases

STROBE: Strengthening the Reporting of Observational studies in Epidemiology

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Ethics approval and consent to participate

This study was extracted from a research project the Asadabad School of Medical Sciences (No. IR.ASAUMS.REC.1399.026).

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Availability of data and materials

The data that support the findings of this study are not publicly available. Data are however available from the authors upon reasonable request and with permission of Asadabad School of Medical Sciences.

Competing interests

None of the authors have competing interests.

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