Prevalence of Waterpipe Smoking in Iran: A Systematic Review and Meta-analysis

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Abstract
Background: Considering the prevalence of waterpipe smoking (WPS) among the majority of people, it is necessary to identify the cause of this behavior. Therefore, this meta-analysis study aimed at evaluating the prevalence of waterpipe consumption in Iran based on province, education level, and gender subgroups.

Materials and Methods: The search was conducted based on the PRISMA guideline. Scopus PubMed, SID, and IranDoc databases were used to retrieve papers related to the prevalence of WPS in Iran from January 1, 2005 to May 10, 2022. The keywords were “air pollution” OR “particulate matter” OR “water-pipe” OR smoking OR “Indoor air” and “Prevalence” OR “Incidence” AND “Iran”. The prevalence of WPS was meta-analyzed based on province, gender, and education level subgroups in the random effects model.

Results: According to the final included papers (17 articles and 48 data reports), the rank order of provinces based on the prevalence of WPS was Kerman (58.30%) > Tehran (52.38%) > Sistan and Baluchistan (42.29%) > Hormozgan (30.69%) > Yazd (24.13%) > Bushehr (19.47%) > Ardabil (19.00%) > Fars (16.37%) > Khuzestan (11.38%). The rank order of education level of participants based on the prevalence of WPS was college education (55.64%) > Student (43.47%) > University Student (17.69%). Finally, the rank order of gender of participants based on the prevalence of WPS was male (31.75%) ~ female (30.99%).

Conclusion: The results demonstrated a high prevalence of WPS. It is a multi-predictor and multi-level phenomenon in several aspects. The impact of geographical location and education levels was clearly visible. There was no difference in the gender-specific gap for WPS. Regarding the substantial effects of WPS prevalence on health, regular surveillance, prevention, intervention, and control are necessary.

Keywords: Waterpipe, Smoking, Prevalence, Meta-analysis, Iran

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Introduction
Waterpipe tobacco smoking is one of the oldest forms of tobacco consumption (1). Waterpipe generally refers to a traditional method of using tobacco, where the smoke passes through water before entering the lungs (2). Waterpipe use does not produce clinical symptoms for many years, thus smokers are encouraged to use it more often. Over time, the accumulation of toxin compounds in tobacco causes respiratory disorders, respiratory rate, asthma, and chronic obstructive pulmonary disease (3,4). According to studies, waterpipe smoking (WPS) is associated with major problems such as mouth cancer (oral cancer), lung cancer, decreased respiratory function, increased systolic and diastolic blood pressure, heart rate, cardiovascular and infectious diseases, and decreased fertility (5,6). Smoking waterpipe can be an important cause of various diseases, disabilities, and premature death all over the world. Waterpipe has harmful effects on the lungs due to the presence of a large amount of carbon monoxide, nicotine, tar, and heavy metals, including arsenic, cobalt, chromium, and lead (7,8).

Global statistics have reported WPS as a common social phenomenon among young people. Iran, India, and Turkey are among the most consumers of waterpipe...
According to Iran's National Health and Disease Plan, the tendency to use waterpipe has significantly increased within the age range of 15-24 years (11). The study on smoking prevalence among the population aged 15-64 in the urban and rural areas of Hormozgan province showed that 13.5% of the studied subjects used waterpipe daily. WPS prevalence was 9.2% and 14.8% in men and women, respectively (12).

Based on research, the risks associated with waterpipes are greater in women than in men (6,10,13). Waterpipe consumption in women raises the risk of early menopause, decreased bone density, infertility, ectopic pregnancy, mortality and neonatal complications, intrauterine growth restriction, and chromosomal abnormalities (14).

The increase in waterpipe consumption has several reasons, including the misperceptions of its health risks compared to other tobacco products, better social acceptability, reasonable prices, easy access and availability in public places (e.g., coffee shops, and restaurants), and more introduction of fruit-flavored tobacco than regular tobacco (15). Considering that waterpipe consumption is highly common in the Middle East, the migration of Middle Eastern people to other parts of the world can also lead to more use of WPS (15). Despite conducting numerous studies on the prevalence of waterpipe consumption in Iran (16-23), there is no systematic review and meta-analysis in this regard. Therefore, this study was conducted with the aim of meta-analyzing the prevalence of waterpipe consumption in Iran based on province, education level, and gender subgroups.

Materials and Methods

Searching Strategy

Articles published from January 1, 2005 to May 10, 2022 in domestic and foreign databases such as Scopus, PubMed, SID, and IranDoc were used to obtain scientific evidence related to the prevalence of waterpipe consumption in Iran. Guidelines reported for systematic reviews and meta-analyses (PRISMA) (24) were used in this study (Figure 1). The keywords were “air pollution” OR “particulate matter” OR “water-pipe” OR smoking OR “Indoor air” and Prevalence” OR “Incidence” AND Iran. In addition, references and sources of all articles related to the subject were examined to obtain scientific evidence and documentation.

Inclusion and Extraction of Data

The inclusion criteria were Persian and English articles that investigated the prevalence of waterpipe consumption in Iran from January 1, 2005 to May 10, 2022, descriptive studies, full text available, and presented prevalence (total sample size and positive sample size). On the other hand, the exclusion criteria included studies published in different languages except for Farsi and English, published cases outside the specified time frame, lack of full text, review studies, and books. The data extracted from each article included province, gender, education level, total sample size, and positive sample size. The quality of the studies was evaluated based on the Newcastle-Ottawa scale (NOS) for cross-sectional studies (Table 1). NOS contains 8 items within 3 domains, and the total maximum score is 9. A study with a score range of 7-9, 4-6, and 0-3 has high quality, high risk, and very high risk of bias, respectively (25).

Meta-analysis of Data

The prevalence of WPS was meta-analyzed based on the total sample size and positive sample size. The meta-
analysis of prevalence was conducted using the meta-probe command. The I² index was used to detect heterogeneity. When heterogeneity is high (I² index > 50%) and low (I² index < 50%), the random-effects model and fixed-effects model are employed for meta-analysis, respectively. The meta-analysis of data was performed by Stata software (version 14; STATA Corp., College Station, TX).

Results

Seventy papers with 48 data reports (26,499 sample size) were included in our meta-analysis (Figure 1 and Table 2). All included studies had a high-quality score based on the NOC checklist (Table 1). Based on the results (Figure 2), the rank order of provinces based on the prevalence of WPS was Kerman (58.30%) > Tehran (52.38%) > Sistan and Baluchistan (42.29 %) > Hormozgan (30.69 %) > Yazd (24.13%) > Bushehr (19.47%) > Ardabil (19.00%) > Fars (16.37%) > Khuzestan (11.38%). The results (Figure 3) further revealed that the rank order of education level of participants based on the prevalence of WPS was college education (55.64%) > Student (43.47%) > University student (17.69%). According to the findings (Figure 4), the rank order of sex of participants based on the prevalence of WPS was male (31.75%) ~ female (30.99%).

Discussion

The consumption of non-cigarette tobacco products, including waterpipe, is rapidly increasing worldwide. Waterpipe use has traditionally been prevalent in Middle Eastern countries and has become a serious health concern in communities. The global trend of smoking is higher among adolescents and young people than in others (36, 37).

The findings of the present study demonstrated that waterpipe use in college education (55.64%) and students (43.47%) was more than in university students (17.69%) and people with university education; the reason for this difference is probably students' greater awareness of the dangers of waterpipe use and their less impact on their peers. The results of Fakhari et al also revealed that the prevalence of waterpipe consumption among students was 44.9% (38,39). Babaei Heydarabadi et al reported that the prevalence of drug use among students was 15.4% (40). The study of Jawad et al on students aged 13-15 years in 25 Eastern Mediterranean and Eastern European countries showed that the prevalence of WPS in the West Bank (32.7%), Lebanon (36.9%), Czech Republic (22.1%), Estonia (21.9%), and parts of Eastern Europe (Latvia 22.7%) had the highest rate (41). The findings of Sabahi et al represented that the mean age of the onset of waterpipe use was 16.3 ± 3.2 years (42,43). Moreover, Aghamolaei et al (34) concluded that students start smoking and using waterpipes at a younger age (between 15 and 20 years). Likewise, Grant et al found that the prevalence of WPS among adults (aged 18 + years) was 11.6% in 2012-2013 (44).

The results of the study by Obeidat et al on Jordan dental students indicated that 3.5% (22 males and 2.3% females), 12.6% (36.6% males and 88.6% females), and 6.9% (41.5% males and 9.1% females) used cigarettes alone, only waterpipe, and both of them, respectively (45). Waterpipe use among young people can be effective due to the lack of information about existing injuries, easy access, low costs, and other factors. In a study by Dehdari et al, Iranian students showed a 40.3% prevalence of waterpipe use. Another study conducted on high school students in Tehran demonstrated that the prevalence of waterpipe use among boys and girls was 34.4% and 51.9%, respectively, with an average prevalence of 43%. A study in Turkey reported that waterpipe use was 37.5% and 28.6% among non-medical and medical students, respectively (38). Babaei Heydarabadi et al in Tehran found that among the types of drugs used by students, the highest frequency was related to cigarette consumption (44.7%) and waterpipe (42.9%), respectively (40). Adolescents' reasons for using waterpipe, compared to the other methods of smoking, are considered to be low-risk behavior and lack of addiction (46). A study on student smoking behavior in Florida, USA, revealed that craving for waterpipe increased the risk of smoking by a factor of 4.32, and lack of craving reduced the risk by 0.64 (47). The results of a study by Sabahi et al in Kerman represented that there was a significant difference between the attitudes of students who were regular or temporary waterpipe users and students who had never smoked water (48).

Based on the findings of the present study, Kerman...
Table 2. Main Characteristic Included our Study

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<th>Province</th>
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<th>Education Level</th>
<th>Total Sample Size</th>
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(58.30%) and Tehran (52.38%) provinces had the highest, while Fars (16.37%) and Khuzestan (11.38%) provinces had the lowest prevalence of waterpipe use. In the study of Shalhsavari Bami et al, a significant difference was observed between the prevalence of waterpipe use (38.1%) and smoking (10%) in Kerman province (Bam). The reason is that waterpipe is much more easily available than other types of tobacco in restaurants, traditional coffee houses, and even homes for teenagers and young people in this province. In addition, in Kerman province, social stigma was lower than waterpipe use compared to the other types of substances. Therefore, this behavior is much easier to do than other tobacco. The study results also demonstrated that participation in social activities and belief in social values derived from social settings such as family, school, and peer groups have a protective role against the use of waterpipe, cigarettes, and alcohol (46). In Bandar Abbas, waterpipe use has a cultural root and
has become a value among residents (49). In a study in Iran, 40.6% of people mentioned that WPS is a healthier and less dangerous way to smoke tobacco (19). A study in Saudi Arabia indicated that girls with fathers who used waterpipes were more eager to do this behavior (47,50).

The main reasons for using waterpipe in recent years are a lack of awareness of the dangerous effects of waterpipe, a positive attitude towards WPS, social acceptance of smoking waterpipe instead of cigarettes, and the traditional role of waterpipe in Iranian society (27). According to the results of Akl et al, the main sources of motivation for using waterpipe were socialization, relaxation, pleasure, and entertainment (51).

The present study findings showed no difference in waterpipe use between males (31.75%) and females (30.99%). According to the latest statistics from Iran, waterpipe use is about 10 times higher among males than females; this may be due to the higher rate of high-risk

Figure 3. Meta-analysis of the Prevalence of Waterpipe Smoking Based on Education Level Subgroups.
behaviors among males and the greater attention females pay to their health (52). The results of a study by Dadipoor et al revealed that about half of females experienced WPS with their friends for the first time (49). The findings of the study by Sighaldeh et al represented that having a positive attitude towards waterpipe use and its availability was an important factor in starting to use waterpipe. Danaei and Momeni reported that cafes or restaurants (34.4%) and friends’ houses (36.8%) were the places for waterpipe use by males and females, respectively. It was also found that males used waterpipes 2.8 times more than females (27). The prevalence of waterpipe use among females in Tehran was 6.3% in 2012 (52).

There were some limitations in our study, including some of the included studies suffered from some limitations such as the lack of data in subgroups such as gender, education level, and non-random sampling of the population. Further, few studies were reported in...
some provinces.

Conclusion
This study aimed to assess the prevalence of WPS in Iran. The results demonstrated a high prevalence of WPS, and the impact of geographical location and education levels was clearly visible. In addition, the result of the current study showed no differences in the gender-specific gap for WPS. The prevalence of WPS is a multi-predictor and multi-level phenomenon in several aspects. The main predictors for their determination exist at multiple levels of individual, interpersonal, organizational, social, political, and environmental factors. Regular surveillance of the prevalence of WPS is necessary for intervention, prevention, and control of the problem, considering that WPS substantially affects one's health.

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Not applicable.

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Formal Analysis: Yadolah Fakhri.
Investigation: Hoda Alinezhadmonfared, Yadolah Fakhri, Somayeh Hoseinvandtabar.
Methodology: Yadolah Fakhri and Somayeh Hoseinvandtabar.
Project administration: Yadolah Fakhri.
Resources: Yadolah Fakhri, Somayeh Hoseinvandtabar.
Supervision: Yadolah Fakhri.
Validation: Yadolah Fakhri, Somayeh Hoseinvandtabar.
Visualization: Yadolah Fakhri.
Writing – original draft: Yadolah Fakhri, Zoherh Kamari, Somayyeh Dehghani, Somayeh Hoseinvandtabar.
Writing – review & editing: Yadolah Fakhri, Zoherh Kamari, Somayyeh Dehghani, Somayeh Hoseinvandtabar.

Conflict of Interest Disclosures
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References
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