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Water Pipe Smoking and Its Association with Cigarette and Cannabis Use in Young Adults in Switzerland

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Key Words
Water pipe smoking · Shisha · Tobacco use · Adolescents · Cannabis · Smoking habits

Abstract
Background: Water pipe is a traditional method of tobacco use, which is epidemically spreading throughout Europe. There are scarce data about the use of water pipe and its relation to other addictive behaviors among young adults in Western countries. ***Objectives:*** It was our aim to identify the sociodemographic characteristics of water pipe users in Switzerland and to describe concurrent cigarette and cannabis smoking habits. ***Methods:*** Young adults aged 16–30 years were evaluated based on a 16-item standardized questionnaire on tobacco consumption and exhaled carbon monoxide. Current water pipe smoking was defined as water pipe use at least once within the last 4 weeks; regular water pipe smoking was defined as water pipe use at least once a week during the last 52 weeks. ***Results:*** Out of 353 volunteers, a total of 204 subjects (mean age 21 ± 3.5 years, 113 males) met the inclusion criteria for the study. A total of 78% (n = 160), 30.0% (n = 55) and 3.9% (n = 8) reported ever, current and regular water pipe smoking, respectively. Males smoked more often than females: 2.8 sessions/year (interquartile range 1.1–8) versus 2 sessions/year (interquartile range 0–4; p = 0.022). The major risk factor for ever smoking water pipe was cigarette smoking (odds ratio 6.22, 95% confidence interval 2.33–16.62), followed by cannabis consumption (odds ratio 1.44, 95% confidence interval 1.29–1.62). Ever water pipe smoking was more common among current cannabis users (100 vs. 0%; $p < 0.0001$) and related to higher exhaled carbon monoxide values (6.0 ± 9.0 vs. 2.1 ± 4.6 ppm; $p < 0.001$). ***Conclusion:*** Water pipe smoking is common among young adults and strongly associated with cigarette smoking and cannabis consumption.

Introduction

There is a dramatic change in youth tobacco use patterns worldwide to non-cigarette forms [1]. Accordingly, a recent global surveillance in 95 countries including more than half a million subjects shows that while cigarette smoking is either stable or declining, other forms of tobacco use are showing a rising trend, most notably water pipe smoking [1]. Water pipe smoking is common among young people in Middle Eastern countries, with prevalence estimates of regular smoking of 11–32% [2]. It

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is a traditional method of tobacco use, especially in the Eastern Mediterranean Region and the Middle and Far East, and is now epidemically spreading throughout Europe and North America [3].

Water pipe (also named hookah, argileh, nargile, hubble-bubble, shisha, goza) smoking is a generic name for a method of tobacco use in which smoke passes through a reservoir of water before inhalation. The water pipe apparatus consists of a base that is filled with water, a bowl, a heating device that contains the tobacco, a pipe that connects the bowl to the base, and a hose that is attached to the base to allow smoke to be inhaled. Water pipe use is a form of social smoking in that the pipes are often shared among friends and family at home or in bars and cafes that provide water pipe to customers. Large numbers of young females are also taking up this habit, perhaps due to a relative permissiveness of adult family members towards water pipe use in contrast to cigarette smoking [4].

It is known that tobacco harms the cardiovascular and other organic systems and that, relative to cigarette smoking, water pipe use is associated with greater carbon monoxide, similar nicotine and dramatically more smoke exposure. Basically, a water pipe consumer inhales the same toxicants as regular smokers: carbon monoxide, which is associated with cardiovascular disease; polycyclic aromatic hydrocarbon, which is associated with lung cancer; and nicotine, which is associated with addiction [5]. The nicotine exposure from daily water pipe use is estimated to be equivalent to smoking 10 cigarettes/day [6]. There is evidence relating chronic water pipe smoking to chronic bronchitis, cardiovascular morbidity and carbon monoxide chronic poisoning [7]. In addition to the usual toxicants contained in tobacco, water pipe smokers are exposed to fine particles from charcoal and many particles from resins, flavorings, sweeteners and perfumes added to the tobacco mass [8]. Use of water pipes in dedicated bars might be linked to the spread of infectious diseases, including tuberculosis, herpes simplex, hepatitis and Aspergillus through the use of the shared mouth pieces, inhalation through the same water by several subjects as well as through cough of participants in a closed environment [9, 10].

There are only scarce data on the frequency and determinants of water pipe use in Europe. The aims of this prospective, observational, cross-sectional study were to identify the sociodemographic characteristics of water pipe users in young adults in Switzerland and to describe concurrent cigarette and cannabis smoking habits. Further, we aimed to evaluate the beliefs of the water pipe smokers in regard to the health risks associated with the smoking habit and to objectively assess carbon monoxide values in the exhaled air within an unannounced evaluation.

Methods

This is a monocentric, observational study including a total of 353 young adults aged between 16 and 30 years entering or leaving the main movie theater complex in Basel, Switzerland. They were asked to participate in a health interview promoted by the University Hospital Basel. The interview was performed during summer (August to September) at 6 weekdays and 1 weekend day in the evening (6–9 p.m.). After providing consent for anonymous scientific analysis and publication of data, volunteers were informed about the topic of interest, i.e. smoking habits, particularly water pipe consumption. Subjects were invited to respond to 16 one-to-one interview questions related to smoking habits and beliefs. After answering all questions, volunteers were asked to perform a measurement of carbon monoxide in the exhaled air.

Current water pipe consumption was defined as water pipe use on at least one occasion within the past month. Current cigarette smoking was defined as consumption of at least 10 cigarettes per day. Regular water pipe consumption was defined as water pipe use at least once a week during the last 52 weeks. Participants were categorized as answering either yes (i.e. use of $\geq$1 of these tobacco products currently or in the previous year) or no (i.e. did not use any of these tobacco products currently or in the previous year).

The primary endpoint of the study was the prevalence (percentage) of subjects reporting water pipe smoking, cigarette smoking and cannabis use in the applied questionnaire. Secondary endpoints were: (1) mean (standard deviation) carbon monoxide values in the exhaled air, and (2) determination of the context of water pipe smoking and beliefs regarding the harmfulness of water pipe smoking in the general population.

The study was submitted and approved by the local institutional review board.

Measuring Instruments

Questionnaire

The questionnaire contained 16 questions, including age, gender, nationality, education, general smoking habits, familiarity with the word 'water pipe', smoking habits, smoking context, smoking frequency, as well as awareness about the harmfulness of water pipe smoking, cigarette and cannabis smoking habits. The questionnaire was adapted from a survey for the assessment of water pipe tobacco use in epidemiological studies, as previously described [11].

Carbon Monoxide Measurement

Carbon monoxide measurements in the exhaled air were performed using a Carbon-Monoxide dosimeter (EC50 Micro III Smokerlyzer, Breath Carbon Monoxide Monitor, Bedfont Instrumentals, UK). The instrument was calibrated daily, according to the manufacturer's instructions. Subjects were instructed to take a deep breath and hold their breath during the 15-second count-

down period. Thereafter, subjects were instructed to exhale slowly and gently, emptying the lung as far as possible. Results were expressed in parts per million.

Statistical Analysis

Differences in dichotomous and continuously distributed variables were evaluated using the χ^2 test, the parametric Student t test and the non-parametric Mann-Whitney U test or Kruskal-Wallis test, as appropriate. Odds ratios (ORs) and 95% confidence intervals (95% CIs) for potential sociodemographic correlates of water pipe use were obtained. Values were expressed as means ± SD or medians (interquartile range, IQR), unless stated otherwise. Statistical analyses were performed with the Statistical Package for Social Sciences (SSPS Inc., version 19 for Windows). A p value <0.05 was considered significant.

Results

From the 353 subjects screened, a total of 204 volunteers met the inclusion criteria. Three subjects left during interrogation, and thus, a total of 201 completed the interview. One hundred and sixty-seven volunteers agreed to undergo both the interview and the carbon monoxide measurement (fig. 1). Table 1 depicts the demographic data of the study population. The mean age was 21 years, and most volunteers were Swiss males. The education level of the study population was well balanced. Current cigarette smoking was reported by 37.8% (n = 77) of the subjects, with a similar distribution between both genders (OR 1.22, 95% CI 0.69–2.16).

Table 2 shows data on water pipe consumption in Switzerland. Remarkably, 78% (n = 160) of the young adults interviewed have ever smoked water pipe. From those, 30.0% (n = 55) were current water pipe smokers. Regular consumption of water pipe was reported by 3.9% (n = 8). There was no statistically relevant gender difference in water pipe consumption (males 82.3%, females 74.4%; OR 1.60, 95% CI 0.81–3.14). However, males more often smoked water pipe as compared to females, with a median of 2.8 sessions/year (IQR 1.1–8) versus 2 sessions/year (IQR 0–4; p = 0.022). The prevalence of ever and current water pipe smoking differed significantly among the three age categories. It was particularly common among subjects aged 16–20 years (87.0 and 46.3%, respectively), as compared to those aged 21–25 years (71.8 and 25.9%) and 26–30 years (73.1 and 15.8%; p = 0.035 and p = 0.008, respectively). Water pipe smoking was equally common among pupils (82%), apprentices (84%) and university students (70%; p = 0.216) as well as among Swiss citizens and foreigners (p = 0.512).

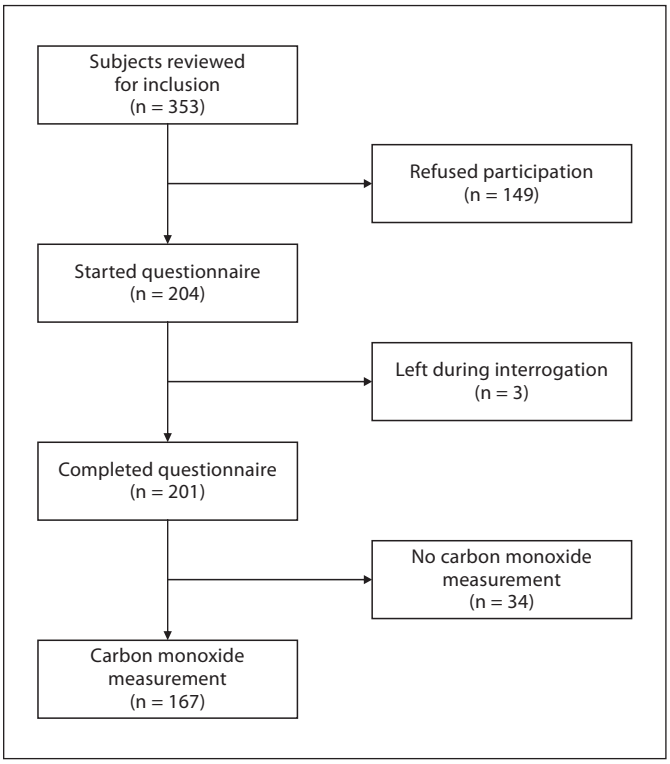

Fig. 1. Flow chart of study subjects.

The majority of subjects (78.1%, n = 125) had their first contact with water pipe smoking together with friends on private grounds (at home or at a friend's home). Less commonly, the first contact with water pipe smoking took place in a foreign country during vacations (13.8%, n = 22) or in a public area, i.e. water pipe bar (8.1%, n = 13).

The major risk factor for ever water pipe smoking was cigarette smoking (OR 6.22, 95% CI 2.33–16.62), followed by cannabis use (OR 1.44, 95% CI 1.29–1.62). Accordingly, the prevalence of ever water pipe smoking was 100% among subjects reporting current cannabis consumption (n = 59) as compared to subjects denying current cannabis smoking (n = 101; p < 0.0001).

Young adults reporting ever water pipe smoking had a non-significantly higher consumption of cigarettes per day as compared to never water pipe smokers (11.0 ± 8.1 vs. 9.2 ± 7.3; p = 0.358). The measured carbon monoxide value in the group of subjects reporting ever water pipe smoking was significantly higher than that in the group of subjects denying water pipe smoking (6.0 ± 9.0 vs. 2.1 ± 4.6 ppm; p < 0.001), probably reflecting the higher prevalence of cigarette smoking in this subgroup.

Table 1. Characteristics of 204 young Swiss adults according to their water pipe smoking habits

	Ever smoked water pipe (n = 160)	Never smoked water pipe (n = 44)	Overall (n = 204)	p
Age, years	21.0 ± 3.2	22.4 ± 3.6	21.0 ± 3.5	0.903
Male gender	93 (58.1)	20 (45.5)	113 (55.4)	0.174
Swiss nationality	129 (80.6)	37 (84.1)	173 (84.8)	0.428
Education				
High school	48 (30.0)	10 (22.3)	58 (28.4)	
Apprenticeship	60 (37.5)	11 (25.0)	71 (34.8)	
University	52 (32.5)	22 (50)	74 (36.3)	0.345
Current cigarette smoker	72 (45)	5 (11.4)	77 (37.8)	<0.001
Duration of cigarette smoking, years[1]	4.4 ± 3.1	5.2 ± 3.0	4.4 ± 3.1	0.942
Consumption of cigarettes per day[1]	11.2 ± 8.1	9.2 ± 7.3	11.0 ± 8.0	0.358
Current cannabis smoker	59 (36.9)	0	59 (28.9)	<0.001
Median joints per month[2]	13.1 ± 25.8	0	13.1 ± 25.8	<0.001
Carbon monoxide value, ppm	6.0 ± 9.0	2.1 ± 4.6	5.2 ± 8.4	<0.001
What is more harmful for your health?				
Cigarette smoking	48 (30)	19 (43.2)	67 (33.8)	
Water pipe smoking	81 (50.6)	11 (25)	92 (46.5)	
Equally harmful	26 (16.3)	11 (25)	37 (18.7)	
Do not know	1 (0.62)	1 (2.3)	2 (1)	0.025

Data are means ± SD, or number of subjects with percentages given in parentheses.
[1] Among cigarette smokers. [2] Among cannabis smokers.

Table 2. Characteristics of water pipe smoking among young adults in Switzerland

Characteristics	
Current water pipe smoker	55 (30.0%)
Regular water pipe smoker	8 (3.9%)
Median time to last water pipe consumption, days	120 [21–360]
Median duration of last water pipe session, min	60 [30–60]
Median frequency of smoking water pipe in the last year	2.5 [1–6]
Mean carbon monoxide exhaled values ± SD, ppm	6 ± 9

Figures in brackets are IQRs.

Finally, almost 50% of the subjects stated believing that water pipe smoking was associated with greater health risks than cigarette smoking. In contrast, one third assumed cigarette smoking to be more harmful than water pipe smoking whereas the minority of the interviewed subjects believed that water pipe and cigarette smoking were equally harmfully. Interestingly, beliefs about the extent of the harmfulness of water pipe smoking did not preclude young adults to smoke water pipe.

Discussion

This study has three main findings. Firstly, the vast majority of young adults between 16 and 30 years of age assessed by this convenience sample in Switzerland reported having ever smoked water pipe. Secondly, water pipe consumption was strongly associated with cigarette smoking and cannabis use. And finally, a large proportion of the interviewed young adults believe water pipe smoking to be associated with less health risks than cigarette smoking.

To our knowledge, this is the first study evaluating the frequency of water pipe smoking among young adults in Switzerland. Alarmingly, almost 80% of the young adults interviewed have reported to have ever smoked water pipe and 30% reported current water pipe smoking.

Ever water pipe use has been reported by 38% British university students and by 40% French high school students [2, 12]. Among a sample of 8,745 students from eight colleges in the US, 29.5% reported ever water pipe use [13]. In Canada, the 2006 Canadian Tobacco Use Monitoring Survey showed that only 8% of youths aged 15–24 years had ever used a water pipe. However, more recent results suggest that up to 70% of the boys and 60% of the girls had

tried water pipe smoking in Demark and in Sweden while prevalence rates range around 40% in Germany [14–16].

While the prevalence of current water pipe smoking among Jordanian university students is 42.7% [17], figures tend to be far less impressive in the western world: studies in universities found that the prevalence of current water pipe use ranges from 7 to 20% in the US and from 16 to 25% in Europe [13, 18, 19]. Similarly, youth tobacco use surveys in the US indicate that 7–9.7% high school students were current water pipe users in Arizona [20–22]. Regular water pipe smoking is reported to range among 2 und 7% in Denmark [14].

Thus, our results are in line with previous surveys of comparable populations. Nevertheless, the reported frequency of ever and current water pipe smoking in Switzerland is remarkably high. Differences to older studies might rely on the fact that most other surveys have focused on children, teenagers and young adults up to 24 years, while we have also included adults up to 30 years. In addition, it is possible that our study has selected a young adult population more prone to exposure to new experiences, as they have been interviewed while going or coming to/from a movie theater.

Similarly disturbing is the high prevalence of cigarette smoking reported in our study. According to an older survey of the Swiss Federal Office of Public Health, daily smoking is reported at 25% in the age range of 20–24 years in Switzerland. Overall, 21% of males between 14 and 65 years of age and 17% of females in the same age range smoke daily [23]. In contrast, 37.8% of young adults in our study reported current smoking of at least 10 cigarettes per day. Noteworthy, taking into account the robust threshold for the definition of current smoking applied in this study (>10 cigarettes per day), the prevalence of any cigarette smoking might have been even higher.

In agreement with previous reports, we suggest that cigarette smoking is strongly associated with water pipe use [2, 14, 24, 25]. In fact, among boys, water pipe smoking frequency was predictive of being a regular cigarette smoker at follow-up 8 months later [14], underlining the role of water pipe use as a potential 'gateway' to smoking progression and onset. A further important finding of the current study is that cannabis consumption seems to be a major risk factor for water pipe smoking. Accordingly, all current cannabis smokers reported having smoked water pipe. Our results are in agreement with the previous observation that 74% of water pipe users report marijuana consumption as compared with 35% of nonusers in North America [26]. Up to now, it still unclear whether water pipe smoking leads to consumption of other kinds of psychoactive substances such as cannabis or whether illicit drug abusers are more prone to try water pipe smoking. In any case, individuals who use multiple psychoactive drugs concurrently are potentially exposed to higher doses of noxious substances and elevated risks of dependence and disease [27], and water pipe users may be among those at highest risk. Use of multiple substances concurrently in this young age group is also associated with increased likelihood of mental health problems [28, 29], greater health service utilization attributable to alcohol and illicit substance use problems [30], and decreased work productivity [26]. Thus, water pipe smoking might be a flag ship for dependency problems.

Almost one third of the interviewed young adults believed that water pipe smoking is less harmful than cigarette smoking while roughly 50% judged water pipe smoking to be more harmful than cigarette smoking. Interestingly, we observed a high prevalence of water pipe smoking even among those who believed water pipe smoking to be more harmful than cigarette smoking. Most of the time, the first contact with water pipe smoking took place in private areas involving a group of friends. This might explain why water pipe smoking achieves a large spread among young adults. Accordingly, the education level did not seem to play a major role in preventing or initiating water pipe smoking.

There seems to be a generally higher exposure to smoke, as assessed by exhaled carbon monoxide, in the group of subjects reporting ever water pipe smoking. This higher exhaled carbon monoxide value in the water pipe group is most likely caused by the addition of increased cigarette and water pipe consumption in this group.

This study has some limitations. It has been performed in one single center (monocentric), which could have generated a selection bias. Unfortunately, personnel and financial restrictions prevented a wider assessment of water pipe consumption in different locations within the city. Nevertheless, interviews were performed on different days of the week, including the weekends, and over several weeks, thus expanding the targeted cohort. As there were no data on water pipe consumption in Switzerland so far, we expect the raising awareness of its harmful effects to support further epidemiological evaluations in the country. A second potential cause of select bias is the fact that some subjects have declined study participation. Nevertheless, due to the consistency in communication, the refusal of participation was not directly related to the topic of the study. Considering that some 20% of the Swiss population is of foreign origin, mostly from Balkan or

Arab countries, where the use of water pipe is part of the tradition, the ethnical background of the interviewed cohort might have affected the prevalence of water pipe smoking. Although we did not find a significant difference in water pipe consumption between Swiss citizens and foreigners, only current citizenship and no detailed ethnical background has been evaluated. Further limitations of this analysis include collection of self-reported data, which may be subject to recall bias, and the use of a convenience sample, which may limit the generalizability of the findings.

In summary, this study suggests a high frequency of water pipe smoking among young adults in Switzerland, and water pipe consumption was strongly associated with cigarette smoking and cannabis use.

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Financial Disclosure and Conflicts of Interest

None.

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