Original investigation

Use of a Water Pipe Is Not an Alternative to Other Tobacco or Substance Use Among Adolescents: Results From a National Survey in Sweden

Maria Rosaria Galanti PhD^{1,2}, Maissa Al-Adhami MSc¹

¹Department of Public Health Sciences, Karolinska Institutet, Stockholm, Sweden; ²Centre for Epidemiology and Community Medicine, Stockholm Health Care District, Stockholm, Sweden

Corresponding Author: Maria Rosaria Galanti, PhD, Department of Public Health Sciences, Karolinska Institutet, 17177 Stockholm, Sweden. Telephone: 46-8-12337165; E-mail: rosaria.galanti@ki.se

Abstract

Introduction: Studies of social characteristics and substance use patterns among young users of water pipe are rare in Western countries, and no such study has been conducted in Sweden.

Methods: Cross-sectional study based on a national survey conducted in 2011, including 4,710 primary school students (15 years of age) and 3,624 high school students (17 years of age). Prevalence of lifetime and current water pipe use was compared among subgroups defined by other substance use, that is, cigarettes, *snus*, alcohol, and illicit drugs. Logistic regression was employed to calculate odds ratios (*OR*) of water pipe use and corresponding 95% confidence intervals (*CI*), conditionally on sociodemographic characteristics.

Results: Use of water pipe was associated with the use of other substances in both age groups. In particular, current use of water pipe at the age of 15 years was strongly associated with current cigarette smoking (*OR* = 6.46; *CI* = 5.13–8.14); use of *snus* (*OR* = 5.62; *CI* = 3.94–7.96); binge drinking (*OR* = 7.39; *CI* = 5.88–9.31); drunkenness (*OR* = 7.05; *CI* = 5.60–8.88); and recent use of illicit drugs (*OR* = 14.20; *CI* = 9.18–22.19). Annual alcohol consumption predicted water pipe use in a dose–response fashion. Cigarette smokers willing to quit used water pipe to a lower extent than smokers who did not intend to quit. Being an exclusive smoker of water pipe was associated with substance use when compared with a nonsmoker of tobacco, but not when compared with an exclusive smoker of cigarettes.

Conclusions: Water pipe use among adolescents in Sweden is not a recreational tobacco use alternative to cigarettes and should be regarded as a marker of multiple substance use.

Introduction

Water pipe use is an emerging lifestyle among young urban populations in Western countries. The analysis of the 2008–2009 National College Health Assessment II found that about 10% of students in the United States, aged 18–24 years, reported past 30-day use of hookah.¹ A French study based on a sample of 300, 15- to 16-year-old, students found that the prevalence of current use of water pipe was 39% in the metropolitan area of Paris.² Likewise, a 2006

National survey among 15-year-old Estonian adolescents showed a 35% prevalence of any frequency of current use and a 6.6% prevalence of weekly use.³

Long-term risks of water pipe smoking are not well known, but increased risk of periodontal disease, respiratory illness, lung cancer, low-birth-weight infants, and possibly decreased fertility have been described.⁴ In addition, a single water pipe session entails a nicotine exposure equivalent to smoking two cigarettes, which presents addictive potential for frequent use.⁵ Diffusion of knowledge around this

issue is lacking and the perception among young people that water pipe smoking is less harmful than cigarette smoking^{6,7} should raise concern. Whether this is associated with lifestyle, a lack of specific information, or poor education in general is unclear since little is known about the psychosocial characteristics of young users of water pipe in Western countries, where the habit is not sustained by long-lasting traditions or community values. In particular, the question of whether water pipe smoking in Western countries represents a leisure-time tobacco use alternative to cigarette smoking, and/or to other forms of substance use, has been addressed in only a few studies.

North American studies of youth found that water pipe smoking was correlated with the use of other tobacco products, alcohol, and other substances.^{1,8,9} In a Danish study, water pipe use was associated with later progression to regular cigarette smoking.¹⁰ However, it is unclear whether these associations reflect the socioeconomic status of youth since this factor has seldom been taken into account.^{8,10} Further, when this has been done, inconsistent associations of youth's socioeconomic circumstances with smoking of water pipe were reported.^{9,11}

Studies exploring use of water pipe in relation to socioeconomic and behavioral characteristics of young users have never been conducted in Sweden, where the first national survey investigating the occurrence of the behavior among youth was conducted by the Swedish Council for Information on Alcohol and Other Drugs (CAN) in 2009. In that year, 33% of the 15-year-old male students and 26% of their female counterparts reported to have smoked water pipe at least once in life. The corresponding figures for students in the second year of the high school aged 17 years were 62% and 64%, respectively.¹²

In this study, we used data from national surveys in order to conduct a descriptive analysis of the social and behavioral characteristics of young users of water pipe in Sweden, with particular focus on the concurrent use of other substances. We hypothesized that water pipe users may be a particular subgroup of young tobacco users, belonging to protected socioeconomic environments that foster initiation with, or early transition to, recreational use of this type of tobacco.

Methods

Due to data collection using anonymous surveys, individual informed consent from participants was not necessary. The study was submitted for scrutiny to the Ethical Review Board in Stockholm Region and approved with decision nr. 2011/1223–31/5.

Survey Methods

The Swedish Council for Information on Alcohol and Other Drugs (CAN) is a national non-profit organization that has been appointed by the Swedish government with the task to monitor the use of alcohol, tobacco, and illicit drugs in the country. CAN is also the Swedish coordinator of the European School Survey Project on Alcohol and Other Drugs survey, a large European investigation of students' substance use (<http://www.espad.org/>).

Since 1971, CAN has conducted an annual national survey of students' substance use in the last year of primary school (9th grade, about 15 years of age) and in the second grade of high school (about 17 years of age). Since 2001, the student sample has been accrued by region-stratified random cluster sampling in two stages. First, a sample of schools is drawn, and second, one class is chosen at random in each school. Each sample encompasses between 4,000 and 5,000 students. The information is collected anonymously, through a paper questionnaire

administered in the classroom. The results of these surveys are published in annual reports and are widely used for surveillance and public health measures. Questions include detailed information on the use of alcohol, cigarettes, the smokeless tobacco *snus*, illicit, and prescription drugs. In 2009, questions on the use of water pipe were included for the first time. For the purpose of this study, we obtained the original data of the surveys conducted by CAN in 2009 and 2011.

Study Samples

Participants in the survey conducted in 2011 constituted the primary study sample. The survey employed a two-stage random sampling, where 300 schools constituted the primary sample and 300 classes (one class per school) constituted the secondary sample in each of the target grades. The proportion participating was 76.5% at the class level and above 80% at the student level.¹³ This study is based on 4,710 students in the 9th grade (about 15 year of age) and 3,624 students in the 2nd grade of high school (about 17 year of age) who answered a question about their lifetime use of water pipe.

Additionally, we used information from the surveys conducted in 2009 (5,271 respondents in the 9th grade and 4,082 in high school) in order to compare age-related differences in the prevalence of water pipe use in the same birth cohort with age-related differences in different birth cohorts.

Information on Substance Use and Other Covariates

Water Pipe Smoking

Lifetime use of water pipe in 2011 was investigated by the question: "Have you ever smoked water pipe?" There were four response alternatives [No; yes, with nicotine; yes, without nicotine; yes, but I do not know on nicotine content]. For the purpose of this analysis, ever use was dichotomized into "Yes" and "No." Average frequency of use was asked with reference to the last 12 months with 7 response alternatives, ranging from "Never" to "Sometimes in a week." For the purpose of this study, we considered "current use" as at least monthly use in the last 12 months. In the 2009 surveys, the question about frequency of use in the past 12 months was asked with reference to the absolute number of times smoked, with response alternatives ranging from "Never" to "More than 12 times." We considered this latter alternative as a measure of "Current use," when comparing the prevalence of 2009 and 2011.

Use of Other Tobacco

Cigarette smoking and the use of Swedish smokeless tobacco *snus* were assessed separately with very similar questions ("Do you smoke?" / "Do you use *snus*?"), with response alternatives: never; just tried; used but quit; every day; almost every day; at parties; now and then. For the purpose of this analysis, students who answered affirmatively to any of the six alternatives indicating use were considered "ever users" of cigarettes or *snus*, while students reporting use every day, almost every day, or at parties were considered "Current smokers/*snus* users."

Intention to quit the use of cigarettes or *snus* was investigated among daily or almost daily users with the question: "Do you want to quit the use of cigarettes/*snus*?" Individuals providing an affirmative answer were categorized as intending to quit.

Alcohol Drinking

Based on answers of frequency and quantity of consumption of five categories of alcoholic beverages (strong liquors, wine, beer, strong beer, and cider) an index of yearly consumption of pure alcohol in

centiliters (cl) was calculated, and categorized into six intervals ranging from 0 (No consumption) to more than 1000 cl.

Experience of binge drinking was investigated with the question: "How often does it happen that you on the same occasion drink as much alcohol as 18 cl of heavy liquors, or one bottle of wine, or 4 large bottles of strong cider/alcohol pops, or 4 cans of strong beer or 6 cans of beer?". A reported frequency of at least once a month was considered as frequent binge drinking.

Frequency of drunkenness was asked as: "How often do you drink so much alcohol that you feel drunk?". We considered reports of monthly drunkenness as an indication of frequent experience.

Use of Illicit Drugs

Lifetime use of illicit drugs (hashish, ecstasy, amphetamine, other) was elicited through the question: "Did you ever use illicit drugs?". A similar question investigated the use of illicit drugs during the past 30 days. Any positive answer to this latter question was categorized as "recent use."

Demographic and Social Characteristics

Three variables were chosen to indicate the social background of the family: parental employment, (categorized as "Full employment" if both parents were employed or "No full employment" if either parent was unemployed or in a nonworking position, e.g., students, retired); parental higher education (whether at least one parent had a post-secondary education); and geographic location of residence (central or northern regions, the southern region, or the Stockholm region of Sweden). Sweden's regions differ in degree of urbanization and population density, as well as in patterns of tobacco and alcohol use, with higher than average prevalence of *snus* use in the northern regions (about 17% vs. 11% country average), higher prevalence of smoking in the southern regions and higher prevalence of risky alcohol consumption in large cities. Thriving in school was defined as answering "Much" or "Very much" to the corresponding question: "How much do you thrive in your school?". Satisfactory school proficiency was defined as self-reported achievement of the grade "pass" in all three core subjects taught in Swedish schools (Swedish, English, and Mathematics).

Statistical Methods

In tabular analyses, we compared the prevalence of water pipe users between subgroups of the study population, defined by levels of their behavioral and psychosocial characteristics. In the same way, we compared prevalence of use among students surveyed in 2009 with those surveyed in 2011. Chi-square analysis was used to explore the departure of the observed proportions from those expected under the null hypothesis. Logistic regression was used to calculate odds ratios (OR) and corresponding 95% confidence intervals of being a water pipe user according to the level of other substance use. Adjustments were done for variables representing potential confounders based on a priori understanding of possible causal pathways: sex, parental employment status, parental education, and geographic area of residence. Likewise, we compared substance use between exclusive water pipe smokers (i.e., users of water pipe who did not smoke cigarettes) and adolescents who either did not smoke any type of tobacco (nonsmokers) or only smoked cigarettes (exclusive cigarette smokers). All analyses were conducted with SAS software version 9.2 SAS Institute Inc.

Results

All in all, 40.8% of the 15-year-old and 60.9% of the 17-year-old students surveyed in 2011 had tried water pipe smoking some time

in life, while the corresponding figures for monthly smoking during the past 12 months (current use) were 10.2% and 9.6%, respectively.

A comparison between cohorts born 2 years apart given an attained age showed that the youngest birth cohort (15 year old in 2011, i.e., born in 1996) had a higher prevalence of current use than the previous birth cohort at the same age (15 year old in 2009, i.e., born in 1994)—10.2% versus 6.5%, despite a lower prevalence of lifetime use (40.8% vs. 43.9%). In turn, the 1996 birth cohort again had a higher prevalence of current use at the age of 17 years than the older birth cohort (17 years in 2009, i.e., born in 1992)—9.6% versus 7.6%, despite lower proportion of lifetime users.

The prevalence of water pipe use according to behavioral and sociodemographic characteristics of the students surveyed in 2011 is shown in Table 1. Among the 15 year olds, the prevalence of both lifetime and current water pipe smoking was significantly higher among boys, those living in the highly urbanized region of Stockholm, having both parents without university education, and having at least one parent without a job position. Subjects that reported not thriving in school and insufficient grades in at least one core subject had more than two-fold higher prevalence than those without these characteristics. Patterns of prevalence were very similar among the 17-year-old students, but there were no associations with parental education and parental employment status, while gender differences were limited to current use.

The use of water pipe in relation to other tobacco use is reported in Table 2. In both age groups, cigarette smokers and *snus* users had a two- to five-fold higher prevalence of lifetime and current use of water pipe compared with peers who did not use the corresponding type of tobacco. Willingness to quit cigarette smoking or *snus* among current daily users was associated with lower prevalence of current use of water pipe, with no difference in lifetime use (Table 2). In addition, the prevalence of current water pipe smoking was higher among current daily cigarette smokers, at 47.5%, than among former cigarette smokers, at 23.7% (data not shown in the table).

The prevalence of water pipe use was higher among all categories of drinkers than among nondrinkers and increased in a dose-response manner with increasing consumption of alcohol. Among 15-year-old students, current use of water pipe was nearly 12 times more common among consumers of 1000 cl alcohol per year or more (36.7%) than among nondrinkers (3.1%). Prevalence of current use of water pipe was also similarly and significantly higher among frequent binge drinkers (28.5% vs. 5.3%), those reporting frequent episodes of drunkenness (27.6% vs. 5.7%), and especially those reporting ever use (40.3% vs. 7.1%) or recent use (59.2% vs. 8.8%) of illicit drugs. Accordingly, the cross-sectional odds to be a current water pipe user at the age of 15 years was 5–15 times higher for all substance use behaviors, compared with non-use, even after adjustment for sociodemographic characteristics (Table 3). Similar results were obtained among the 17-year-old students. Table 4 displays the ORs of being an exclusive current smoker of water pipe (monthly user) rather than a nonsmoker of any tobacco (left side of the table) or an exclusive smoker of cigarettes (right side of the table) among the 15-year-old students. About half of the current smokers of water pipe were not cigarette smokers ($n = 233$), that is, were exclusive water pipe smokers, while 72% of the current cigarette smokers ($n = 607$) were not currently using water pipe, that is, were exclusive cigarette smokers. When compared with nonsmokers, exclusive water pipe use was strongly associated to all substance use, in the same fashion as in the whole population.

Table 1. Prevalence of Lifetime and Current Use of Water Pipe Among Swedish Students According to Sociodemographic Characteristics, 2011

	Students in the 9th grade (15 year old) N = 4,710			Students in the 2nd year of the high school (17 year old) N = 3,624		
	N ^a	Ever smoked water pipe (%)	Current smoker of water pipe (%)	N ^a	Ever smoked water pipe (%)	Current smoker of water pipe (%)
Sex						
Males	2,400	42.6*	11.9*	1,813	61.0	11.1*
Females	2,303	38.9	8.4	1,804	60.6	8.0
Geographical area of residence						
Center and North	1,081	36.9*	9.1*	893	54.3*	5.4*
Stockholm	1,004	46.3	13.9	804	72.9	15.4
South	2,312	41.0	10.0	1,462	59.2	9.6
Both parents employed						
No	800	44.0*	14.4*	563	57.0	10.6
Yes	3,476	38.8	8.6	2,778	60.4	8.7
At least one parent with university education						
No	2,493	41.4*	10.8*	1,809	60.1	9.0
Yes	1,959	38.1	8.3	1,707	60.6	9.7
Satisfactory school performance						
No	526	55.5*	20.5*	430	68.6*	12.9*
Yes	4,063	38.8	8.7	3,092	59.7	9.1
Thrives in school						
No	701	50.2*	16.9*	382	68.3*	14.6*
Yes	3,981	39.1	8.9	3,223	59.9	8.9

^aNumbers do not sum up to the total because of missing values.*Chi-square statistics, $p < .05$.**Table 2.** Prevalence of Lifetime and Current Use of Water Pipe Among Swedish Students in Relation to Other Tobacco Use, 2011

	Students in the 9th grade (15 year old) N = 4,710			Students in the 2nd year of the high school (17 year old) N = 3,624		
	N ^a	Ever smoked water pipe (%)	Current smoker of water pipe (%)	N ^a	Ever smoked water pipe (%)	Current smoker of water pipe (%)
Ever smoked cigarettes						
No	2,207	15.0*	1.7*	1,147	23.8*	2.1*
Yes	2,493	63.7	17.7	2,473	78.0	13.0
Current cigarette smoking						
No	3,847	31.8*	6.2*	2,557	49.8*	5.6*
Yes	853	81.4	28.0	1,063	87.5	19.0
Willingness to quit cigarette smoking among daily smokers						
No	85	95.3	57.8*	56	92.9	37.5*
Yes	376	88.4	30.6	485	93.2	20.5
Ever used snus						
No	3,180	27.5*	5.2*	1,917	42.3*	5.4*
Yes	1,488	69.1	20.9	1,694	81.8	14.2
Current snus use						
No	4,422	38.5*	8.9*	3,175	57.0*	8.5*
Yes	246	81.7	33.6	436	88.5	16.7
Willingness to quit snus among daily users						
No	90	87.8	43.8*	147	91.8	24.0*
Yes	88	81.8	23.3	197	88.3	13.3

^aNumbers do not sum up to the total because of missing values.*Chi-square statistics, $p < .05$.

Table 3. Adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) of Current Water Pipe Use According to Other Substance Use Among 15-Year-Old Swedish Students, 2011

	OR ^a (95% CI)
Ever cigarette smoking (vs. never)	13.80 (9.45–21.03)
Current cigarette smoking (vs. no current smoking)	6.46 (5.13–8.14)
Ever snus use (vs. never)	5.03 (3.99–6.36)
Current snus use (vs. no current use)	5.62 (3.94–7.96)
Annual alcohol consumption in cl/year (vs. nondrinker)	
≤50	1.92 (1.24–2.99)
51–150	3.95 (2.46–6.33)
151–300	6.19 (3.82–10.00)
301–500	7.57 (4.57–12.47)
501–1000	10.86 (6.90–17.23)
1000+	20.85 (14.02–31.58)
Frequent (monthly) binge drinking (vs. no or less than monthly)	7.39 (5.88–9.31)
Frequent (monthly) drunkenness (vs. no or less than monthly)	7.05 (5.60–8.88)
Ever used illicit drugs (vs. never)	8.09 (6.23–10.49)
Recent (past 30 days) use of illicit drugs vs. no use or nonrecent use	14.20 (9.18–22.19)

^aAdjusted for sex, parental employment, parental education, and region of residence.

Table 4. Adjusted Odds Ratio (OR)^a and 95% Confidence Interval (CI) of Being an Exclusive Water Pipe Smoker Rather Than a Nonsmoker of Tobacco or an Exclusive Cigarette Smoker Among 15-Year-Old Swedish Students According to Use of Other Substances, 2011

	OR ^b (95% CI)	OR ^c (95% CI)
Ever snus use (vs. never)	5.09 (3.68–7.06)	0.44 (0.30–0.65)
Current snus use (vs. no current use)	5.72 (3.16–10.02)	0.62 (0.34–1.11)
Alcohol consumption in cl/year (vs. nondrinker)		
≤50	1.85 (1.15–2.99)	0.32 (0.15–0.69)
51–150	3.73 (2.11–6.48)	0.13 (0.06–0.27)
151–300	5.16 (2.73–9.43)	0.10 (0.04–0.23)
301–500	7.62 (4.04–13.97)	0.16 (0.07–0.36)
501–1000	10.07 (5.34–18.55)	0.10 (0.04–0.22)
1000+	15.09 (8.79–25.92)	0.17 (0.08–0.35)
Monthly binge drinking (vs. no or less than monthly)	5.98 (4.30–8.29)	0.60 (0.42–0.85)
Monthly drunkenness (vs. no or less than monthly)	6.53 (4.67–9.11)	0.52 (0.36–0.75)
Ever used illicit drugs (vs. never)	6.58 (4.21–10.09)	0.65 (0.41–1.01)
Past 30 days use of illicit drugs vs. no use or nonrecent use	13.39 (5.87–30.14)	1.17 (0.54–2.43)

^aAdjusted for sex, parental employment, parental education, and region of residence.

^bExclusive water pipe smoker vs. nonsmoker of tobacco.

^cExclusive water pipe smoker vs. exclusive cigarette smoker.

On the other hand, the probability to be an exclusive water pipe user rather than an exclusive cigarette smoker was negatively associated to substance use, with the possible exception of recent use of illicit drugs. The same pattern was seen when lifetime use of cigarettes or water pipe was analyzed.

Discussion

In line with other studies from Western countries, use of water pipe seems to be a widespread behavior among Swedish adolescents, especially in the highly urbanized region of Stockholm. According to data from 2012, CAN's most recently available national survey (using the same instrument as in our study), found that by the age of 17 years, 6 out of 10 students had tried water pipe smoking, and about 1 in 10 were still a current user.¹⁴ Interestingly, data from 2009 and 2011 analyzed in this study showed that the proportion of current users among 17 year olds was not higher than among the 15 year olds in the same year, suggesting that the progression from early trial to regular use happens in early adolescence. Also, data

indicated that this progression may have been faster in the younger birth cohorts compared with the older.

Our primary hypothesis was that adolescent users of water pipe in Sweden would represent a subgroup of youth from families with high socioeconomic status, who use this sophisticated way of tobacco smoking rather than cigarettes, in the belief that the exposure is less dangerous and facilitates relaxation and stress relief.¹⁵ Users of water pipe tend to believe that this way of smoking tobacco is less harmful than smoking cigarettes.^{16,17} a belief that may be further reinforced because the smoked substance might not always contain tobacco or nicotine. The hypothesized social and behavioral patterns were not supported by this in-depth analysis of data from Swedish national surveys. Taken as a whole, young water pipe users were indeed more often individuals whose parents were less educated and less often in a paid employment position than the average population. However, these sociodemographic differences attenuated with age, suggesting that a relatively disadvantaged social environment may rather be a correlate of early use rather than of use *per se*.¹⁸

Irrespective of age, the psychosocial and substance use profile of water pipe smokers was indicative of low school attachment and performance, as well as of poly-drug use. That cigarette smokers used water pipe more often than nonsmokers was not surprising, but that the prevalence of water pipe use among current cigarette smokers was higher than among former cigarette smokers—as well as among smokers that did not want to quit cigarettes—speaks against water pipe smoking as a transitional behavior toward a “healthier and unconventional” profile of substance use. An American study indeed suggested that attitudes toward tobacco smoking as stress-relieving and socially acceptable predicts water pipe smoking beyond the behavioral correlation between cigarette and water pipe use.¹⁵

Further, our data indicated that youth who remain or turn into exclusive users of water pipe are indeed a particular subgroup, with higher probability of substance use compared with nonsmokers of any tobacco but lower probability compared with cigarette smokers.

This is the first Swedish study addressing an in-depth description of psychosocial and substance use profile of young water pipe users. The paucity of equivalent studies conducted in Western countries, especially in Europe, hampers the possibility of extensive comparisons. However, very similar findings have been presented in a few studies from North America and Europe. In Canadian samples, water pipe use was correlated with ever and current use of cigarettes, as well as with alcohol misuse and use of marijuana.^{8,9} In a survey conducted in Estonia among 11–15 year olds, water pipe use was strongly correlated with cigarette smoking.³ In a small sample of young theater attenders in Switzerland, water pipe users were associated with both cigarette smoking and cannabis use.¹⁹ In a Danish study, there was some evidence that water pipe smoking is longitudinally associated to progression of cigarette smoking, at least among boys.¹⁰ Finally, a recent cross-sectional study from the United Kingdom indicated a strong correlation between lifetime water pipe use, cigarette smoking, alcohol drinking, and illicit drugs use.²⁰

The socioeconomic characteristics of young water pipe users in Western countries deserve consideration as studies have reported different associations. In a study conducted in Arizona among students in middle and high schools, planning higher education was associated with lower prevalence of water pipe smoking.¹¹ In the Swiss study cited above,¹⁹ the prevalence of university education was higher among never users of water pipe than among users, although educational differences were not statistically significant. In the Canadian study by Dugas *et al.*,⁹ increasing household income was cross-sectionally associated with use of water pipe among young adults. These apparent inconsistencies can be interpreted in the light of contextual and cultural differences between samples, probably originating from ethnic composition.

In fact, two studies from the United Kingdom indicated that ethnicity was strongly linked to water pipe use. In one study from the urban area of London with high prevalence of inhabitants of South Asian and Middle Eastern origin, water pipe smoking among secondary school students was more prevalent than cigarette smoking.²¹ In the study by Jawal *et al.*,²⁰ conducted in a socially deprived area of the United Kingdom, Asian ethnicity was a positive correlate of water pipe use but a negative correlate of cigarette smoking. Along with this unusual pattern, in both studies the prevalence of water pipe smoking was lower among students qualifying for free school meals, than among more economically advantaged students.^{20,21} We did not have information on ethnicity or geographic origin of the

participants in our survey; therefore, we are unable to conduct subgroup analyses of patterns of substance use.

On the other hand, studies from countries where the use of water pipe is traditional show both similarities and differences with western patterns. The observation of water pipe use clustering with other risk behaviors such as cigarette smoking,^{22,23} alcohol misuse,^{23,24} use of illicit drugs, fighting, negative relation to school,²³ and low school achievements²⁵ has been noted in several studies from Middle Eastern countries. The association with socioeconomic status, on the other hand, although not consistent, indicated higher prevalence of use in households with above average educational levels and/or income in several studies.^{24,26,27} A possible explanation is that in societies where the use of water pipe is rooted in tradition, the norms concerning this type of smoking behavior are more subject to cultural and inter-generational transmission and less dictated by policy and health issues. For instance, it is common that the onset of use among youth happens within the family, in leisure time or celebrations.^{22,28} Also, it may be hypothesized that the stage of cigarette smoking epidemics²⁹ may be an important modifier of norms concerning water pipe use, with traditional tobacco smoking being gradually replaced by cigarette smoking as the epidemics progresses.

Strengths of this study include information from large nationally representative samples, with consolidated survey methodology. Due to the good response rate (above 80%), bias arising from participant selection is unlikely. The cross-sectional design, suitable for the descriptive purpose of this analysis, prevents drawing conclusions about the time of onset of different behaviors and possible transitions between different stages of substance use. Lack of objective validation of self-reports may have led to underestimation of the frequency of some behaviors, especially concerning the use of illicit drugs. However, data were collected anonymously and confidentially, which is likely to minimize the frequency of biased reports. Unless underreporting of substance use was dramatically higher among nonusers than among users of water pipe, it would not explain the strong cross-sectional associations we found, which are rather likely underestimated. Current use was not assessed during the past 30 days as in most international surveys, but it was estimated from the average frequency of use during the past year, which somewhat hampers international comparisons with regard to crude prevalence. Finally, changes in the survey instrument from 2009 and 2011 may have at least partly biased the comparison of prevalence over time, and in subsequent birth cohorts.

We conclude that water pipe use among adolescents in Sweden, as in many Western countries, should be regarded as a marker of propensity to multiple substance use, rather than as an indicator of health conscious, alternative recreational use of tobacco.

Supplementary Material

Supplementary Table 1 can be found online at <http://www.ntr.oxfordjournals.org>

Funding

The work was supported by the Swedish National Institute for Public Health (HFÅ 2011–174 to MRG) and by the Stockholm County Council.

Declaration of Interest

None declared.

Acknowledgments

We are indebted to Björn Hibell, former Head of the Swedish Council for Information on Alcohol and Other Drugs (CAN) for allowing the use of survey data; to Simon Lind for support during the stage of data analysis; and to Charisse Johnson for language revision.

References

1. Jarrett T, Blosnich J, Tworek C, Horn K. Hookah use among U.S. college students: results from the National College Health Assessment II. *Nicotine Tob Res.* 2012;14:1145–1153.
2. Chéron-Launay M, Baha M, Mautrait C, Lagrue G, Le Faou AL. [Identifying addictive behaviors among adolescents: a school-based survey]. *Arch Pediatr.* 2011;18:737–744.
3. Pärna K, Usin J, Ringmets I. Cigarette and waterpipe smoking among adolescents in Estonia: HBSC survey results, 1994–2006. *BMC Public Health.* 2008;8:392.
4. Akl EA, Gaddam S, Gunukula SK, Honeine R, Jaoude PA, Irani J. The effects of waterpipe tobacco smoking on health outcomes: a systematic review. *Int J Epidemiol.* 2010;39:834–857.
5. Neergaard J, Singh P, Job J, Montgomery S. Waterpipe smoking and nicotine exposure: a review of the current evidence. *Nicotine Tob Res.* 2007;9:987–994.
6. Aljarrah K, Ababneh ZQ, Al-Delaimy WK. Perceptions of hookah smoking harmfulness: predictors and characteristics among current hookah users. *Tob Induc Dis.* 2009;5:16.
7. Smith-Simone S, Maziak W, Ward KD, Eissenberg T. Waterpipe tobacco smoking: knowledge, attitudes, beliefs, and behavior in two U.S. samples. *Nicotine Tob Res.* 2008;10:393–398.
8. Chan WC, Leatherdale ST, Burkhalter R, Ahmed R. Bidi and hookah use among Canadian youth: an examination of data from the 2006 Canadian Youth Smoking Survey. *J Adolesc Health.* 2011;49:102–104.
9. Dugas E, Tremblay M, Low NC, Cournoyer D, O'Loughlin J. Water-pipe smoking among North American youths. *Pediatrics.* 2010;125:1184–1189.
10. Jensen PD, Cortes R, Engholm G, Kremers S, Gislum M. Waterpipe use predicts progression to regular cigarette smoking among Danish youth. *Subst Use Misuse.* 2010;45:1245–1261.
11. Primack BA, Walsh M, Bryce C, Eissenberg T. Water-pipe tobacco smoking among middle and high school students in Arizona. *Pediatrics.* 2009;123:e282–e288.
12. Hvitfeldt T, Gripe I. *Skolelever drogvanor 2009. CAN rapport 118.* (CAN) (Ed.). Stockholm: CAN; 2009.
13. Henriksson C, Leifman H. *Skolelever drogvanor 2011. CAN rapport 129.* (CAN) (Ed.). Stockholm: CAN; 2011.
14. Leifman H. *Skolelever drogvanor 2012. CAN rapport 133.* (CAN) (Ed.). Stockholm: CAN; 2013.
15. Barnett TE, Curbow BA, Weitz JR, Johnson TM, Smith-Simone SY. Water pipe tobacco smoking among middle and high school students. *Am J Public Health.* 2009;99:2014–2019.
16. Akl EA, Jawad M, Lam WY, Co CN, Obeid R, Irani J. Motives, beliefs and attitudes towards waterpipe tobacco smoking: a systematic review. *Harm Reduct J.* 2013;10:12.
17. Smith JR, Novotny TE, Edland SD, Hofstetter CR, Lindsay SP, Al-Delaimy WK. Determinants of hookah use among high school students. *Nicotine Tob Res.* 2011;13:565–572.
18. Tjora T, Hetland J, Aarø LE, Øverland S. Distal and proximal family predictors of adolescents' smoking initiation and development: a longitudinal latent curve model analysis. *BMC Public Health.* 2011;11:911.
19. Albisser S, Schmidlin J, Schindler C, Tamm M, Stolz D. Water pipe smoking and its association with cigarette and cannabis use in young adults in Switzerland. *Respiration.* 2013;86:210–215.
20. Jawad M, McIver C, Iqbal Z. Prevalence and correlates of lifetime waterpipe, cigarette, alcohol and drug use among secondary school students in Stoke-on-Trent, UK: a post hoc cross-sectional analysis [published online ahead of print February 03, 2014]. *J Public Health.* doi:10.1093/pubmed/dfu002.
21. Jawad M, Wilson A, Lee JT, Jawad S, Hamilton FL, Millett C. Prevalence and predictors of water pipe and cigarette smoking among secondary school students in London. *Nicotine Tob Res.* 2013;15:2069–2075.
22. Kelishadi R, Mokhtari MR, Tavasoli AA, et al. Determinants of tobacco use among youths in Isfahan, Iran. *Int J Public Health.* 2007;52:173–179.
23. Korn L, Harel-Fisch Y, Amitai G. Social and behavioural determinants of nargila (water-pipe) smoking among Israeli youth: findings from the 2002 HBSC survey. *J Subst Use.* 2008;13:225–238.
24. Tamim H, Terro A, Kassem H, et al. Tobacco use by university students, Lebanon, 2001. *Addiction.* 2003;98:933–939.
25. Korn L, Magnezi R. Cigarette and nargila (water pipe) use among Israeli Arab high school students: prevalence and determinants of tobacco smoking. *ScientificWorldJournal.* 2008;8:517–525.
26. Azab M, Khabour OF, Alkaraki AK, Eissenberg T, Alzoubi KH, Primack BA. Water pipe tobacco smoking among university students in Jordan. *Nicotine Tob Res.* 2010;12:606–612.
27. Khabour OF, Alzoubi KH, Eissenberg T, et al. Waterpipe tobacco and cigarette smoking among university students in Jordan. *Int J Tuberc Lung Dis.* 2012;16:986–992.
28. Asfar T, Ward KD, Eissenberg T, Maziak W. Comparison of patterns of use, beliefs, and attitudes related to waterpipe between beginning and established smokers. *BMC Public Health.* 2005;5:19.
29. Lopez AD, Collishaw NE, Piha T. A descriptive model of the cigarette epidemic in developed countries. *Tob Contr.* 1994;3:242–247.