Chronic respiratory effect of narguileh smoking compared with cigarette smoking in women from the East Mediterranean region

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Abstract: Narguileh is a water pipe. Narguileh smoking is a traditional pattern of smoking among Eastern Mediterranean women, publicly considered as a harmless entertainment. We performed a survey aimed at tracking chronic respiratory symptoms and alteration in respiratory functions in 77 female narguileh smokers, 77 cigarette smokers, and controls. A questionnaire about respiratory symptoms, quantity, and duration of smoking was completed by each woman, and a flow-volume loop was performed with all women. Women were then categorized in subgroups according to a cumulative smoking duration of over 5 years, and cumulative quantity of 50 kilograms smoked. We obtained 8 subgroups for quantity and 10 for duration. Results showed a higher proportion of chronic bronchitis in narguileh smokers compared with cigarette smokers for both quantity and duration (p value < 0.001), as well as quasi-permanent alteration in maximum mid-expiratory flow (MMEF 25%–75%) in narguileh smokers compared with cigarette smokers (p value < 0.001). Forced expired volume in one second was more altered in cigarette smokers than in narguileh smokers (p value > 0.001). These results will help to raise health authority awareness that narguileh smoking is also dangerous for women.

Keywords: sheesha, narguileh, narguile, COPD, MMEF, smoking in women

Introduction

Along with the relatively modern habit of cigarette smoking (Haglund 2000), women in the East Mediterranean region have been smoking narguileh water pipes for centuries (Orlando 2000). This exercise is so widely spread that the narguileh smoking has become an inseparable part of the social image of women in their daily gatherings and that the untested idea of the narguileh being a harmless "toy" has become a common misconception even among physicians.

The narguileh is a water pipe (Figure 1) consisting of three main parts: a glass pitcher, a hose, and firebrands. The glass pitcher is half filled with water; a vertical tube is dipped in the water, and the upper tip of this tube is connected to a cup containing tobacco lit with brands. The pitcher is connected with another tube that reaches to the hose through which the smoke is drawn out by a series of puffs after bubbling through the water. This needs a high suction pressure and deep inspiratory effort to overcome the resistance of this long pathway. The tobacco used is called tombak, and takes the form of domestic pure tombak in Syria, meassel mixed with honey, and jurak, which is a tobacco fruit mixture cooked to produce a dark colored paste in Saudi Arabia (AL-Fayez et al 1980); tombak is burned with a piece of coal. The ignition temperature is 308 °C. (Omar and Salem 1996). Sheesha, shisha, chicha, Goza, hubble bubble, hookah, and narguile are synonymous to narguileh.

It is a social custom that a narguileh could be consumed by one woman or a group of women at during a session (Omar and Salem 1996; Orlando 2000). A pack of

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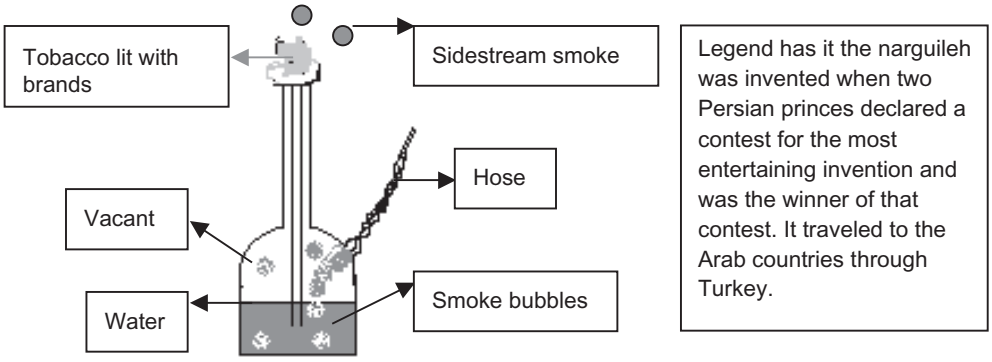

Figure 1 Narguileh scheme.
Notes: Narguileh: consists of three parts: a glass pitcher, a hose through which the smoker draws bubbles of smoke from the tobacco burning in the firebrand cup through the water to cool the smoke.

tombak is 40 g, and for each session 10 to 20 g of tombac are burned. The resulting smoke is inhaled over 1–1.5 hour-long sessions. Every aspiration or puff lasts 4 seconds, with an 8-second rest (Brahim 1983).

At this time antismoking campaigns are mainly focused on the dangers of cigarette smoking. Nevertheless, in recent years, some papers have been published on potential health effects of narguileh smoking. In Syria, accordingly to unpublished data from the health ministry, 17% of women in the coastal Mediterranean region smoke narguileh. 90% of them are urban, compared with 15% women cigarette smokers.

The general observation of our clinic in Syria indicates that narguileh-smoking women frequently share some chronic respiratory symptoms. This basic clinical observation led us to perform a survey aiming to compare prevalence of chronic respiratory symptoms and lung function in three groups of women: narguileh smokers, cigarette smokers, and nonsmokers (control). The results of the few former studies and our own study could induce changes in the public opinion, and help raise awareness within health authorities regarding this specific manner of smoking, and so encourage campaigns on the potential noxious effect of narguileh.

Materials and methods

Population

The survey was performed during the first semester of 1994 among 77 female narguileh smokers, and was completed in the first semester of 1995 for 77 cigarette smokers and 100 nonsmoker controls. All these women were older than 14 (range 14–70) and were recruited from the general population by a field survey.

For a woman to be eligible, they were required to have no comorbidity, no respiratory symptoms related to factors other than smoking, and no exposure to other known risk factors in her daily life. None of the subjects smoked both narguileh and cigarettes. The nature and goals of the study were explained to the subjects who all gave their consent.

We had the ethical approval of the university council.

The questionnaire

The questionnaire (Figure 2) includes general sociodemographic variables (age, occupation, domestic location), information on smoking for cigarette and narguileh (daily quantity and age of initiation), and respiratory symptoms: recurrent cough and sputum reflecting chronic bronchitis (CBH) and dyspnea. Our question about the consumption of narguileh was locally designed and pilot-tested. The questions for CBH, cigarette smoking, and dyspnea were derived from the European Coal and Steel Community (ECSC) questionnaire (Minette 1989).

Women were categorized up to their cumulative duration of smoking by 5 years for time and to the cumulative quantity smoked by 50 kilos for quantity. We obtained 10 pairs of subgroups for time and 8 pairs of subgroups for quantity.

Duration of smoking was directly obtained from the questionnaire, while a quantitative evaluation of smoking was indirectly calculated according to the type of smoking:

For narguileh smokers, we used the following formula:

$$Q = S.q\ (g).T\ (days)/1000$$

Where:

- Q = Cumulative quantity smoked in kg.
- S = Number of sessions per day.
- q = Quantity smoked per session in grams.
- T = Duration of smoking in days.
- *n* = number of smokers per session.

For cigarettes smokers, we used the following formula:

$$Q = N\ (g).T\ (days)/1000$$

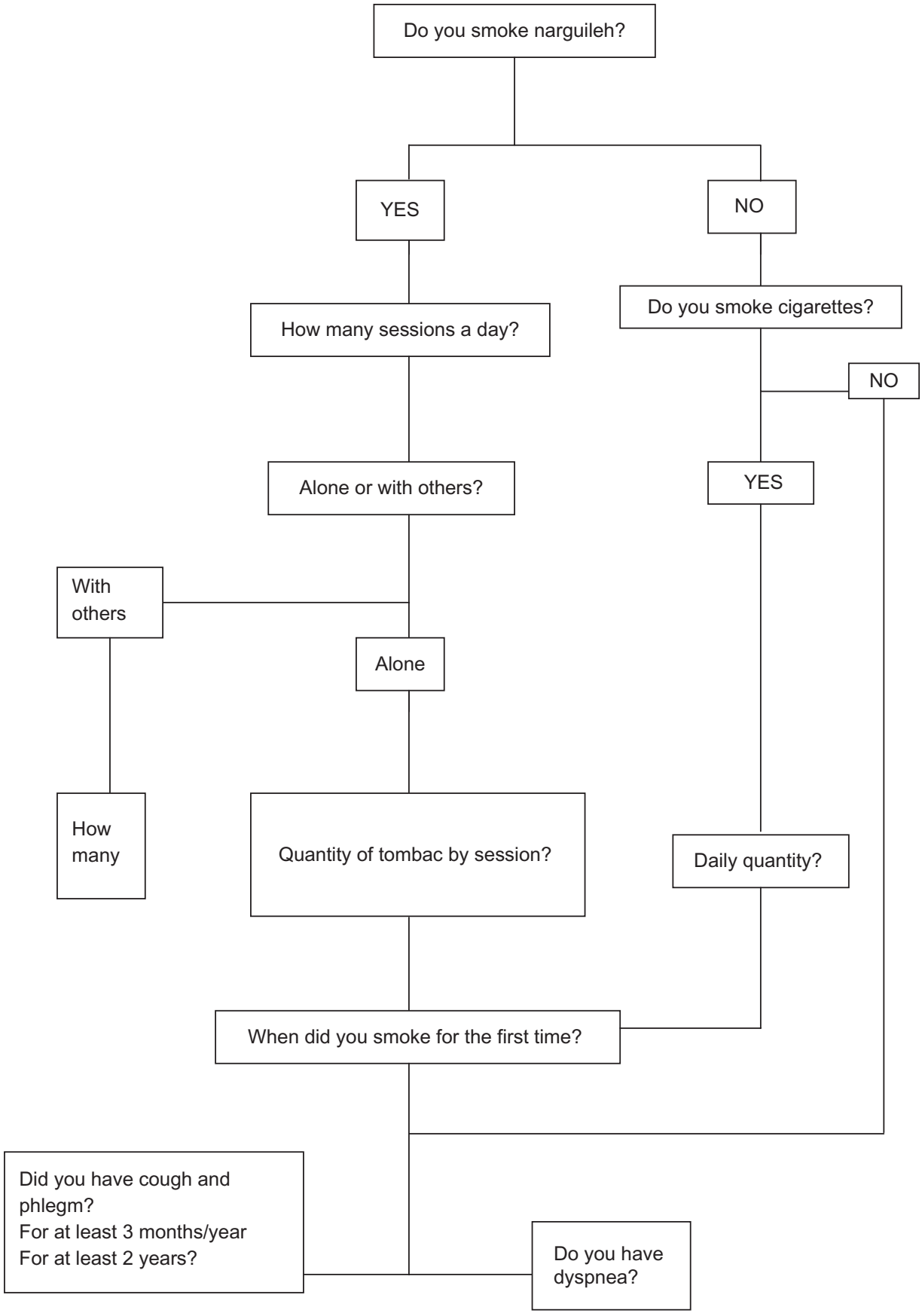

Figure 2 The questionnaire: Name, age, occupation, domestic location, smoking, and clinical history. The following box diagram describes the questionnaire.

Where:

- Q = Cumulative quantity smoked in Kg.
- N = Number of cigarettes per day (based on the fact that every cigarette contains one gram of tobacco).
- T = Duration of smoking in days.

The result was divided by 1000 to convert g into kg.

Outcome measures: Five variables

Clinically: CBH and dyspnea (dysp).

- Respiratory function: 1-The maximum mid-expiratory flow (MMEF), which is the volume delivered between 25% and 75% of the forced vital capacity (FVC) reported in % of predicted value, reflecting small airway alteration (Sherman 1992; Khaled and Joel 1997; West 2000) which is altered while FEV1 is still normal in smokers. MMEF 25%–75% is also expressed in the medical literature by the forced expiratory flow rate (FEF 25%–75%) (West 2000). It is also expressed by MMF (Shiraishi 1994).
- 2- Forced expiratory volume in one second (FEV1), FVC, and the ratio FEV1/FVC to determine the presence and severity of obstruction (expiratory airflow limitation), with FEV1 reflecting the increase in airway resistance (Sherman 1992; Quartier et al 1993; Desrues et al 1993; Khaled and Joel 1997; Gary et al 2000; GOLD 2005).

The flow – volume loop for all subjects was consequently analyzed. MMEF and FEV_1 values were compared with normal predicted values, and were considered abnormal if less than 80% of predicted. $FEV_1/FVC < 70\%$ was considered to reflect obstruction (Sherman 1992; Quartier et al 1993; Desrues et al 1993; Khaled and Joel 1997; Gary et al 2000; GOLD 2005).

Predicted values were considered for the CECA (Quartier et al 1993). The percentage of alteration for each variable (CBH, dypn, MMEF, FEV_1, and FEV_1/FVC) was calculated in all subgroups.

Data collection

Female narguileh smokers were first visited at their homes during their daily gathering. The questionnaire was completed and they were then invited to the outpatient clinic for office spirometry and investigations for differential diagnosis and comorbidity. 100 were seen, 23 were excluded: 7 for comorbidities, 3 for noncooperating with spirometry, 11 refused to come for spirometry, and 2 for positive reversibility test with bronchodilators.

Data were collected by a well trained postgraduate pulmonary medical student who directly administered the questionnaire. Each participant performed flow – volume loop by automatic calibrated spirometer (Gary et al 2000). Flow – volume loops were repeated several times until three reliable tracings were obtained; the best two tracings for FVC are within 5% or 100 ml of each other, and the highest values were retained for the study analysis. As per the recommendations of the European Union (Quartier et al 1993), noncooperating subjects were rejected from the data.

The spirometric measurement was performed by a calibrated office spirometer at times when the women were not having any acute respiratory episodes. A reversibility test was performed when FEV_1 was altered and those fully reversible were discarded.

We repeated this in 1995 for cigarette smokers and 100 controls.

Statistical analysis

A descriptive analysis was firstly performed with Excel (Microsoft, Redmond, WA) for the subgroups, including clinical variables and functional variables. The proportion of alteration was calculated for CBH: presence of chronic cough and phlegm for at least three months/year for two years, dyspnea, MMEF, second FEV_1, and FEV_1/FVC%.

The second analysis was, in each pair of subgroups, the relationship among the percentage of alteration of the listed variables had been compared for narguileh and cigarette smokers, according to duration and cumulative quantity smoked.

Student test was performed with the statistical package, STATGRAPHICS 2.2 (StatPoint Inc., Herndon, VA), to determine the significance of differences obtained between different pairs of subgroups of narguileh smokers or cigarettes smokers, either for quantity or for duration (p value).

Results were presented in charts.

Results

The characteristics of our subjects are presented in Table 1. 7% of narguileh smokers are employed, versus 64% of cigarette smokers, and 58% of control. Cigarette smoking is linked with modernization.

Chronic bronchitis is more prevalent in narguileh smokers than cigarette smokers, either for cumulative quantity or for duration. The mean deviation for the quantity is 40 ± 3.8 for cigarette smokers and 58 ± 3.8 for narguileh smokers (p value < 0.001). For duration, the mean deviation is 38 ± 3.81 for cigarette smokers, and 60 ± 3.81 for narguileh smokers (p value < 0.001).

For MMEF, the mean deviation is constant for narguileh smokers, and significantly higher than it is for cigarette smokers, both for quantity and duration (p value < 0.001).

FEV_1/FVC alteration and dyspnea are more presents in cigarette smokers; with a significantly higher degree of obstruction expressed by a greater decrease in FEV_1 in cigarettes smokers, both for quantity and duration ($p < 0.001$).

Alteration of all these variables in control subjects is very low (5%–7%). Our principal results are presented in charts 1, 2, 3, 4, 5, and 6.

Discussion

COPD is defined as a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases (GOLD 2005).

The role of cigarette smoke as chief predominant risk factor for CBH and COPD is established (Sherman 1992; Quartier et al 1993; Desrues et al 1993; Khaled and Joel 1997; Gary et al 2000; GOLD 2005). But narguileh smoking, which is traditional in oriental women, was rarely approached, being considered as safe in the public opinion. Our study was aimed at investigating the chronic respiratory effects of narguileh compared with cigarettes.

Our results show for the first time that narguileh smoking in women provokes significantly more CBH than cigarettes for the same quantity or duration (p value < 0.001). Chronic bronchitis is defined as phlegm and cough during at least three months, and for at least two consecutive years. The definition of CBH is only clinical. FEV_1 and FEV_1/FVC could be normal and their alteration means the occurrence of COPD (Sherman 1992; Quartier et al 1993; Desrues et al 1993; Khaled and Joel 1997; Gary et al 2000; GOLD 2005).

Our results also show a quasi-constant alteration in small airways (2 mm of internal diameter) in narguileh smokers, expressed by MMEF $< 80\%$ of predicted. No former study mentioned this quasi-constant alteration of MMEF 25%–75% in narguileh smokers regardless of cumulative quantity or duration of smoking, as demonstrated by our results, and that is significantly more important than for cigarettes (p value < 0.001). No published data so far can explain this difference, and data on narguileh smoke diffusion and the size of particles are not available.

Although MMEF 25%–75% is not considered either for the diagnosis or for staging of COPD (GOLD 2005), it has been validated to reflect early small airway alteration in current cigarette smokers. It is altered early in the natural history of COPD, especially before FEV_1 (Sherman 1992; West 2000). It is also considered a risk factor for the development of COPD (Poe et al 1982; Sherman1992; Desrues et al 1993; Quartier et al 1993; Gary et al 2000). A Japanese study (Sato and Kio 1997) found that the rate of decline of FEV_1 is greater when MMEF is decreased. Studies even show that after quitting smoking, MMEF will return to normal. (Emmons et al 1992; Sherman 1992; Buist et al 1993).

These arguments could be convincing in advising female narguileh or cigarette smokers to quit, taking into consideration that, until now, the factors responsible for some smokers developing COPD while others do not is still unknown (Sherman 1992; GOLD 2005). We can inform the patient or the smoker that when they present with CBH or an altered MMEF, they should stop smoking as these are risk factors for COPD.

Our results show also that narguilleh smoking causes pulmonary obstruction, but the presence of obstruction, expressed FEV_1/FVC $< 70\%$ of predicted, and its severity, expressed by the percentage of alteration of FEV_1, is higher in cigarette smokers. This is true for either the cumulative quantity smoked, or the duration ($p < 0.001$).

A former study in Saudi Arabia in both sexes showed that in both narguileh and cigarette smokers, the mean value of FEV_1 and FVC was significantly decreased when compared with controls, regardless of sex, and contrary to our results, the risk was in both sexes higher for narguileh (Al-Fayez et al 1980). That could be explained by the fact that the more precise quantification of the cumulative quantity smoked in our study was due to more subgroups. The Saudi study divided narguileh smokers into mild if they smoked only 2 sessions/day, and heavy if they smoked more. They also failed to consider

Table 1 Population characteristics of the three groups

	NgS (n = 77)	CS (n = 77)	NS (n =100)
Mean age ± SD	40.99 ± 12.54	44.84 ± 10.55	39.13 ± 12.898
Domestic	Town 75 (97.5%)	Town 63 (81%)	Town 87(87%)
Profession	Employed 6 (7%)	Employed 50 (64%)	Employed 58 (58%)
Chronic bronchitis	51 (67%)	40 (52%)	5 (5%)
Dyspnea	21 (27%)	40 (52%)	5 (5%)
MMEF < 80%	75 (97%)	68 (88%)	7 (7%)
FEV_1 < 80%	25 (32%)	51 (66%)	6 (6%)

Abbreviations: CS, cigarette smokers; FEV_1, forced expiratory volume in one second; MMEF, ; NgS, narguileh smokers; NS, nonsmokers, control; SD, standard deviation.

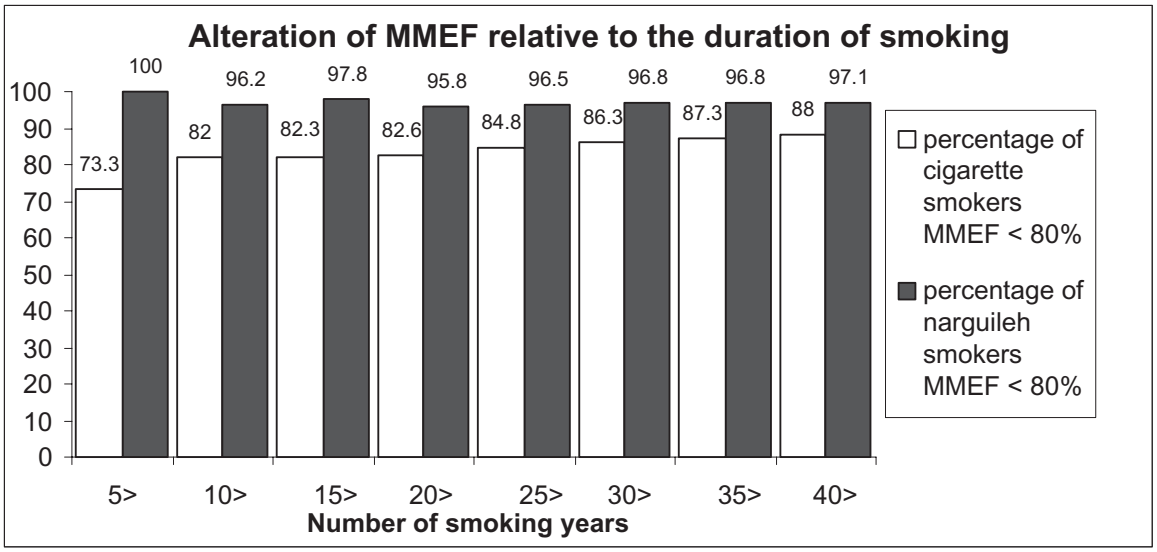

Chart 1 Alteration of MMEF* relative to the duration of smoking by female narguileh smokers versus cigarette smokers.
Note: The percentage of abnormal MMEF among narguileh smokers is independent of time, and at all times greater than the percentage among cigarette smokers. Value: $p < 0.001$. The percentage of abnormal MMEF was 7% for the control nonsmoking group.
Abbreviation: MMEF, maximum mid-expiratory flow.

those who smoke narguileh only a few times per week. For cigarettes, they considered two categories of smokers: heavy if more than 20 cigarettes/day, and light smokers if less.

We will also remark that they used jurak and we used pure domestic tombac; the influence of these two brands in the pathogenesis of airflow limitation has not been investigated yet. However, our two studies confirm the role of narguileh smoke in airways obstruction.

Other former regional studies about narguileh showed:

- Narguileh or goza smoking decreases the oxygen saturation in arterial blood more than cigarette smoking, which was considered to be due to the presence of a higher

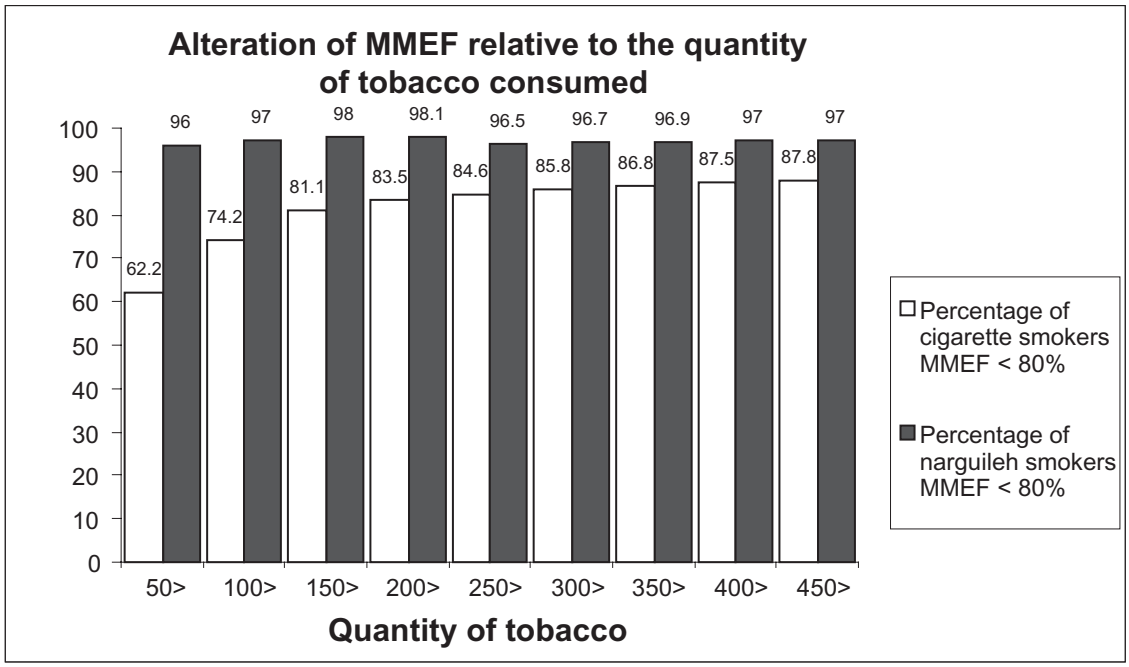

Chart 2 Alteration of MMEF relative to the quantity of tobacco smoked by female narguileh smokers versus cigarette smokers.
Notes: For narguileh smokers the percentage of abnormal MMEF is practically constant and independent of quantity. Again the percentage for narguileh smokers is "always" higher than for cigarette smokers (p value <0.001).
Abbreviation: MMEF, maximum mid-expiratory flow.

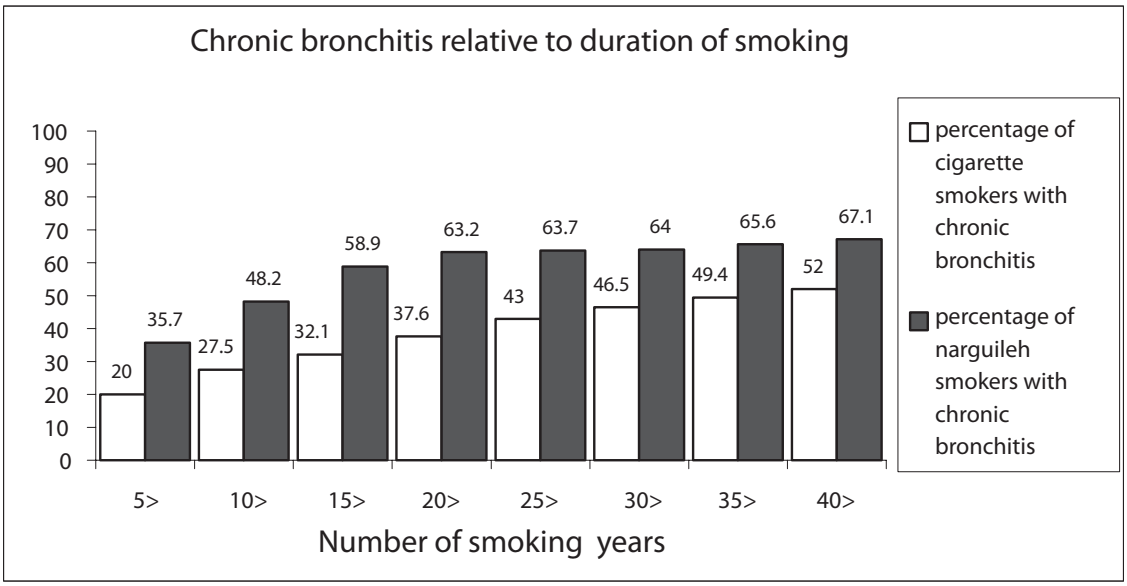

Chart 3 Chronic bronchitis relative to the duration of smoking by female narguileh smokers versus cigarette smokers.
Notes: The percentage of chronic bronchitis among narguileh smokers is greater at all times than that among cigarette smokers (p value <0.001) with Student t-test. The percentage of chronic bronchitis was 5% in the control nonsmokinggroup.

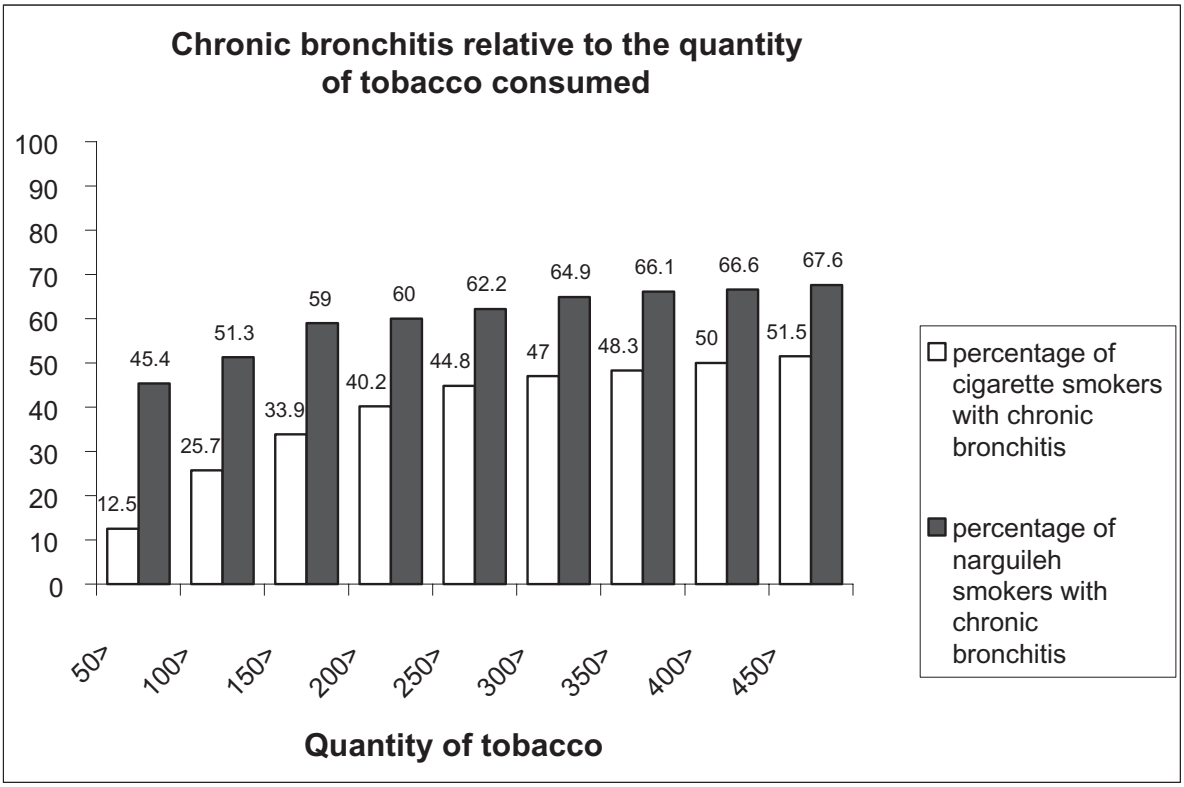

Chart 4 Chronic bronchitis relative to the quantity smoked by female narguileh smokers versus cigarette smokers.
Notes: For all quantity values, the percentage in narguileh smokers is higher than the one in cigarette smokers (p value = 0.001).

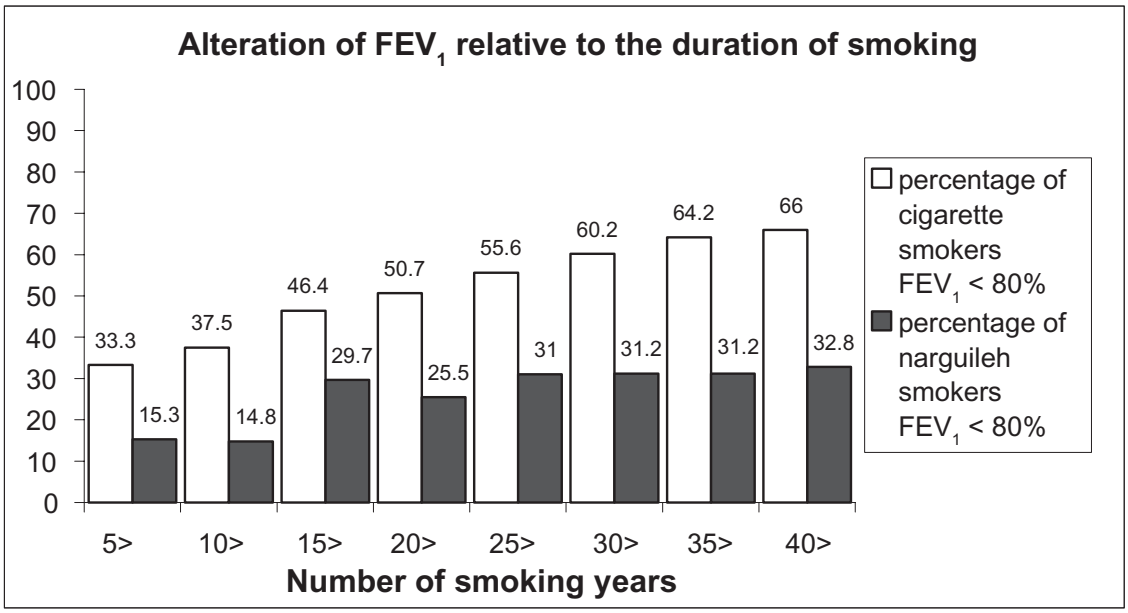

Chart 5 FEV_1 alteration relative to smoking duration in female narguileh smokers versus cigarette smokers.
Notes: In this graph the proportion of altered FEV_1, for cigarette smokers is always higher than for narguileh smokers (p value <0.001). For the control group the percentage of abnormal FEV_1 was 6%.
Abbreviation: FEV_1, forced expiratory volume in one second.

quantity of carbon monoxide in narguileh smoke (Zahran et al 1985).

- Narguileh smoking plays a role in transmitting respiratory infections, especially tuberculosis, by passing the tube from person to person, although it has a less carcinogenic effect (Omar and Salem 1996; Srinath 1996).
- Low birth-weight was also documented in children of narguileh smoking women (Nuwayhid et al 1998).

Our study was limited by the following factors:

- However we perform the quantification of cumulative quantity smoked for naguileh, our process will remain open to criticism because it is very hard to record the

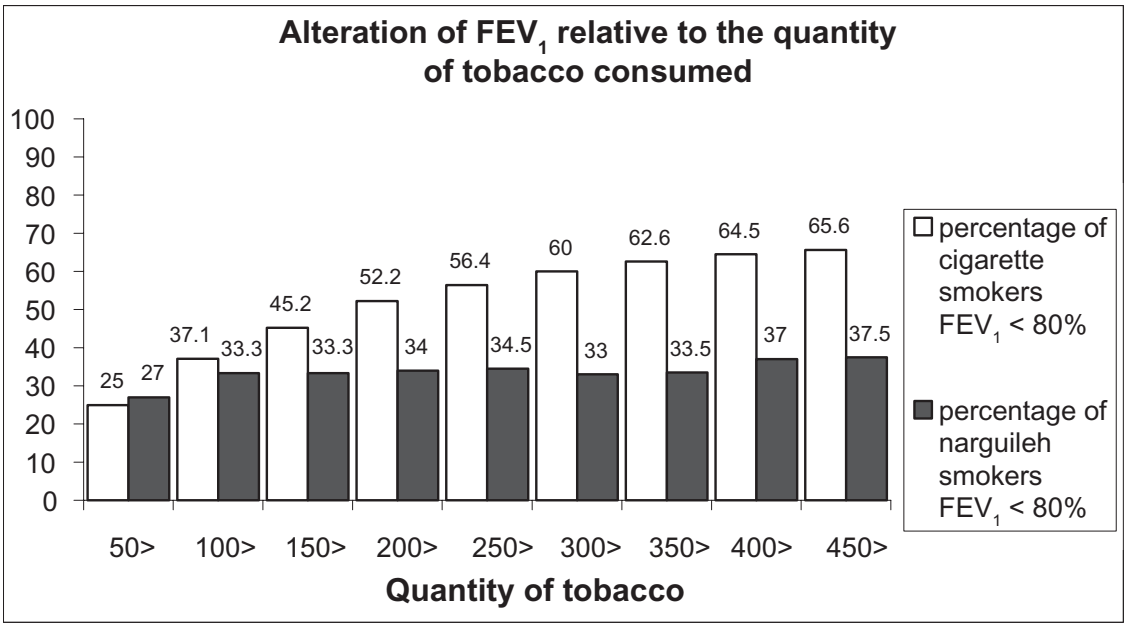

Chart 6 Alteration of FEV_1 relative to the quantity smoked in women narguileh smokers versus cigarette smokers.
Notes: The graph for cigarette smokers shows the same behavior as in the last duration diagram, the percentage of abnormal FEV_1 augment with the cumulative quantity smoked. The percentage in narguileh smokers is approximately stable for all quantities. The two percentages start almost equal but the percentage then becomes greater in cigarette smokers than it is in narguileh smokers for all quantities ($p < 0.001$).
Abbreviation: FEV_1, forced expiratory volume in one second.

effects of passing the narguileh buccal tube from one person to the other during the session, and measure the time that women take to chat while smoking narguileh. To overcome this, we divided the quantity smoked during one session by the number of women sharing it.

- Another bias that we did not consider is passive smoking (Xu and Li 1995).
- As with the Saudi study (Al-Fayez et al 1980), the functional standard values used are for Caucasians. We lack standard values for our population.

Nonetheless, we feel that these factors are unimportant because the aim of our study was to highlight the underestimated danger of the traditional pattern of smoking narguileh among women.

Pathological changes characteristic of COPD are found in the central airways, peripheral or small airways <2 mm of internal diameter, lung parenchyma, and pulmonary vasculature. Reversible components, which appear early, include edema, accumulation of inflammatory cells, mucus hyper secretion, and smooth muscle contraction. Further exposure to tobacco smoke can induce, irreversible tissue damage, tissue remodeling, and fixed airway obstruction expressed by the decrease in FEV_1/FVC ratio and FEV_1 alteration in some individuals. Components of this irreversible fixed obstruction are also the loss of parenchmal attachment and of elastic recoil, but small airways fibrosis and narrowing play the major role (GOLD 2005).

Could the reversibility of MMEF alteration after quitting smoking reflect the above mentioned transient reversible pathological changes? And why does narguileh smoke provoke higher proportions of CBH and MMEF reduction? What are the pathogenetical mechanisms responsible for some patients at risk for COPD because their CBH and MEEF alteration may develop COPD and not others? Clearly, further research is needed.

Women share narguileh sessions in closed places, at their homes, and chronic respiratory symptoms provoked by this environmental tobacco-smoke in children is another potential area for research (US Surgeon General 2006).

Conclusion

Our results illustrate the need to change the public opinion on narguileh, and to encourage antitobacco campaigns. Both narguileh and cigarette smoking is harmful, but special attention toward narguileh smoking is recommended in our region because women traditionally smoke together in closed places with children around. This is a problem of indoor environmental tobacco smoke. This study has been considered by the health ministry in Syria to involve the harm of narguileh smoke in the National Program of Anti-Tobacco Campaign in Syria.

When performing spirometry with a smoker, it provides one with the opportunity to convince them to quit (Gary et al 2000). The following arguments could be convincing: quitting may provide a chance for the altered MMEF to return to normal (Teculescu et al 1989; Emmons et al 1992; Buist et al 1994) and prevent a potential obstruction if FEV_1 is still normal, or to reduce the annual decline of FEV_1 if this value had been already altered (Camilli et al 1987; Hugues et al 1987; Emmons et al 1992; US Surgeon General 1994). These are part of the recommendations of the National Lung Health Education Program in the USA, and are true for both cigarettes and narguileh, especially when we know that obstruction can precede symptoms by several years in some cases.

Acknowledgments

I am grateful to Dr. Jean Francois Tessier, INSERM Bordeaux, France, for his advice in the preparation of this manuscript. The authors report no conflicts of interest.

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