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Narghile (Hubble-Bubble) Smoking, Low Birth Weight, and Other Pregnancy Outcomes

Iman A. Nuwayhid,[1] Bassem Yamout,[2] Ghassan Azar,[2] and Mona Al Kouatly Kambris[1]

Narghile smoking, a common habit among women in many non-Western societies, is assumed by the public to be minimally harmful. This study aims at identifying the effect of smoking narghiles during pregnancy on the weight of the newborn and other pregnancy outcomes. Three groups of pregnant women were interviewed in several hospitals in Lebanon between 1993 and 1995: 106 who smoked narghiles during their pregnancy, 277 who smoked cigarettes, and 512 who did not smoke. The adjusted mean birth weight of babies born to women who smoked one or more narghiles a day during pregnancy and to women who started smoking in the first trimester was more than 100 g less than that of babies born to nonsmokers ($p < 0.1$). The adjusted odds ratio of having babies with low birth weight (<2,500 g) among the narghile smokers was 1.89 (95% confidence interval (CI) 0.67–5.38). The risk increased to 2.62 (95% CI 0.90–7.66) among those who started smoking narghiles in the first trimester. A stronger association and a dose-response relation were found among cigarette smokers. The association between narghile smoking and other pregnancy outcomes, especially Apgar score and respiratory distress, was also noticeable. Further research and a policy action to fight the misperception that narghile smoking is safe are both recommended. *Am J Epidemiol* 1998;148:375–83.

infant, low birth weight; pregnancy; smoking

The association among cigarette smoking, low birth weight, and other pregnancy outcomes has been documented in several studies (1–4). It is now accepted that the weight of babies born to mothers who smoke cigarettes during their pregnancy is at least 150–400 g less than that of babies born to nonsmoking mothers (1–4), thereby increasing the proportion of newborns under the low birth weight limit of 2,500 g (1, 2, 4). Moreover, a dose-response relation between cigarette smoking and low birth weight has been reported (1, 2), with some even suggesting 15 cigarettes per day as a threshold dose (1). The association between cigarette smoking and other pregnancy outcomes such as placenta abruptio, premature labor, placenta previa, and strabismus has also been reported (5, 6). These associations have not been studied for all types of tobacco smoking, such as narghile smoking.

Narghile smoking, also known as water-pipe, shisha, hookah, or hubble-bubble smoking, is common among the men and women of several non-Western countries. The tobacco is placed on a tray situated on a bottle half-filled with water. A tube stemming from the tray is submerged under the water. The tobacco is burnt directly by a piece of charcoal, and the smoke passes through the water before being inhaled through a long flexible tube attached to the bottle. In some societies, narghile smoking is preferred to cigarette smoking and is more socially acceptable for women. It is reported that 11 percent of Egyptian men and women smoke narghiles (7). A household survey of 1,217 individuals aged 18–95 years and living in Beirut, Lebanon, in 1993–1994 revealed that 12 percent of men and 13 percent of women smoked narghiles with or without cigarette smoking (8). Narghile smoking is also common in the Arabian peninsula, Turkey, India, Pakistan, Bangladesh, and some regions of China (9–13).

Earlier studies have reported an association between narghile smoking and oral cancer (9), esophageal and gastric carcinoma (10), lung cancer (11), increased cadmium in hair and nails (12), reduced pulmonary function (14), and decreased fertility (15). Furthermore, when compared with cigarette smokers and nonsmokers, narghile smokers were found to have a higher carboxyhemoglobin level (13). However, to the public and many health professionals, smoking narghiles is perceived as being less harmful than cig-

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Abbreviations: CI, confidence interval; OR, odds ratio; SD, standard deviation.

[1] Faculty of Health Sciences, American University of Beirut, Beirut, Lebanon.
[2] Faculty of Medicine, American University of Beirut, Beirut, Lebanon.
Reprint requests to Dr. Iman Nuwayhid, American University of Beirut, c/o 850 Third Avenue, New York, NY 10022.

arette smoking or even not harmful based on the presumption that the inhaled smoke is filtered through water. An online search of MEDLINE from 1966 to 1996 revealed no articles on the effects of narghile smoking on pregnancy outcomes. To our knowledge, this study represents the first such attempt. It aims at identifying the effect of smoking narghiles during pregnancy on the weight of newborn infants and other pregnancy outcomes and compares it with that of cigarette smoking.

MATERIALS AND METHODS

Study population

The study population included a sample of pregnant women delivering in hospitals in Lebanon. Three groups of women were targeted according to their exposure status during pregnancy: nonsmokers, narghile smokers, and cigarette smokers. Only singletons, live births, and those that completed 28 weeks of gestation were eligible for the study. A total of 913 women, all married, were interviewed. Of these, 18 were excluded for incompleteness of data, leaving a total of 106 women who smoked narghiles during their pregnancy, 254 women who smoked cigarettes, 23 women who smoked both cigarettes and narghiles, and 512 women who did not smoke at all during their pregnancy. Women who stopped smoking before getting pregnant were considered nonsmokers.

Fieldwork and data collection were completed in two phases. The first was conducted in early 1993, whereby a sample of 33 narghile smokers, 152 cigarette smokers, 10 cigarette and narghile smokers, and 167 nonsmokers were interviewed from hospitals in different regions of the country. The slow enrollment rate for narghile smokers in some hospitals called for a hiatus in the study, which resumed in May 1994 after introducing a few amendments to the questionnaire. The second phase focused on a fewer number of hospitals where women who smoked narghiles were more likely to be identified. In the second phase of the study and over a period of 12 months, pregnant cigarette smokers and nonsmokers were interviewed at a steady rate from the different hospitals, while narghile smokers were interviewed as they showed up. A total of 73 narghile smokers, 102 cigarette smokers, 13 cigarette and narghile smokers, and 345 nonsmokers were interviewed.

Data collection

Because of the extended period of the study and the geographic spread of the hospitals, more than 10 interviewers were involved in data collection. Interviewers were adequately trained, and women were interviewed after obtaining their consent and the permission of the hospital administration. After their smoking habits were identified, women were informed of the study goal to determine the factors leading to successful pregnancy and birth. The response rate exceeded 90 percent in all three categories of smoking behavior. The questionnaire inquired about the mother's age, weeks of pregnancy, pregnancy history, weight of previous babies, smoking habits before and during pregnancy, and exposure to passive smoking, different illnesses, trauma, and intake of medications during pregnancy. The interviewer then abstracted, with the help of the attending physician or nurse-in-charge, the following information from the medical record of the newborn: weeks of pregnancy, weight, 1-minute and 5-minute Apgar scores, head circumference, type of delivery, and presence of meconium, respiratory distress, or malformation. Information on prenatal visits, father's height, prepregnancy weight, and placenta abruptio was asked for only in the second phase. The number of cigarettes and narghiles smoked per day was recorded in precoded categories in the first phase and as a continuous variable in the second. The data were edited, entered twice on a computer, and then manually checked for errors.

Analytical variables

The main outcome of interest was the weight of the newborn. Low birth weight was defined as weight of a newborn less than 2,500 g. Other pregnancy outcomes, including head circumference of the baby, presence of meconium, type of delivery, Apgar scores, presence of malformation, and perinatal complications, were also abstracted. The quality of medical records varied widely among hospitals. In a few cases, even the basic information, such as the birth weight, was not recorded and consequently was missing from our data.

The main exposure of interest was smoking. Women were asked about their smoking habits during pregnancy. Nonsmokers were asked whether they smoked before and, if so, when they stopped smoking. Smokers were asked about the type and quantity of their smoking and the trimester they started smoking. Those who smoked both cigarettes and narghiles were found to be similar to those who smoked cigarettes only; hence, this group ($n = 23$) was lumped with cigarette smokers. The number of cigarettes smoked was either collected as or collapsed into a categorical variable (1–5, 6–10, 11–20, >20 cigarettes per day). The same applied for the number of narghiles smoked (<1, 1, and >1 narghiles per day). None smoked pipe or cigar.

Covariates included the age of the mother, weeks of pregnancy, trimester of first prenatal visit (none, first, second, third), number of children, birth order (first,

second-third, fourth or more), number of pregnancies, number of miscarriages, previous children with low birth weight, the hospital's location (Beirut, South, North), height and weight of mother, exposure to passive smoking (husband's or colleague's smoking), and trauma, illnesses, intake of medications, or intake of alcohol during pregnancy. Illnesses included infections, cardiac problems, chronic hypertension, diabetes, gland disorders, preeclampsia, and anemia. Gestational age (weeks of pregnancy) was abstracted from the medical record of the newborn; where absent, the variable was abstracted from the mother's questionnaire. More than 80 percent of the women received supplements of iron and vitamins alone or with other medications such as antibiotics, steroids, tocolytics, or progesterone. Hence, the intake of medications was categorized into three groups: no medications, intake of supplements alone, and intake of other medications with or without supplements.

Data analysis

Analysis was performed on the total sample of 895 women (106 narghile smokers, 277 cigarette smokers, and 512 nonsmokers). A few variables, such as prenatal visits, previous smoking, and height and weight, were limited to the second phase's questionnaire and were analyzed for that group only. Missing values were treated as such with no attempt to fill in replacement values.

Nonsmokers were separately compared with cigarette smokers and narghile smokers. The birth weight of the newborns, the proportion of low birth weight, and other pregnancy outcomes were assessed by the quantity of smoking and the trimester smoking started. Student's t test was used to compare continuous variables, whereas chi-square analysis was used to compare categorical variables. Statistical significance was set at $p < 0.05$. Odds ratios and 95 percent confidence intervals were computed. Multiple linear regression and logistic regression analyses were used to assess the independent effect of smoking narghiles and smoking cigarettes on the mean birth weight of the newborn and the presence of low birth weight, respectively. The covariates adjusted for were risk factors for low birth weight in this sample or were reported to be so in the literature. Gestational age was included in linear and quadratic forms. This had no effect on the beta estimates of the exposure of interest; hence, the linear form is presented. Odds ratios and 95 percent confidence intervals were computed using the logistic regression model, while adjusted mean birth weights were estimated from the multiple linear regression. Data were analyzed using SPSS for Windows (16).

RESULTS

General characteristics

The 895 pregnant women were distributed over 36 hospitals, five of which contributed 60 percent of the study sample. A total of 50 narghile smokers (47.2 percent) and 109 cigarette smokers (39.3 percent) were interviewed in hospitals outside Beirut as compared with 138 (27.6 percent) of the nonsmoking group ($p < 0.001$, both comparisons) (table 1).

Sixty-seven of the 106 narghile smokers (63.2 percent) smoked one or more narghiles a day, and 123 of the 274 cigarette smokers (44.9 percent) smoked 11 or more cigarettes a day (table 1). More than three fourths of each group smoked in the first trimester.

No statistically significant differences were noted between the nonsmokers and the narghile smokers regarding gestational period, age, birth order of newborn, regularity of prenatal visits, number of previous pregnancies, number of miscarriages, previous pregnancy history, previous low birth weight babies, intake of alcohol during pregnancy, presence of preeclampsia, intake of medications, or exposure to trauma during pregnancy (table 1). No differences were noted regarding the presence of cardiac problems, chronic hypertension, diabetes, or gland disorders. However, a higher proportion of women in the narghile-smoking group, as compared with the nonsmokers, reported anemia ($p < 0.07$), infections ($p < 0.02$), and exposure to passive smoking ($p < 0.04$) during their pregnancy (table 1).

In contrast, more differences were noted between women in the nonsmoking and the cigarette-smoking groups. Among the cigarette-smoking group, the gestational period was shorter ($p < 0.001$), and the number of previous pregnancies was higher ($p < 0.001$) as were the number of previous miscarriages ($p < 0.001$) and the number of previous low birth weight babies ($p < 0.09$). A higher proportion of cigarette-smoking women reported being exposed to passive smoking ($p < 0.001$), suffering from infections ($p < 0.001$), and taking medications ($p < 0.001$) during their pregnancy. A lower proportion of women in the cigarette-smoking group had regular prenatal visits ($p < 0.02$).

No statistically significant differences were noted between each of the narghile- and cigarette-smoking groups and the nonsmoking group regarding consanguinity, height and prepregnancy weight of the mother, height of the father, and time of the first prenatal visit (data not shown).

Mean birth weight

The unadjusted mean birth weight of babies born to nonsmoking women was 3.32 (standard deviation

TABLE 1. Background characteristics of nonsmoking, cigarette-smoking, and narghile-smoking pregnant women delivering in hospitals in Lebanon, 1993–1995

	Nonsmokers (n = 512) (A)		Narghile smokers (n = 106) (B)		Cigarette smokers (n = 277) (C)		p value*	
	%	No.	%	No.	%	No.	B:A	C:A
Mean age (years)	28.46 (5.61)†	498	27.55 (5.19)	106	29.08 (5.16)	276	0.12	0.13
No. of cigarettes smoked/day						274		
1–4					22.6			
5–10					32.5			
11–20					24.8			
>20					20.1			
No. of narghiles smoked/day				106				
<1			36.8					
≥1			63.2					
Mean gestation (weeks)	39.09 (1.67)	494	38.85 (2.00)	105	38.46 (2.49)	274	0.18	0.00
Birth order of newborn		512		106		277		
First	23.2		18.9		13.0		0.26	0.00
Second-third	31.6		27.4		26.7			
Fourth or more	45.1		53.8		60.3			
Regular prenatal visits	84.5	349	87.8	74	78.3	117	0.56	0.02
Mean no. of previous pregnancies	2.52 (2.15)	512	2.68 (1.96)	106	3.27 (2.33)	277	0.47	0.00
Mean no. of miscarriages	0.54 (0.86)	392	0.51 (0.80)	78	0.96 (1.20)	183	0.81	0.00
Previous pregnancy history		512		106		277		
None (first baby)	23.2		18.9		13.0		0.78	0.00
Yes + no losses	36.3		37.7		24.9			
Yes + losses	26.6		27.4		38.3			
Yes + unknown losses	13.9		16.0		23.8			
Any previous baby <2,500 g		512		106		277		
Yes	4.1		3.8		7.2		0.99	0.09
No	91.2		91.5		89.9			
Unknown	4.7		4.7		2.9			
Passive smoking‡	87.1	466	94.2	104	94.1	273	0.04	0.00
Alcohol intake during pregnancy	5.4	498	1.9	106	8.4	273	0.12	0.11
Trauma during pregnancy	15.7	502	21.7	106	19.3	275	0.14	0.21
Infections during pregnancy	14.6	512	23.6	106	23.8	277	0.02	0.00
Anemia during pregnancy	4.9	512	9.4	105	5.8	277	0.07	0.59
Preeclampsia during pregnancy	4.3	512	7.6	105	4.7	277	0.15	0.79
Intake of medications during pregnancy		480		100		263		
None	18.3		12.0		24.7		0.29	0.00
Supplements§	62.7		66.0		47.9			
Other + supplements§	19.0		22.0		27.4			
Hospital of delivery		501		106		277		
Beirut	72.5		52.8		60.6		0.00	0.00
South	16.2		32.1		20.2			
North	11.4		15.1		19.1			

* Using Student's t test comparing each smoking group separately with nonsmokers.
† Numbers in parentheses, standard deviation.
‡ Exposure to smokers at home or at work.
§ Supplements include iron and vitamins; other includes medications such as antibiotics, steroids, or tocolytics.

(SD), 0.49) kg. It was higher than that of babies born to women smoking narghiles (3.25 (SD, 0.61) kg, $p < 0.24$) and of babies born to women smoking cigarettes (3.15 (SD, 0.62) kg, $p < 0.001$) (table 2). The mean birth weight of newborns decreased gradually with the increase in the number of cigarettes smoked per day (p for trend < 0.001). Such a trend was not noted among babies born to women smoking narghiles. However, the weight of babies born to women who smoked more than one narghile a day decreased to 3.20 (SD, 0.60) kg and was of borderline statistical significance when compared with that of babies born to nonsmokers ($p < 0.10$). The mean birth weight of babies born to women who started smoking narghiles (3.19 (SD, 0.66) kg) or cigarettes (3.11 (SD, 0.63) kg) in the first trimester was significantly less than that of babies born to women who did not smoke (3.32 (SD, 0.49) kg) during their pregnancy ($p < 0.05$, both comparisons) (table 2).

When adjusted for other covariates, the mean birth weight of babies born to narghile-smoking women was 40 g less than that of babies born to nonsmokers (table 3). The reduction in the adjusted mean birth weight increased to 110 g among women who smoked one narghile or more a day ($p < 0.1$) and to 120 g among women who started smoking narghiles in the first trimester ($p < 0.1$). The reduction in the adjusted mean birth weight of babies born to women smoking cigarettes was more pronounced (table 3). Again, the reduction was most striking among women smoking more than 20 cigarettes (−300 g, $p < 0.001$) and women who started smoking cigarettes in the first trimester (−160 g, $p < 0.001$).

Low birth weight

In the study sample, the risk of low birth weight increased about 18 times among women with a history of previous low birth weight babies (odds ratio (OR) = 17.78, 95 percent confidence interval (CI) 8.56–37.00) and about six times among women exposed to passive smoking (OR = 5.82, 95 percent CI 0.97–237.11), as compared with women with no previous low birth weight babies and no exposure to

TABLE 2. Birth weight of newborns and proportion of low birth weight by smoking status among women delivering in hospitals in Lebanon, 1993–1995

Smoking status	No. of women	Birth weight (kg)		Low birth weight		
		Mean	SD†	No.	%	95% CI†
Overall						
Nonsmoker	512	3.32	0.49	22	4.3	2.5 to 6.1
Narghile smoker	106	3.25	0.61	8	7.5	2.5 to 12.5
Cigarette smoker	277	3.15	0.62***	28	10.1	6.6 to 13.6***
Quantity of smoking						
Narghile smoker						
Nonsmoker	512	3.32	0.49	22	4.3	2.5 to 6.1
<1/day	38	3.36	0.63	3	7.9	−0.7 to 16.5
≥1/day	67	3.20	0.60*	5	7.5	1.2 to 13.8
Test for linear trend		$p < 0.12$			$p < 0.18$	
Cigarette smoker						
Nonsmoker	512	3.32	0.49	22	4.3	2.5 to 6.1
1–4 cigarettes/day	62	3.31	0.46	2	3.2	−1.2 to 7.6
5–10 cigarettes/day	89	3.21	0.58*	6	6.7	1.5 to 11.9
11–20 cigarettes/day	68	3.13	0.53***	8	11.8	4.1 to 19.5**
>20 cigarettes/day	55	2.89	0.83***	12	21.8	16.9 to 26.7***
Test for linear trend		$p < 0.00$			$p < 0.00$	
Trimester smoking started						
Narghile smoker						
Nonsmoker	512	3.32	0.49	22	4.3	2.5 to 6.1
Second or third trimester	25	3.38	0.37	0		
First trimester	78	3.19	0.66**	8	10.3	3.6 to 17.0**
Cigarette smoker						
Nonsmoker	512	3.32	0.49	22	4.3	2.5 to 6.1
Second or third trimester	54	3.28	0.53	2	3.7	1.3 to 8.7
First trimester	214	3.11	0.63***	25	11.7	7.4 to 16.0***

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$ (compared with nonsmokers).
† SD, standard deviation; CI, confidence interval.

TABLE 3. Adjusted odds ratios of low birth weight and adjusted mean birth weight by type and amount of smoking during pregnancy and trimester started among women delivering in hospitals in Lebanon, 1993–1995

	Adjusted OR*	Adjusted mean birth weight (kg)†
Narghile smokers vs. nonsmokers		
Nonsmokers	1.00 (Reference)	3.34 (3.26–3.42)‡
All narghile smokers	2.17 (0.74–6.33)	3.30 (3.22–3.38)
Smoked <1 narghile/day	2.36 (0.52–10.73)	3.34 (3.26–3.42)
Smoked ≥1 narghile/day	2.07 (0.54–7.94)	3.23 (3.15–3.31)
Started smoking first trimester	2.93 (0.97–8.83)	3.22 (3.14–3.30)
Started smoking second/third trimester	Undefined	3.27 (3.20–3.36)
Cigarette smokers vs. nonsmokers		
Nonsmokers	1.00 (Reference)	3.32 (3.24–3.39)
All cigarette smokers	2.00 (0.96–4.20)	3.20 (3.12–3.27)
Smoked 1–4 cigarettes/day	1.22 (0.26–5.76)	3.27 (3.20–3.34)
Smoked 5–10 cigarettes/day	1.29 (0.39–4.20)	3.24 (3.16–3.31)
Smoked 11–20 cigarettes/day	1.88 (0.62–5.75)	3.23 (3.15–3.30)
Smoked >20 cigarettes/day	4.56 (1.62–12.89)	3.02 (2.93–3.10)
Started smoking first trimester	2.25 (1.04–4.86)	3.16 (3.09–3.23)
Started smoking second/third trimester	1.24 (0.27–5.78)	3.29 (3.22–3.36)

* OR, odds ratio (adjusted, using logistic regression, for previous low birth weight, passive smoking, age, location of hospital, and gestational period).
† Adjusted, using multiple linear regression, for previous low birth weight, passive smoking, age, location of hospital, and gestational period.
‡ Numbers in parentheses, 95% confidence interval.

passive smoking, respectively. The mean gestational age for low birth weight babies was 36.06 (SD, 3.71) weeks, significantly lower than that of babies weighing 2.5 kg or more (39.05 (SD, 1.71) weeks, $p < 0.00$).

A total of 22 babies of 512 born to nonsmoking women (4.3 percent, 95 percent CI 2.5–6.1) weighed less than 2.5 kg as compared with 8 of 106 babies born to narghile-smoking women (7.5 percent, 95 percent CI 2.5–12.5) and 28 of 277 babies born to cigarette-smoking women (10.1 percent, 95 percent CI 6.6–13.6). The proportion of low birth weight babies did not change with the number of narghiles smoked per day (p for trend < 0.18) but gradually increased with the number of cigarettes smoked per day ($p < 0.001$) (table 2). All low birth weight babies born to women who smoked narghiles were born to those who smoked them in the first trimester of their pregnancy ($n = 8$, 10.3 percent). This was significantly higher than the proportion of low birth weight babies among nonsmokers ($p < 0.05$). The proportion of low birth weight babies among women who smoked cigarettes only in the second or third trimesters did not differ much from that among nonsmokers, while it increased by 2.5 times for those smoking cigarettes in the first trimester ($p < 0.01$).

Table 3 reports adjusted odds ratios and 95 percent confidence intervals. The overall risk of low birth weight babies among narghile smokers, when adjusted for previous low birth weight babies, exposure to passive smoking, location of the hospital, age of mother, and gestational age, more than doubled as compared with that among nonsmokers (95 percent CI 0.74–6.33). Similar results were noted for those smoking less than one or one or more narghiles a day. The adjusted risk of low birth weight among babies born to women who started smoking narghiles in the first trimester was 2.93 times (95 percent CI 0.97–8.83) more than that among babies born to women who did not smoke during their pregnancy.

The overall adjusted risk of having low birth weight babies among cigarette smokers doubled (OR = 2.00, 95 percent CI 0.96–4.20) when compared with that of nonsmokers (table 3). The odds of having a low birth weight baby gradually increased with the increase in the number of cigarettes smoked per day; the odds ratio among those who smoked more than 20 cigarettes a day was 4.56 (95 percent CI 1.62–12.89) as compared with that among nonsmokers. As for the trimester when cigarette smoking started, it was noted that the risk of low birth weight babies was 2.25 times more among those who started smoking in the first semester as compared with that of nonsmokers (95 percent CI 1.04–4.86). No significant increase in risk was noticed among those who started smoking cigarettes in the second or third trimesters (table 3).

Other pregnancy outcomes

Table 4 presents the results for other pregnancy outcomes. The adjusted risk of having a mean Apgar score at 1 minute or 5 minutes of less than seven, pulmonary problems, malformations (e.g., cardiac, hip, hydrocephalus), or perinatal complications (e.g., jaundice, respiratory, cord prolapse) increased among babies born to narghile and cigarette smokers when compared with that among babies born to nonsmokers. The risk was consistently highest among narghile smokers, especially for the presence of pulmonary problems where the odds ratio of having a baby with such problems was 3.65 (95 percent CI 1.52–8.75). No statistically significant differences, however, were detected among babies born to women in any of the three groups regarding the head circumference of the newborn, presence of placenta abruptio, delivery by cesarean section, or presence of meconium.

DISCUSSION

To date, the health effects of narghile smoking have not been sufficiently investigated. The lack of such studies could be explained by the following reasons: 1) narghile smoking is prevalent only in non-Western societies; hence, it was not investigated in due time; 2) the habit of narghile smoking, in particular among women, is only recently becoming widespread in such societies; and 3), most importantly, it is rather difficult to measure the pure effect of narghile smoking because most narghile smokers are current or former cigarette smokers.

The study of pregnancy outcomes among narghile smokers provides an almost unique exception. The outcome is clear and the follow-up period is limited to that of gestation. Hence, the exposure of interest, narghile smoking, could be discerned separately from other types of tobacco smoking.

The findings of the present study suggest that smoking one or more narghiles a day during pregnancy or smoking narghiles in the first trimester is associated with at least a 100-g reduction in the adjusted mean birth weight ($p < 0.1$). The impact of narghile smoking during pregnancy, however, is more clearly associated with an increase in the proportion of low birth weight babies and in other ill-pregnancy outcomes. The risk of delivering low birth weight babies almost tripled among those who smoked narghiles in the first semester (OR = 2.62, 95 percent CI 0.90–7.66) after adjusting for other risk factors. In addition, babies born to women who smoked narghiles during pregnancy had a higher proportion of other problems, such as a lower Apgar score and an increase in pulmonary problems at birth.

TABLE 4. Occurrence of selected pregnancy outcomes and adjusted odds ratios by smoking status among women delivering in hospitals in Lebanon, 1993–1995

	Nonsmokers (n = 512) (A)		Narghile smokers (n = 106) (B)		Cigarette smokers (n = 277) (C)		B:A		C:A	
	Mean	No.	Mean	No.	Mean	No.	Adjusted OR†	95% CI†	Adjusted OR	95% CI
Apgar score at 1 minute‡	7.87 (1.13)§	427	7.63 (1.21)*	85	7.59 (1.25)***	225	1.73	0.73–4.14	1.59	0.82–3.07
Apgar score at 5 minutes‡	9.39 (0.78)	452	9.10 (1.11)***	92	9.19 (0.91)***	218	3.39	0.54–21.42	2.62	0.56–12.29
Presence of pulmonary problems (%)	2.8	505	11.4***	105	6.9***	275	3.65***	1.52–8.75	1.76	0.80–3.87
Presence of malformation (%)	1.8	507	4.8*	104	2.6**	270	2.01	0.59–6.88	1.36	0.49–3.80
Presence of perinatal complications (%)	7.5	506	12.6*	103	12.5**	271	1.67	0.82–3.41	1.50	0.87–2.57

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$ (compared with nonsmokers).
† OR, odds ratio (adjusted for previous low birth weight, passive smoking, age, location of hospitals, and gestational period); CI, confidence interval.
‡ Cutoff point for dichotomous variable (1–6 vs. 7–10).
§ Numbers in parentheses, standard deviation.

The direction of the associations between cigarette smoking and birth weight and other pregnancy outcomes, shown in this study, was in accordance with the literature. On the average, babies born to women who smoked cigarettes during their pregnancy were 120 g lighter than those born to nonsmokers. However, the decrease in birth weight is lower than what is reported in the literature (mostly 200–300 g) (1–4). If the underestimated positive association between cigarette smoking and low birth weight in this study applies to the narghile smokers as well, then this will probably mean that the true proportion of low birth weight among women who smoke narghiles during pregnancy is higher than is reported in the present study.

A clear dose-response relation was noted between low birth weight and cigarette smoking. The proportion of low birth weight babies more than doubled among all cigarette smokers (10.5 percent) and quadrupled among those who smoked more than 20 cigarettes a day (21.8 percent). The positive dose-response relation between low birth weight and cigarette smoking in the study sample is in accordance with the literature. This adds to the internal validity of the data obtained on narghile smoking in the present study.

The study sample was limited to women delivering in hospitals. In Lebanon, more than 90 percent of the deliveries occur in hospitals, rendering it a minor limitation. Due to the relative scarcity and the slow rate of inclusion of pregnant narghile smokers, the study was completed in two phases. The consistent findings observed in both phases justified the combination of the data from both phases. However, the overall small sample size of the narghile smokers remains the major limitation of the study. This could explain the wide confidence intervals obtained and the lack of statistically significant findings, although there was a consistent increase in the risk of pregnancy outcomes among narghile smokers as compared with nonsmokers. In addition, no information was available on the socioeconomic background of the women. Differences in education or occupation could have affected the findings in either direction. However, other variables such as the number of children, the location of the hospital, the regularity of prenatal visits, and the trimester the first prenatal visit was made might reflect the path through which the socioeconomic background could have acted.

Other limitations may have reflected on the quality of collected data. The slow enrollment of narghile smokers entailed the periodic need for new interviewers. In spite of basic similar training for all interviewers, the quality of interviewing and data collected could not be fully standardized, especially in the presence of poor medical records in some hospitals. Nevertheless, there is no reason to believe that the interviewing, quality of medical records, or data abstraction varied by exposure status. Second, information on exposure to narghile and cigarette smoking (type, amount, trimester started) was collected from the women retrospectively after delivery. The pregnancy outcome, the health condition of the woman postdelivery, and memory lapse could have affected the recall of such information. The reliability and validity of such information, however, could not be assessed. Third, contrary to cigarette smoking, it is not easy to estimate the number of narghiles smoked per day. Although estimated to range between 20 and 30 g, the amount of tobacco used each time could vary. Some prefer to prepare their narghiles with bigger amounts of tobacco to last them a longer time, while others prefer to reduce the amount of tobacco used. The type of tobacco used also differs; it could be pure or mixed with fruit flavor or honey (ma'asal). In addition, the size of the narghile, the length of its flexible tube, and the amount of water through which smoke is bubbled vary widely. The previous elements could affect the amount of smoke inhaled per day and the concentration of carbon monoxide in the blood (13). Fourth, the nonsmokers' group included those who stopped smoking during pregnancy (about 12 percent). Some of them could have smoked for days or weeks before pregnancy was confirmed. This could have diluted the differences between the groups of smokers and nonsmokers.

Finally, it is worth noting that, in this study, the main effect was observed among those who started smoking in the first trimester. Smoking in the first trimester might have lasting harmful effects on the developing embryo and fetus. However, in some studies (17, 18), it was reported that smoking in the second half of pregnancy where fetal weight gain is fastest could have the most deleterious effect on birth weight.

In conclusion, narghile smoking during pregnancy may be associated with a decrease in the mean birth weight and an increase in the proportion of low birth weights, although less significantly than cigarette smoking. However, its effect on other pregnancy outcomes, especially respiratory distress, was similar to, if not larger than, that of smoking cigarettes. Nevertheless, there is still a need for further investigations of the health effects of narghile smoking with larger sample sizes and of the extent to which bubbling of smoke through water reduces the risk for smoking-related illnesses.

If the negative impact of narghile smoking on low birth weight and other pregnancy outcomes is true,

then this should carry a lot of policy implications. There is a need for the inclusion of narghile smoking as a clear risk factor for low birth weight and other pregnancy outcomes. Hundreds of thousands of women who are engaged in narghile smoking, and some health specialists, are under the assumption that it is not harmful to them or their babies. International health agencies, such as the World Health Organization, should be involved with national ministries of health in informing men and women of the vices of narghile smoking and in fighting the misperception of narghile's being an unharmful or safe alternative to cigarette smoking.

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REFERENCES

1. Peacock JL, Bland JM, Anderson HR, et al. Cigarette smoking and birthweight: type of cigarette smoked and a possible threshold effect. Int J Epidemiol 1991;20:405–12.
2. Fielding JE. Smoking: health effects and control. In: Last JM, Wallace RB, eds. Public health & preventive medicine. 13th ed. Norwalk: Appleton & Lange, 1992:715–40.
3. McCormick MC, Brooks-Gunn J, Shorter T, et al. Factors associated with smoking in low-income pregnant women: relationship to birth weight, stressful life events, social support, health behaviors, and mental distress. J Clin Epidemiol 1990;43:441–8.
4. Haste FM, Brooke OG, Anderson HR, et al. The effect of nutritional intake on outcome of pregnancy in smokers and non-smokers. Br J Nutr 1991;65:347–54.
5. Meyer MB, Jonas BS, Tonascia JA. Perinatal events associated with maternal smoking during pregnancy. Am J Epidemiol 1976;103:464–76.
6. Hakim RR, Tielsch JM. Maternal cigarette smoking during pregnancy. A risk factor for childhood strabismus. Arch Ophthalmol 1992;110:1459–62.
7. Lancaster J. Smoking through the bubbles. Washington Post 1996 Apr 8 (final edition); sect A:17.
8. Nuwayhid I, Sibai A, Adib S, et al. Morbidity, mortality, and risk factors. In: Deeb M, ed. Beirut: a health profile 1984–1994. Beirut: American University of Beirut, 1997: 123–82.
9. Gupta PC, Murti PR, Bhonsle RB. Epidemiology of cancer by tobacco products and the significance of TSNA. Crit Rev Toxicol 1996;26:183–98.
10. Gunaid AA, Sumairi AA, Shidrawi RG, et al. Oesophageal and gastric carcinoma in the Republic of Yemen. Br J Cancer 1995;71:409–10.
11. Lubin JH, Qiao YL, Taylor PR, et al. Quantitative evaluation of the radon and lung cancer association in a case control study of Chinese tin miners. Cancer Res 1990;50:174–80.
12. Sukumar A, Subramanian R. Elements in hair and nails of residents from a village adjacent to New Delhi. Influence of place of occupation and smoking habits. Biol Trace Elem Res 1992;34:99–105.
13. Zahran FM, Al-Fayez S. Carboxyhaemoglobin concentrations in smokers of sheesha and cigarettes in Saudi Arabia. Br Med J 1985;291:1768–70.
14. Al-Fayez SF, Ardawi MSM, Zahran FM. Effects of sheesha and cigarette smoking on pulmonary function of Saudi males and females. Trop Geogr Med 1988;40:115–23.
15. Inhorn MC, Buss KA. Ethnography, epidemiology, and infertility in Egypt. Soc Sci Med 1994;39:671–86.
16. SPSS. SPSS 6.1 for Windows. Chicago: SPSS, Inc, 1994.
17. Comstock GW, Shah FK, Meyer MB, et al. Low birth weight and neonatal mortality rate related to maternal smoking and socioeconomic status. Am J Obstet Gynecol 1971;111:53–9.
18. Lowe CR. Effect of mothers' smoking habits on birth weight of their children. Br Med J 1959;2:673–6.