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Waterpipe dependence in university students: effect of normative beliefs

Abstract

Background: Waterpipe (WP) smoking is increasing in popularity, particularly in young people; this behavior is highly affected by peers and societal influence, and may induce addictive dependence, a more serious situation. The objective of this study was to quantitatively assess the magnitude of normative beliefs influences on WP dependence among university WP smokers in Lebanon, in comparison with cigarette smokers.

Methods: A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence scales.

Results: Correlates to WP smoking were studying in a private university and ever smoking cigarettes; clear friends' and societal influence were found on smoking behavior and dependence. Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence, a more deleterious behavior. Parents' and friends' disagreement with smoking had a protective effect on cigarette smoking and dependence, while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence.

Conclusion: Parallel to what should be done in case of cigarette smoking, efforts should be made to decrease fashion related to WP smoking, establish peer education and help parents advising their young offspring about the importance of non smoking WP. Future research is necessary to carry out to further improve our understanding of drivers of WP smoking and dependence.

Introduction

Waterpipe (WP) smoking is increasing in popularity, particularly among youth of Lebanon *[1-4]*. WP is thought to contain toxic substances, similar to those contained in cigarette [*5-6*]. WP has been shown to increase the risk of several diseases, including chronic bronchitis [*7*], COPD [*8*], different types of cancer [*9*], and other ailments [*9*].

WP has also been demonstrated to contain nicotine, the substance responsible, at least partially, of addictive effects [10*; 11*]. It has been associated to an identified dependence effect similar to what could be found with cigarette, in addition to a social factor that adds to its potential addictive effect [12]; as expected, WP dependence per se was associated with higher smoking frequency and higher risk of health effects among WP smokers, as compared to non dependent WP smokers [*7,8*].

The structure of the WP associated dependence concept was shaped by the previous development and validation of a specific score, the Lebanese Waterpipe Dependence Scale-11 (LWDS-11) [*13*]. In this score, we had found that WP dependence concept could be fit over a 4 factors structure in adults: nicotine physiological dependence, positive reinforcement, negative reinforcement, and psychological craving [*13*]. The positive reinforcement factor included items of "smoking to please others" and "smoking for pleasure", two items shown to have a high importance in late adolescence and young adulthood [*14*]. In fact, the main motives for WP smoking are declared to be socializing, relaxation, pleasure and entertainment; this was suggested in a systematic review with qualitative data synthesis of numerous studies. Peer pressure, fashion, and curiosity were additional motives declared by university students, while expression of cultural identity seemed an additional motive for people in the Middle East [*15*].

Among young cigarette smokers, students' perceptions of smoking among the successful/elite and disapproval by parents/peers were independently associated with susceptibility to smoking [16]. In parallel, some epidemiological studies were conducted to evaluate these effects in case

of WP smoking, and showed that parents' tolerance of WP smoking, peer WP smoking and the idea of popularity were main drivers of this behavior *[17-19].*

For cigarette dependence, earlier onset of monthly cigarette smoking, heavier overall consumption and peers' smoking were associated with higher nicotine dependence in Saudi young students *[20].* Moreover, parental smoking restrictions may have the potential to impede adolescent progression to adult smoking behavior by reducing smoking rates and nicotine dependence *[21].* No studies have been conducted to our knowledge regarding WP dependence.

Thus, although we may know what drives WP smoking in youngsters, no studies have ever quantitatively assessed the magnitude of normative beliefs influences among university smokers on WP dependence, a more health deleterious behavior; the objective of this study was to evaluate such effect in Lebanon, in comparison with cigarette smokers' dependence.

Methods

Population and sampling

A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. A list of universities in Lebanon, provided by the Center for Pedagogic Researches, was used to adjust the sample size *[22].* A sample size of at least 3000 individuals was targeted to allow for adequate power for bivariate and multivariate analysis to be carried out.

Most universities' administrative offices in Lebanon that we approached did not allow drawing a random sample of their enrolled students to participate in the study: they did not provide us with the lists of students and permission was not granted to enter classrooms and search for students nominatively. Thus our research group had to work with a nonrandom sample of students outside their classes. Students were approached on campus during break times between courses by a field worker.

The latter explained the study objectives to the student; and after obtaining oral consent, the student was handed the anonymous and self-administered questionnaire. On average, the questionnaire was completed by participants within approximately 20 minutes. At the end of the process, the completed questionnaires were placed in closed boxes and sent for data entry. During the data collection process, the anonymity of the students was guaranteed, to allow for lower information bias. Out of 4900 distributed questionnaires, 3384 (69.1%) were returned to the field worker. Further methodological details are presented in more details elsewhere *[3].*

Questionnaires

The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence questions: for cigarette dependence, we assessed the Young Adults Cigarette Dependence (YACD) scale [*23*], and for waterpipe dependence, the LWDS-11 *[8],* both of which were developed by our team for the Lebanese population. The YACD was developed

for university students; it is composed of sixteen items, loading over six factors: nicotine

dependence, craving intensity; positive reinforcement and negative reinforcement [23].

Moreover, since the LWDS-11 was developed for adults, its validity and reliability were

confirmed in this young adults' sample before use.

Moreover, normative beliefs questions were taken from a study performed on cigarette

smokers by Primack and collaborators: measures of students' perceptions of smoking among

successful people, cool people and idols, and disapproval by parents and peers were evaluated

by Likert scale questions [24].

Statistical analysis

Data entry was performed by independent lay persons that were unaware of the objectives of

the study. Statistical analysis was performed using SPSS software, version 13.0. A p-value of

0.05 was considered significant. Cluster sampling effect was taken into account according to

Rumeau-Roquette and collaborators [24]. Data weighting was performed according to the

Center for Educational Research and Development – Lebanese Ministry of Education [22].

To confirm the LWDS-11 validity and reliability in the study sample, an exploratory factor

analysis was first performed with its items, after ensuring sample adequacy with the Kaiser-

Meyer-Olkin (KMO) index, and Bartlett's Chi square test of sphericity. Factors were extracted

using the principal component analysis. Items were retained if they loaded 0.3 or more on

factors. Since factors were found to be correlated, we chose to perform a promax rotation with

Kaiser normalization. Afterwards, reliability analysis was performed by Chronbach's alpha

values for factors and the total scale.

Comparison of means was performed using ANOVA in bivariate analysis, with Bonferoni

correction on post-hoc tests. To decrease confounding bias, we performed multivariate

analyses: multiple regressions were carried out using a stepwise backward method, after

ensuring sample adequacy, linearity of the model, residual normality, and non collinearity of

retained items (Variance Inflation Factor < 2). We took WP dependence and cigarette

dependence as dependent variables in respective models, using socio-demographic characteristics, other forms of smoking and normative beliefs as independent variables. A p-value <0.05 was considered significant; missing data was not replaced for this analysis due to their low percentage (<10%).

For indicative purposes, we also conducted multiple logistic regressions, using current waterpipe and cigarette smoking as respective dependent variables, and socio-demographic characteristics, other forms of smoking and normative beliefs as independent variables. After ensuring non colinearity and sampling adequacy by Hosmer-Lemeshow test, we reported adjusted odds ratios (aOR).

Results

Among 3384 university students, 779 (23%) reported they were current WP smokers, and 649(19.2%) that they were current cigarette smokers. Among WP smokers, 760 (97.6%) answered to all questions of the LWDS-11 scale. Among cigarette smokers, 595 (91.7%) answered to all questions of the YACD scale.

Description of the current WP and cigarettes smokers' subsamples

Among WP smokers (n=779), the mean number of waterpipes smoked per week was 4.12 (SD=4.76), while the mean duration of smoking was 6.96 years (SD=2.33). The mean age of the first waterpipe intake was 16.46 years (SD=2.43). Among WP smokers, 35% declared having the intention to stop smoking later, and 20% declared wanting to stop smoking immediately. Moreover, 28.7% ever tried to stop smoking but did not succeed. LWDS mean was 10.23, its median was 9, and standard deviation 6.03. The minimum was zero and maximum 30. Its distribution was almost normal, with a skewness of 0.1.

Among cigarette smokers (n=649), the mean number of cigarettes smoked per day was 17.23 (SD=9.3), while the mean duration of smoking was 4.32 years (SD=2.25). The mean age of the first cigarette intake was 15.89 years (SD=2.35). Among cigarette smokers, 43.2% declared having the intention to stop smoking later, and 27.2% declared wanting to stop smoking immediately. Moreover, 48.7% ever tried to stop smoking but did not succeed. YACD mean was 13.92, its median was 14.04, and standard deviation 5.95. The minimum was 2.5 and maximum 29. Its distribution was almost normal, with a skewness of 0.6.

We note that 234(6.9% of the total students sample) were currently dual smokers of both cigarettes and WP. They constituted 36.4% of cigarette smokers and 30% of current WP smokers.

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Validity and reliability of the LWDS-11 in Lebanese university students

The Kaiser-Meyer-Olkin Measure of sampling adequacy was 0.79 (p<0.001). All communalities were higher than 0.35, and the extracted principal component sums of squared loadings explained 66.58% of the total variance.

The Promax rotation with Kaiser normalization gave a four factors solution with the following pattern (Table 1): factor 1 (physiological dependence; 33.14% of the variance explained), factor 2 (psychological craving; 13.08% of the variance explained), factor 3 (negative reinforcement; 11.59% of the variance explained) and factor 4 (positive reinforcement; 8.78% of the variance explained). Reliability measured by Cronbach's alpha for the total score was 0.770. We note that the structure is highly similar to the one found in adults, with one difference: the income item which originally loaded on physiological dependence, now loaded on psychological craving. For the rest of psychometric properties, the scale gave almost identical results. Factors were correlated with each others: factor 1 correlated with factors 2 (r_{12}=0.42), 3 (r_{13}=0.39) and 4 (r_{14}=0.09), factor 2 correlated with factors 3 (r_{23}=0.40) and 4 (r_{24}=0.02), and factor 3 correlated with factor 4 (r_{34}=0.14).

Waterpipe and cigarette dependence variation with socio-demographic characteristics

Waterpipe dependence was significantly higher in widow or divorced individuals (p=0.006), and among individuals who have higher numbers of smokers at home (p<0.001) (table 2). However, cigarette dependence was higher in males (p=0.006), lower socioeconomic status individuals (p=0.051), the 20-21 years age class (p<0.001), the public university (p=0.005), and among individuals who have higher numbers of smokers at home (p<0.001); it was also lower in South Lebanon versus other regions (p<0.001) (table 2).

Normative beliefs influence on waterpipe and cigarette dependence

Waterpipe dependence was higher in case individuals believe that successful people smoke (p<0.001), rich people smoke (p=0.002), their idols smoke (p=0.03); it was lower in case individuals knew it was important for their parents, their friends and people of their age that

they do not smoke (p<0.01) (table 3). Nearly similar results were found for cigarette dependence, except for an additional significant higher dependence in case individuals believed that cool people smoked (p=0.002), and a lower trend for significant for the peers' opinion about smoking (p=0.088) (table 3).

Multivariate analysis of WP and cigarette current smoking

Studying in a private university and ever smoking cigarettes were correlated to current waterpipe smoking; moreover, thinking that successful and cool people smoke increased the odds of being a current waterpipe smoker, while having friends who disagree with smoking was correlated with lower waterpipe smoking (table 4). On another hand, being of male sex, not single, higher age, residing in Mount or North Lebanon, studying in a private university, and ever smoking waterpipes increase the odds of being a current cigarette smoker; thinking that successful people or idols smoke was correlated to increased cigarette smoking probability, while having parents who disagree with smoking was correlated with lower cigarette smoking (table 4).

Multivariate analysis of WP and cigarette dependence

In multiple regression of WP dependence, parents and friends' opinion against smoking were inversely associated while belief that idols smoke were positively associated with WP dependence; moreover, higher age class was also associated with higher WP dependence (Table 4). For cigarette dependence, parents' opinion against smoking was strongly and inversely associated, while the perception that idols, rich and successful people smoked were positively associated with cigarette dependence (Table 4). We note that performing the analysis on dual smokers gave similar results of dependence correlates for both WP and cigarettes, except for a visible association of dual dependence (OR=5.10[2.83; 9.19]; p<0.001) (other results not shown).

Discussion

The LWDS-11 was of adequate validity and reliability in university students of Lebanon; the structure was highly similar to the one found in adults *[13]*, with one difference: the income item which originally loaded on physiological dependence in adults, now loaded on psychological craving. One explanation could be that may adults adapt their smoking frequency and agree to pay portions of their incomes according to physiological nicotine needs, while younger university students would be ready to pay higher portions of their incomes only in case of extreme psychological craving. Access to money being more limited for university students than among adults may clarify this issue; in parallel, it is worth noting that in the YACD, the money item had also loaded on the psychological craving factor, not on the nicotine dependence factor *[23]*. Additional studies would be necessary to confirm this finding; nevertheless, the LWDS-11 demonstrated adequate validity and reliability, and could thus be used for the current study.

For WP current smoking, correlates of this behavior were studying in a private university (representing access to money), ever smoking cigarettes, and clear friends' and societal influence, as found in other studies *[17-19; 25]*. Moreover, friends' disagreement with smoking decreased WP dependence: in the latter case, smoking for conviviality during social gatherings is absent, and this component of positive reinforcement and cue for smoking in many individuals would be expected to affect individuals' dependence to WP *[13]*. Idols' smoking of university students increased the risk of WP dependence, which may also be considered the reverse side of the medal of the societal influence.

Age increased the risk of WP dependence; this may be explained by the establishment of this habit with time during life in university and more frequent exposure, or due to its possible insidious nature of dependence that may only appear after repeated exposures. The nature of WP dependence installation may differ from cigarette dependence that seems to install in young people after only a few cigarettes *[26-28]*. Indeed, Asfar et al have shown the existence

of beginners and established WP smokers, the latter being less willing to quit WP smoking and more hooked on the habit [29].

Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence, a more deleterious behavior. A social tolerance of WP smoking by parents may explain this finding [17], who may intervene with their offspring in case of dependence only; additional studies are necessary to evaluate whether parents are able to differentiate between occasional WP smokers and dependent WP smokers among their children.

As for cigarette smoking, numerous socio-demographic factors were found to correlate with the behavior: male sex, high age, married/widow/divorced marital status, residing in Mount and North Lebanon, studying in a private university and ever smoking waterpipes. Parents' disagreement with smoking had a protective effect on cigarette smoking and dependence, while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence, similarly to other researchers' findings [16; 30]. Friends influence was also visible, as with other studies [16; 30-31].

The idea of dual smoking deserves to be noted: smoking one kind of tobacco is associated with higher odds of smoking the other, and being dependent to one kind of tobacco increases the risk of dependence to other kinds. Similar results were found in British university students, where cigarette smoking was a major driver of waterpipe smoking [32] and in US students, where the majority of WP smokers were also cigarette smokers [33]. The fact that dependence to cigarettes and to waterpipe includes nicotine dependence components clearly explains this finding [11; 34-35]. This may also biologically be confirmed with results found by Rastam and collaborators, where cigarette and WP both decrease nicotine craving symptoms in dual smokers, and WP may spoil cigarette smoking cessation [36].

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Limitations of the study

Our study, as with any, has its limitations: a selection bias could have been possible since the sample is not a random sample and may not be representative of the young adults and students' population in Lebanon. This non random sampling could lead to an overrepresentation of students who skip classes and may have higher risky behaviours, such as smoking. There could also be a possibility of respondent and information bias, since the results of our study are based on a self-administered questionnaire. Despite the fact that we ensured anonymity and confidentiality of all data that has been collected, respondents may have underreported some of their behaviours that lead to missing values. Furthermore, we have not taken into account all factors that may predict nicotine dependence, since it has been shown that background factors, psychological characteristics and genetic variation in nicotinic cholinergic receptors contribute independently or interactively to smoking initiation and to severity of nicotine dependence in young people *[37]*. We suggest that further research be carried taking into account these limitations; we also suggest prospective studies to thoroughly evaluate the effect of parents and friends on future smoking behaviours, in addition to qualitative research that can explore the knowledge, attitudes, and values behind these behaviours.

Conclusion

In conclusion, WP smoking and dependence are influenced by parents' and friends' opinions, and idols' smoking status. Efforts should be made to establish peer education and help parents advising their young offspring about the importance of non smoking. Future research is necessary to carry out to further improve our understanding of drivers of WP smoking and dependence.

What this study adds

- This is the first study exploring normative believes effect on waterpipe smoking in university students
- Although the role of parents was not visible in decreasing WP smoking WP, their protective influence decreased WP dependence, a deleterious behavior.
- We found out that efforts should be made to establish peer education and help parents advising their young offspring about the importance of non smoking WP.

Contributorship

All authors:
- Contributed to the study design and helped in data collection
- Contributed to the results' analysis reviewing
- Contributed to the manuscript reviewing

Funding

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Table 1 – Validity and reliability of the LWDS-11 among university students of Lebanon

Items	Factor 1 Physiological dependence	Factor 2 Psychological craving	Factor 3 Negative reinforcement	Factor 4 Positive reinforcement
How many times were you able to stay 7 days without smoking waterpipe?	0.877			
How many days could you stay without smoking waterpipe?	0.871			
Number of smoked waterpipes per week?	0.798			
Would you smoke waterpipe even if you are ill/ bedridden?		0.836		
Are you ready not to eat in exchange for a waterpipe?		0.827		
Would you smoke waterpipe alone?		0.547		
How much of your income are you ready to pay for waterpipe smoking?		0.426		
Smokes waterpipe to relax his nerves			0.868	
Smokes waterpipe to improve his morale			0.862	
Smokes waterpipe to please others (conviviality)				0.910
Smokes waterpipe for pleasure				0.573
Cronbach's alpha reliability measure	0.806	0.659	0.671	0.527

Table 2 –LWDS-11 and YACD means in different socio-demographic categories of smokers

Characteristic	LWDS-11 Mean (SD)	p-value	YACD (SD)	p-value
Sex		0.082		0.006
Male	10.62(6.21)		14.22(5.95)	
Female	9.86(5.84)		12.70(5.98)	
Marital status		0.006*		0.664
Married	10.00 (4.85)		14.76(7.65)	
Single	10.19(6.02)		13.84(5.99)	
Widow or divorced	17.50 (6.17)		11.5(0.00)	
Sosio-economic status quartiles		0.35		0.051
Quartile 1	9.69(5.51)		15.61(6.09)	
Quartile 2	10.67(5.78)		14.11(6.11)	
Quartile 3	9.68(6.04)		13.51(5.65)	
Quartile 4	10.47(6.90)		13.70(5.95)	
Age classes		0.053**		<0.001*
17-19 years	9.42(5.86)		11.69(5.37)	
20-21 years	10.75(5.88)		14.93(5.90)	
22 years and more	10.14(6.36)		13.27(6.07)	
Private university	10.21(6.03)	0.422	13.33(5.88)	0.005
Public university	9.86(6.07)		14.77(6.09)	
Region		0.135		<0.001†
Beyrouth	10.72(6.62)		13.21(5.99)	
Mount Lebanon	9.55(6.03)		14.05(5.89)	
North Lebanon	10.91(4.87)		15.47(6.43)	
South Lebanon	10.55(6.21)		9.99(3.47)	
Bekaa plain	9.95(6.07)		12.28(6.31)	
Number of smokers at home		<0.001*		<0.001‡
No smokers	9.00(5.51)		11.98(5.19)	
One smoker	8.87 (5.65)		11.68(5.44)	
Two smokers	10.21(5.75)		12.46(5.45)	
Three and more	12.28(6.42)		16.21(5.92)	

*All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ‡Difference significant between third category and others is significant; †South Lebanon significantly different from other regions

Table 3 – LWDS-11 means bivariate analysis with societal influence

Characteristic	LWDS-11 Mean (SD)	p-value	YACD Mean (SD)	p-value
Successful people smoke		<0.001*		<0.001¶
Yes	9.93(5.80)		12.81(5.91)	
Maybe	9.61(5.61)		12.50(5.39)	
No	11.92(6.90)		16.43(5.66)	
Cool people smoke		0.163		0.002#
No	9.93(6.30)		12.79(5.91)	
Maybe	9.91(5.99)		13.88(5.95)	
Yes	10.79(5.91)		14.76(5.94)	
Rich people smoke		0.002*		<0.001¶
No	10.04(6.21)		12.71(5.89)	
Maybe	9.55(5.60)		13.72(5.89)	
Yes	11.79(5.86)		16.69(5.35)	
My idols smoke		0.030#		<0.001¶
No	10.03(6.09)		12.49(5.78)	
Maybe	9.90(5.69)		12.86(5.96)	
Yes	11.43(6.58)		16.77(5.65)	
For my parents, it is important not to smoke		<0.001*		<0.001¶
No	13.25(6.88)		16.99(5.24)	
Maybe	10.28(6.17)		16.18(5.51)	
Yes	9.78(5.78)		12.57(5.77)	
For my friends, it is important not to smoke		<0.001**		<0.001‡
No	12.22(6.50)		15.49(5.79)	
Maybe	10.00(5.65)		13.26(5.52)	
Yes	9.34(5.81)		13.05(6.19)	
For people of my age, it is important not to smoke		0.009*		0.088
No	11.33(6.31)		14.53(6.04)	
Maybe	9.37(5.69)		13.45(5.70)	
Yes	9.79(6.03)		13.39(6.06)	

*All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ¶Difference was not significant between categories 1 & 2; ‡Difference was not significant between categories 2 & 3

Table 4 – Multivariate analysis tobacco use and dependence

Binomial dependent variable	Independent variables	Adjusted OR	[95% of CI]	p-value
Current waterpipe smoking†,‡	Studying in a private university	1.33	[1.10;1.61]	0.004
	Successful people smoke	1.45	[1.27;1.66]	<0.001
	Cool people smoke	1.24	[1.10;1.39]	<0.001
	Friends think it is important not to smoke	0.73	[0.63;0.84]	<0.001
	Ever smoking cigarettes	2.04	[1.61;2.60]	<0.001
Current cigarette smoking†,‡	Female sex	0.24	[0.19;0.29]	<0.001
	Other than single marital status	2.63	[1.20;5.76]	0.016
	Higher age class	1.37	[1.19;1.57]	<0.001
	Mount Lebanon versus Beirut	1.37	[1.03;1.82]	0.029
	North Lebanon versus Beirut	1.46	[1.00;2.13]	0.053
	South Lebanon versus Beirut	0.48	[0.30;0.78]	0.003
	Bekaa plain versus Beirut	0.61	[0.36;1.02]	0.057
	Studying in a private university	1.96	[1.58;2.43]	<0.001
	Successful people smoke	1.75	[1.52;2.01]	<0.001
	My idols smoke	1.13	[0.99;1.30]	0.074
	Parents think it is important not to smoke	0.81	[0.70;0.93]	0.002
	Ever smoking waterpipes	1.56	[1.22;1.99]	<0.001

Continuous dependent variable	Independent variables	Adjusted standardized beta values	Adjusted Beta values [95% CI]	p-value
LWDS-11 among WP smokers*,‡	Parents think it is important not to smoke	-0.113	-0.98[-1.75;-0.22]	0.012
	Friends think it is important not to smoke	-0.139	-1.04[-1.69;-0.38]	0.002
	My idols smoke	0.106	0.86[0.22;1.50]	0.008
	Higher age class	0.087	0.75[0.08;1.41]	0.027
YACD among cigarette smokers**,‡	Parents think it is important not to smoke	-0.251	-1.89[-2.51;-1.27]	<0.001
	My idols smoke	0.165	1.19[0.53;1.84]	<0.001
	Rich people smoke	0.109	0.79[0.14;1.45]	0.018
	Successful people smoke	0.104	0.71[0.09;1.33]	0.025

†Performed on whole university students sample; Conditions for sample adequacy satisfied; stepwise backward model; all other variables were not retained in the model.

*R=0.255; Adjusted R square=0.065; Stepwise model; VIF<2; residuals are normal; all other variables were not retained in the model.

**R=0.426; Adjusted R square=0.175; Stepwise model; VIF<2; residual are normal; all other variables were not retained in the model.

‡Variables included in all models: sex, marital status, socioeconomic classes, age classes, region of residence, private university (versus public), successful people smoke, cool people smoke, rich people smoke, my idols smoke, parents think it is important not to smoke, friends think it is important not to smoke, people of the same age think it is important not to smoke, smoking other type of tobacco.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported on page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	NA

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	*NA*
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	*NA*
		Cross-sectional study—Report numbers of outcome events or summary measures	*9*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007; **370**:1453-7

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Waterpipe dependence in university students: effect of normative beliefs

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Waterpipe dependence in university students: effect of normative beliefs

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Waterpipe dependence in university students: effect of normative beliefs

Abstract

Background: Waterpipe (WP) smoking is increasing in popularity, particularly in young people; this behavior is highly affected by peers and societal influence, and may induce addictive dependence, a more serious situation. The objective of this study was to measure the correlates, including normative beliefs, associated with waterpipe and cigarette prevalence and dependence. **Methods:** A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence scales. **Results:** Correlates to WP smoking were studying in a private university and ever smoking cigarettes; clear friends' and societal influence were found on smoking behavior and dependence. Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence, a behavior that is considered more deleterious for health. Parents' and friends' disagreement with smoking had a protective effect on cigarette smoking and dependence, while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence. **Conclusion:** In conclusion, WP smoking and dependence are influenced by parents' and friends' opinions, and idols' smoking status; these results suggest the potential possibility of establishing peer education and help parents advising their young offspring about the importance of non smoking WP. Future research is necessary to further improve our understanding of motives for WP smoking and dependence.

Keywords: waterpipe, smoking, dependence, LWDS-11, YACD, peer pressure, parental guidance, normative belief.

Article summary

Strengths of the study

- This is the epidemiological first study exploring normative believes effect on waterpipe smoking in university students
- This is the first study in the region concerning WP dependence in university students
- The study was conducted over a large number of university students in Lebanon
- Anonymity and non traceability of participants increases the possibility of straight answers
- The study showed that parents' opinion did not affect WP smokers, while it had a protective effect against WP dependence.

Limitations of the study

- The sample was not random, thus a selection bias could not be excluded
- Information bias is also possible, because results were based on self declared answers
- The use of self completed questionnaires may increase the risk of non response to certain items
- We have not taken into account all factors that may predict nicotine dependence
- Qualitative studies could be useful to further explain the results we obtained

Introduction

Waterpipe (WP) smoking is increasing in popularity, particularly among young people and university students *[1-4]*. WP is thought to contain toxic substances, similar to those contained in cigarette [*5-6*]. WP has been shown to increase the risk of several diseases, including chronic bronchitis [*7*], COPD [*8*], lung cancer [*9*], and other ailments [*9*].

WP has also been demonstrated to contain nicotine, the substance responsible, at least partially, of addictive effects [10*; 11*]. It has been associated to an identified dependence effect similar to what could be found with cigarette, in addition to a social factor that adds to its potential addictive effect [12]; as expected, WP dependence per se was associated with higher smoking frequency and higher risk of health effects among WP smokers, as compared to non dependent WP smokers [*7,8*].

The structure of the WP associated dependence concept was shaped by the previous development and validation of a specific score, the Lebanese Waterpipe Dependence Scale-11 (LWDS-11) [*13*]. The score included items of "smoking to please others" and "smoking for pleasure", two items shown to have a high importance in late adolescence and young adulthood [*14*]. The main motives for WP smoking are declared to be socializing, relaxation, pleasure and entertainment; this was suggested in a systematic review with qualitative data synthesis of numerous studies. Peer pressure, fashion, and curiosity were additional motives declared by university students, while expression of cultural identity seemed an additional motive for people in the Middle East *[14, 15]*.

Among young cigarette smokers, students' perceptions of smoking among the successful/elite and disapproval by parents/peers were independently associated with susceptibility to smoking [16]. In parallel, some epidemiological studies were conducted to evaluate these effects in case of WP smoking, and showed that parents' tolerance of WP smoking, peer WP smoking and the idea of popularity were main motives for this behavior *[17-19].*

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For cigarette dependence, earlier onset of at least once a month cigarette smoking, heavier overall consumption and peers' smoking were associated with higher nicotine dependence in Saudi young students *[20]*. Moreover, parental smoking restrictions may have the potential to impede adolescent progression to adult smoking behavior by reducing smoking rates and nicotine dependence *[21]*.

In parallel, very few studies have been conducted to our knowledge regarding WP dependence, particularly in the Middle Eastern region, while normative beliefs have hardly been addressed. Thus, although we may know what drives WP smoking in youngsters, no studies have ever quantitatively assessed the magnitude of normative beliefs influences among university smokers on WP dependence, a more deleterious behavior for health. The objective of this study was to measure the correlates, including normative beliefs, associated with waterpipe and cigarette prevalence and dependence.

Methods

Population and sampling

A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. A list of universities in Lebanon, provided by the Center for Pedagogic Researches, was used to adjust the sample size *[22]*. A sample size of at least 3000 individuals was targeted to allow for adequate power for bivariate and multivariate analysis to be carried out on several factors; this sample size is powerful enough for any factor prevalence and association OR above 2.

Most universities' administrative offices in Lebanon that we approached did not allow drawing a random sample of their enrolled students to participate in the study: they did not provide us with the lists of students and permission was not granted to enter classrooms and search for students nominatively. Thus our research group had to work with a nonrandom sample of students outside their classes. Students were approached on campus during break times between courses by a field worker.

The latter explained the study objectives to the student; and after obtaining oral consent, the student was handed the anonymous and self-administered questionnaire. On average, the questionnaire was completed by participants within approximately 20 minutes. At the end of the process, the completed questionnaires were placed in closed boxes and sent for data entry. During the data collection process, the anonymity of the students was guaranteed, to allow for lower information bias. Out of 4900 distributed questionnaires, 3384 (69.1%) were returned to the field worker; the sample included students from 17 universities (the public university of Lebanon that accounts for half the university students in Lebanon and 16 private ones which account together for the other half). Further methodological details are presented in more details elsewhere *[3]*.

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Questionnaires

The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence questions. Socioeconomic status of students was defined using their mean monthly income per family divided by the number of family members; afterwards, quartiles were calculated and used to classify individuals into four levels.

Current WP smoking was defined as smoking at least one WP per month, while current cigarette smoking was defined as smoking at least one cigarette per day. For cigarette dependence, we used the Young Adults Cigarette Dependence (YACD) scale [23], and for waterpipe dependence, the LWDS-11 [13], both of which were developed by our team for the Lebanese population. The YACD has been developed for university students; it is composed of sixteen items, loading over six factors: nicotine dependence, craving intensity; positive reinforcement and negative reinforcement [23]. The LWDS-11 is composed of a 11 items, loading on a 4 factors structure in adults: nicotine physiological dependence, positive reinforcement, negative reinforcement, and psychological craving [13]; its validity and reliability had to be confirmed in this young adults' sample before use.

Moreover, normative beliefs questions were taken from a study performed on cigarette smokers by Primack and collaborators: measures of students' perceptions of smoking among successful people, cool people and idols, and disapproval by parents and peers were evaluated by Likert scale questions [16]: 0 indicated strongly disagree; 1, disagree; 2, maybe, 3, agree; and 4, strongly agree. These were further collapsed in bivariate analysis into yes (3 & 4), maybe (2), and no (0&1).

Statistical analysis

Data entry was performed by independent lay persons that were unaware of the objectives of the study; these were masters' students that were not involved in data collection process. Data cleaning was performed by researchers, and a sample of 50 questionnaires was completely

checked for errors. The error rate was lower than 1%; thus, data entry was considered
adequate.

Statistical analysis was performed using SPSS software, version 13.0. A p-value of 0.05 was
considered significant. Cluster sampling effect was taken into account according to Rumeau-
Roquette and collaborators [24]. Data weighting was performed according to the total number
of students per university, as described by the Center for Educational Research and
Development – Lebanese Ministry of Education [22].

To confirm the LWDS-11 validity and reliability in the study sample, an exploratory factor
analysis was first performed with its items, after ensuring sample adequacy with the Kaiser-
Meyer-Olkin (KMO) index, and Bartlett's Chi square test of sphericity. Factors were extracted
using the principal component analysis. Items were retained if they loaded 0.4 or more on
factors. Since factors were found to be correlated, we chose to perform a promax rotation with
Kaiser normalization. Afterwards, reliability analysis was performed by Chronbach's alpha
values for factors and the total scale.

Comparison of means was performed using ANOVA in bivariate analysis, with Bonferoni
correction on post-hoc tests. Non parametric tests were used in case of small subgroups
(Kruskall-Wallis and Wilcoxon tests, respectively).

To decrease confounding bias, we performed multivariate analyses: multiple regressions were
carried out using a stepwise backward method, after ensuring sample adequacy, linearity of the
model, residual normality, and non collinearity of retained items (Variance Inflation Factor < 2).
We took WP dependence and cigarette dependence as dependent variables in respective
models, using socio-demographic characteristics normative beliefs and other forms of smoking
(i.e. WP smoking among cigarette smokers and cigarette smoking among WP smokers) as
independent variables. Both dependent variables were normally distributed. A p-value <0.05

was considered significant; missing data was not replaced for this analysis due to their low

percentage (<10%).

For indicative purposes, we also conducted multiple logistic regressions, using current

waterpipe and cigarette smoking as dichotomous dependent variables respectively, and socio-

demographic characteristics, other forms of smoking and normative beliefs as independent

variables. After ensuring non colinearity and sampling adequacy by Hosmer-Lemeshow test, we

reported adjusted odds ratios (aOR).

Results

Among 3384 university students, 779 (23%) reported they were current WP smokers, and 649(19.2%) that they were current cigarette smokers. Among WP smokers, 760 (97.6%) answered to all questions of the LWDS-11 scale, while among cigarette smokers, 595 (91.7%) answered to the complete YACD scale questions.

Description of the current WP and cigarettes smokers' subsamples

Among WP smokers (n=779), the mean number of waterpipes smoked per week was 4.12 (SD=4.76), while the mean duration of smoking was 6.96 years (SD=2.33). The mean age of the first waterpipe intake was 16.46 years (SD=2.43). Among WP smokers, 35% declared having the intention to stop smoking later, and 20% declared wanting to stop smoking immediately. Moreover, 28.7% ever tried to stop smoking but did not succeed. LWDS mean was 10.23, its median was 9, and standard deviation 6.03. The minimum was zero and maximum 30. Its distribution was almost normal, with a skewness of 0.1.

Among cigarette smokers (n=649), the mean number of cigarettes smoked per day was 17.23 (SD=9.3), while the mean duration of smoking was 4.32 years (SD=2.25). The mean age of the first cigarette intake was 15.89 years (SD=2.35). Among cigarette smokers, 43.2% declared having the intention to stop smoking later, and 27.2% declared wanting to stop smoking immediately. Moreover, 48.7% ever tried to stop smoking but did not succeed. YACD mean was 13.92, its median was 14.04, and standard deviation 5.95. The minimum was 2.5 and maximum 29. Its distribution was almost normal, with a skewness of 0.6.

We note that 234(6.9% of the total students sample) were currently dual smokers of both cigarettes and WP. They constituted 36.4% of cigarette smokers and 30% of current WP smokers.

Validity and reliability of the LWDS-11 in Lebanese university students

The Kaiser-Meyer-Olkin Measure of sampling adequacy was 0.79 (p<0.001). All communalities were higher than 0.35, and the extracted principal component sums of squared loadings explained 66.58% of the total variance.

The Promax rotation with Kaiser normalization gave a four factors solution with the following pattern (Table 1): factor 1 (physiological dependence; 33.14% of the variance explained), factor 2 (psychological craving; 13.08% of the variance explained), factor 3 (negative reinforcement; 11.59% of the variance explained) and factor 4 (positive reinforcement; 8.78% of the variance explained). Reliability measured by Cronbach's alpha for the total score was 0.77. We note that the structure is highly similar to the one found in adults, with one difference: the income item which originally loaded on physiological dependence, now loaded on psychological craving. For the rest of psychometric properties, the scale gave almost identical results.

Factors were correlated with each others: factor 1 correlated with factors 2 (r_{12}=0.42), 3 (r_{13}=0.39) and 4 (r_{14}=0.09), factor 2 correlated with factors 3 (r_{23}=0.40) and 4 (r_{24}=0.02), and factor 3 correlated with factor 4 (r_{34}=0.14).

Waterpipe and cigarette dependence variation with socio-demographic characteristics

In table 2, we firstly present the characteristics of the whole sample of university students, for descriptive purposes. Waterpipe dependence was significantly higher in widow or divorced individuals, and among individuals who have higher numbers of smokers at home (table 2). However, cigarette dependence was higher in males, lower socioeconomic status individuals, the 20-21 years age class, the public university, and among individuals who have higher numbers of smokers at home; it was also lower in South Lebanon versus other regions (table 2).

Normative beliefs influence on waterpipe and cigarette dependence

Waterpipe dependence was higher in case individuals believed that successful people smoke, rich people smoke, their idols smoke; it was lower in case individuals knew it was important for their parents, their friends and people of their age that they do not smoke (table 3). Nearly

similar results were found for cigarette dependence, except for an additional significant higher

dependence in case individuals believed that cool people smoked, and a lower trend for

significant for the peers' opinion about smoking (table 3).

Multivariate analysis of WP and cigarette current smoking

Studying in a private university and ever smoking cigarettes were correlated to current

waterpipe smoking; moreover, thinking that successful and cool people smoke increased the

odds of being a current waterpipe smoker, while having friends who disagree with smoking was

correlated with lower waterpipe smoking (table 4). On another hand, being of male sex, not

single, higher age, residing in Mount or North Lebanon, studying in a private university, and

ever smoking waterpipes increase the odds of being a current cigarette smoker; thinking that

successful people or idols smoke was correlated to increased cigarette smoking probability,

while having parents who disagree with smoking was correlated with lower cigarette smoking

(table 4).

Multivariate analysis of WP and cigarette dependence

In multiple regression of WP dependence, parents and friends' opinion against smoking were

inversely associated while belief that idols smoke were positively associated with WP

dependence; moreover, higher age class was also associated with higher WP dependence

(Table 4). For cigarette dependence, parents' opinion against smoking was strongly and

inversely associated, while the perception that idols, rich and successful people smoked were

positively associated with cigarette dependence (Table 4).

We note that performing the analysis among dual smokers gave similar results of dependence

correlates for both WP and cigarettes with normative beliefs, except for a visible association of

dual dependence with male gender versus females (OR=5.10[2.83; 9.19]; p<0.001) (other

results not shown).

Discussion

In this study, we found that correlates of current WP smoking were studying in a private university (representing access to money), ever smoking cigarettes, and clear friends' and societal influence, as found in other studies [17-19; 25]. Moreover, friends' disagreement with smoking decreased WP dependence: in the latter case, smoking for conviviality during social gatherings is absent, and this component of positive reinforcement and cue for smoking in many individuals would be expected to affect individuals' dependence to WP [13]. Idols' smoking of university students increased the risk of WP dependence, which may also be considered the reverse side of the medal of the societal influence.

Age increased the risk of WP dependence; this may be explained by the establishment of this habit with time during life in university and more frequent exposure, or due to its possible insidious nature of dependence that may only appear after repeated exposures. The nature of WP dependence installation may differ from cigarette dependence that seems to install in young people after only a few cigarettes [26-28]. Indeed, Asfar et al have shown the existence of beginners and established WP smokers, the latter being less willing to quit WP smoking and more hooked on the habit [29].

Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence; the latter behavior has been shown to be more deleterious for health [7, 8]. A social tolerance of WP smoking by parents may explain this finding [17], who may intervene with their offspring in case of dependence only; additional studies are necessary to evaluate whether parents are able to differentiate between occasional WP smokers and dependent WP smokers among their children.

As for cigarette smoking, numerous socio-demographic factors were found to correlate with the behavior: male sex, high age, married/widow/divorced marital status, residing in Mount and North Lebanon, studying in a private university and ever smoking waterpipes. Parents' disagreement with smoking had a protective effect on cigarette smoking and dependence,

while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence, similarly to other researchers' findings *[16; 30]*. Friends influence was also visible, as with other studies *[16; 30-31]*.

The idea of dual smoking deserves to be noted: smoking one kind of tobacco is associated with higher odds of smoking the other, and being dependent to one kind of tobacco increases the risk of dependence to other kinds. Similar results were found in British university students, where cigarette smoking was a major motive for waterpipe smoking *[32]* and in US students, where the majority of WP smokers were also cigarette smokers *[33]*. The fact that dependence to cigarettes and to waterpipe includes nicotine dependence components clearly explains this finding *[11; 34-35]*. This may also biologically be confirmed with results found by Rastam and collaborators, where cigarette and WP both decrease nicotine craving symptoms in dual smokers, and WP may interact with cigarette smoking cessation *[36]*.

One more conceptual issue deserves our attention: the LWDS-11 was of adequate validity and reliability in university students of Lebanon; the structure was highly similar to the one found in adults *[13]*, with one difference: the income item which originally loaded on physiological dependence in adults, now loaded more adequately on psychological craving among students. One explanation could be that may adults adapt their smoking frequency and agree to pay portions of their incomes according to usual physiological nicotine needs, while younger university students would be ready to pay higher portions of their incomes only in case of extreme psychological craving (which is considered a more compelling urge than usual physiological dependence). Access to money being more limited for university students than for working adults may clarify this issue; in parallel, it is worth noting that in the YACD, the money item had also loaded on the psychological craving factor, not on the nicotine dependence factor *[23]*. Additional qualitative studies would be necessary to confirm this finding; nevertheless, the LWDS-11 demonstrated adequate validity and reliability, and could thus be used for the current study.

Limitations of the study

Our study, as with any, has its limitations: a selection bias could have been possible since the sample is not a random sample and may not be representative of the young adults and students' population in Lebanon. This non random sampling could lead to an overrepresentation of students who skip classes and may have higher risky behaviours, such as smoking. There could also be a possibility of respondent and information bias, since the results of our study are based on a self-administered questionnaire. Despite the fact that we ensured anonymity and confidentiality of all data that has been collected, respondents may have underreported some of their behaviours that lead to missing values. Furthermore, we have not taken into account all factors that may predict nicotine dependence, since it has been shown that background factors, psychological characteristics and genetic variation in nicotinic cholinergic receptors contribute independently or interactively to smoking initiation and to severity of nicotine dependence in young people *[37].* We suggest that further research be carried taking into account these limitations; we also suggest prospective studies to thoroughly evaluate the effect of parents and friends on future smoking behaviours, in addition to qualitative research that can explore the knowledge, attitudes, and values behind these behaviours.

Conclusion

In conclusion, WP smoking and dependence are influenced by parents' and friends' opinions, and idols' smoking status; these results suggest the potential possibility of establishing peer education and help parents advising their young offspring about the importance of non smoking WP. Future research is necessary to further improve our understanding of motives for WP smoking and dependence.

What this study adds

- This is the first study exploring normative believes effect on waterpipe smoking in university students
- Although the role of parents was not visible in decreasing WP smoking WP, their protective influence decreased WP dependence, a more deleterious behavior for health.
- We found out that efforts should be made to establish peer education and help parents advising their young offspring about the importance of non smoking WP.

Contributorship
All authors:
- Contributed to the study design and helped in data collection
- Contributed to the results' analysis reviewing
- Contributed to the manuscript drafting and reviewing

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Competing interests
Authors have no competing interests to declare.

Data Sharing
No additional data available

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Table 1 – Validity and reliability of the LWDS-11 among university students of Lebanon

Items	Factor 1 Physiological dependence	Factor 2 Psychological craving	Factor 3 Negative reinforcement	Factor 4 Positive reinforcement
How many times were you able to stay 7 days without smoking waterpipe?	0.877			
How many days could you stay without smoking waterpipe?	0.871			
Number of smoked waterpipes per week?	0.798			
Would you smoke waterpipe even if you are ill/ bedridden?		0.836		
Are you ready not to eat in exchange for a waterpipe?		0.827		
Would you smoke waterpipe alone?		0.547		
How much of your income are you ready to pay for waterpipe smoking?		0.426		
Smokes waterpipe to relax his nerves			0.868	
Smokes waterpipe to improve his morale			0.862	
Smokes waterpipe to please others (conviviality)				0.910
Smokes waterpipe for pleasure				0.573
Cronbach's alpha reliability measure	0.806	0.659	0.671	0.527

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Table 2 –LWDS-11 and YACD means in different socio-demographic categories of smokers

Characteristic†	Total n=3384	LWDS-11 Mean (SD)	p-value	YACD (SD)	p-value
Sex			0.082		0.006
Male	1980(58.5%)	10.62(6.21)		14.22(5.95)	
Female	1399(41.3%)	9.86(5.84)		12.70(5.98)	
Marital status			0.006*		0.664
Married	115(3.4%)	10.00 (4.85)		14.76(7.65)	
Single	3243(95.8%)	10.19(6.02)		13.84(5.99)	
Widow or divorced	9(0.3%)	17.50 (6.17)		11.5(0.00)	
Socio-economic status quartiles¶			0.35		0.051
Quartile 1	736(21.7%)	9.69(5.51)		15.61(6.09)	
Quartile 2	746(22.0%)	10.67(5.78)		14.11(6.11)	
Quartile 3	632(18.7%)	9.68(6.04)		13.51(5.65)	
Quartile 4	746(22.1%)	10.47(6.90)		13.70(5.95)	
Age classes			0.053**		<0.001*
17-19 years	958(28.3%)	9.42(5.86)		11.69(5.37)	
20-21 years	1424(42.1%)	10.75(5.88)		14.93(5.90)	
22 years and more	982(29.0%)	10.14(6.36)		13.27(6.07)	
Private university	1754(51.8%)	10.21(6.03)	0.422	13.33(5.88)	0.005
Public university	1630(48.2%)	9.86(6.07)		14.77(6.09)	
Region			0.135		<0.001†
Beyrouth	526(15.5%)	10.72(6.62)		13.21(5.99)	
Mount Lebanon	1606(47.5%)	9.55(6.03)		14.05(5.89)	
North Lebanon	505(14.9%)	10.91(4.87)		15.47(6.43)	
South Lebanon	474(14.0%)	10.55(6.21)		9.99(3.47)	
Bekaa plain	221(6.5%)	9.95(6.07)		12.28(6.31)	
Number of smokers at home			<0.001*		<0.001‡
No smokers	896(26.5%)	9.00(5.51)		11.98(5.19)	
One smoker	1022(30.2%)	8.87 (5.65)		11.68(5.44)	
Two smokers	722(21.3%)	10.21(5.75)		12.46(5.45)	
Three and more	604(17.8%)	12.28(6.42)		16.21(5.92)	

*†ANOVA was used in all comparisons, with Bonferoni adjustment; Kruskall-Wallis non parametric test was used for marital status due to small subgroup size, with further Wilcoxon two-by-two comparison. ¶ Socioeconomic status of students was defined using their mean monthly income per family divided by the number of family members; afterwards, quartiles were calculated and used to classify individuals into four levels; we note that 524(15.5%) gave no valid answer for socio-economic status *All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ‡Difference significant between third category and others is significant; †South Lebanon significantly different from other regions*

Table 3 – LWDS-11 & YACD means bivariate analysis with societal influence

Characteristic†	LWDS-11 Mean (SD)	p-value	YACD Mean (SD)	p-value
Successful people smoke		<0.001*		<0.001¶
Yes	9.93(5.80)		12.81(5.91)	
Maybe	9.61(5.61)		12.50(5.39)	
No	11.92(6.90)		16.43(5.66)	
Cool people smoke		0.163		0.002#
No	9.93(6.30)		12.79(5.91)	
Maybe	9.91(5.99)		13.88(5.95)	
Yes	10.79(5.91)		14.76(5.94)	
Rich people smoke		0.002*		<0.001¶
No	10.04(6.21)		12.71(5.89)	
Maybe	9.55(5.60)		13.72(5.89)	
Yes	11.79(5.86)		16.69(5.35)	
My idols smoke		0.030#		<0.001¶
No	10.03(6.09)		12.49(5.78)	
Maybe	9.90(5.69)		12.86(5.96)	
Yes	11.43(6.58)		16.77(5.65)	
For my parents, it is important not to smoke		<0.001*		<0.001¶
No	13.25(6.88)		16.99(5.24)	
Maybe	10.28(6.17)		16.18(5.51)	
Yes	9.78(5.78)		12.57(5.77)	
For my friends, it is important not to smoke		<0.001**		<0.001‡
No	12.22(6.50)		15.49(5.79)	
Maybe	10.00(5.65)		13.26(5.52)	
Yes	9.34(5.81)		13.05(6.19)	
For people of my age, it is important not to smoke		0.009*		0.088
No	11.33(6.31)		14.53(6.04)	
Maybe	9.37(5.69)		13.45(5.70)	
Yes	9.79(6.03)		13.39(6.06)	

†ANOVA was used in all comparisons, with Bonferoni adjustment; *All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ¶Difference was not significant between categories 1 & 2; ‡Difference was not significant between categories 2 & 3

Table 4 – Multivariate analysis tobacco use and dependence

Binomial dependent variable	Logistic regression Independent variables	Adjusted OR	[95% of CI]	p-value
Current waterpipe smoking†,‡	Studying in a private university	1.50	[1.26;1.79]	<0.001
	Successful people smoke	1.46	[1.29;1.65]	<0.001
	Cool people smoke	1.25	[1.12;1.39]	<0.001
	Friends think it is important not to smoke	0.86	[0.78;0.96]	0.006
	Ever smoking cigarettes	1.80	[1.44;2.26]	<0.001
	Female sex versus male	1.00	[0.83;1.21]	0.969
	Higher age class	1.01	[0.90;1.13]	0.871
Current cigarette smoking†,‡	Female sex versus male	0.24	[0.19;0.29]	<0.001
	Other than single marital status	2.63	[1.20;5.76]	0.016
	Higher age class	1.37	[1.19;1.57]	<0.001
	Mount Lebanon versus Beirut	1.37	[1.03;1.82]	0.029
	North Lebanon versus Beirut	1.46	[1.00;2.13]	0.053
	South Lebanon versus Beirut	0.48	[0.30;0.78]	0.003
	Bekaa plain versus Beirut	0.61	[0.36;1.02]	0.057
	Studying in a private university	1.96	[1.58;2.43]	<0.001
	Successful people smoke	1.75	[1.52;2.01]	<0.001
	My idols smoke	1.13	[0.99;1.30]	0.074
	Parents think it is important not to smoke	0.81	[0.70;0.93]	0.002
	Ever smoking waterpipes	1.56	[1.22;1.99]	<0.001
Continuous dependent variable	**Multiple regression Independent variables**	**Adjusted standardized beta values**	**Adjusted Beta values [95% CI]**	**p-value**
LWDS-11 among WP smokers*,‡	Parents think it is important not to smoke	-0.124	-1.09[-1.79;-0.28]	0.002
	Friends think it is important not to smoke	-0.117	-0.87[-1.46;-0.28]	0.004
	My idols smoke	0.079	0.63[0.06;1.21]	0.031
	Higher age class	0.069	0.58[-0.01;1.17]	0.053
	Female sex versus Male	-0.019	-0.23[-1.09;0.64]	0.609
YACD among cigarette smokers**,‡	Parents think it is important not to smoke	-0.24	-1.87[-2.45;-1.29]	<0.001
	My idols smoke	0.16	1.18[0.56;1.80]	<0.001
	Rich people smoke	0.13	0.97[0.37;1.57]	0.002
	Successful people smoke	0.08	0.56[-0.02;1.14]	0.059
	Higher age class	0.07	0.58[-0.06;1.21]	0.075
	Female sex versus male	-0.06	-0.77[-1.77;0.24]	0.136

†Performed on whole university students sample; Conditions for sample adequacy satisfied; stepwise backward model; all other variables were not retained in the model. Gender and age class were forced in the models.

*R=0.255; Adjusted R square=0.065; Stepwise model; VIF<2; residuals are normal; all other variables were not retained in the model. Gender and age class were forced in the models.

**R=0.426; Adjusted R square=0.175; Stepwise model; VIF<2; residual are normal; all other variables were not retained in the model. Gender and age class were forced in the models.

‡Variables included in all models: marital status, socioeconomic classes, region of residence, private university (versus public), successful people smoke, cool people smoke, rich people smoke, my idols smoke, parents think it is important not to smoke, friends think it is important not to smoke, people of the same age think it is important not to smoke, smoking other type of tobacco. Gender and age class were forced in the models.

Waterpipe dependence in university students: effect of normative beliefs

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What this study adds

- This is the first study exploring normative believes effect on waterpipe smoking in university students
- Although the role of parents was not visible in decreasing WP smoking WP, their protective influence decreased WP dependence, a more deleterious behavior for health.
- We found out that efforts should be made to establish peer education and help parents advising their young offspring about the importance of non smoking WP.

Contributorship
All authors:
- Contributed to the study design and helped in data collection
- Contributed to the results' analysis reviewing
- Contributed to the manuscript drafting and reviewing

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Authors have no competing interests to declare.

Waterpipe dependence in university students: effect of normative beliefs

Abstract

Background: Waterpipe (WP) smoking is increasing in popularity, particularly in young people; this behavior is highly affected by peers and societal influence, and may induce addictive dependence, a more serious situation. The objective of this study was to measure the correlates, including normative beliefs, associated with waterpipe and cigarette prevalence and dependence. **Methods:** A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence scales.
Results: Correlates to WP smoking were studying in a private university and ever smoking cigarettes; clear friends' and societal influence were found on smoking behavior and dependence. Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence, a behavior that is considered more deleterious for health. Parents' and friends' disagreement with smoking had a protective effect on cigarette smoking and dependence, while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence. **Conclusion:** In conclusion, WP smoking and dependence are influenced by parents' and friends' opinions, and idols' smoking status; these results suggest the potential possibility of establishing peer education and help parents advising their young offspring about the importance of non smoking WP. Future research is necessary to further improve our understanding of motives for WP smoking and dependence.

Keywords: waterpipe, smoking, dependence, LWDS-11, YACD, peer pressure, parental guidance, normative belief.

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Article summary

Strengths of the study

- This is the epidemiological first study exploring normative believes effect on waterpipe smoking in university students
- This is the first study in the region concerning WP dependence in university students
- The study was conducted over a large number of university students in Lebanon
- Anonymity and non traceability of participants increases the possibility of straight answers
- The study showed that parents' opinion did not affect WP smokers, while it had a protective effect against WP dependence.

Limitations of the study

- The sample was not random, thus a selection bias could not be excluded
- Information bias is also possible, because results were based on self declared answers
- The use of self completed questionnaires may increase the risk of non response to certain items
- We have not taken into account all factors that may predict nicotine dependence
- Qualitative studies could be useful to further explain the results we obtained

Introduction

Waterpipe (WP) smoking is increasing in popularity, particularly among young people and university students *[1-4]*. WP is thought to contain toxic substances, similar to those contained in cigarette [*5-6*]. WP has been shown to increase the risk of several diseases, including chronic bronchitis [*7*], COPD [*8*], lung cancer [*9*], and other ailments [*9*].

WP has also been demonstrated to contain nicotine, the substance responsible, at least partially, of addictive effects [10*; 11*]. It has been associated to an identified dependence effect similar to what could be found with cigarette, in addition to a social factor that adds to its potential addictive effect [12]; as expected, WP dependence per se was associated with higher smoking frequency and higher risk of health effects among WP smokers, as compared to non dependent WP smokers [*7,8*].

The structure of the WP associated dependence concept was shaped by the previous development and validation of a specific score, the Lebanese Waterpipe Dependence Scale-11 (LWDS-11) [*13*]. The score included items of "smoking to please others" and "smoking for pleasure", two items shown to have a high importance in late adolescence and young adulthood [*14*]. The main motives for WP smoking are declared to be socializing, relaxation, pleasure and entertainment; this was suggested in a systematic review with qualitative data synthesis of numerous studies. Peer pressure, fashion, and curiosity were additional motives declared by university students, while expression of cultural identity seemed an additional motive for people in the Middle East *[14, 15]*.

Among young cigarette smokers, students' perceptions of smoking among the successful/elite and disapproval by parents/peers were independently associated with susceptibility to smoking [16]. In parallel, some epidemiological studies were conducted to evaluate these effects in case of WP smoking, and showed that parents' tolerance of WP smoking, peer WP smoking and the idea of popularity were main motives for this behavior *[17-19]*.

For cigarette dependence, earlier onset of at least once a month cigarette smoking, heavier overall consumption and peers' smoking were associated with higher nicotine dependence in Saudi young students *[20].* Moreover, parental smoking restrictions may have the potential to impede adolescent progression to adult smoking behavior by reducing smoking rates and nicotine dependence *[21].*

In parallel, very few studies have been conducted to our knowledge regarding WP dependence, particularly in the Middle Eastern region, while normative beliefs have hardly been addressed. Thus, although we may know what drives WP smoking in youngsters, no studies have ever quantitatively assessed the magnitude of normative beliefs influences among university smokers on WP dependence, a more deleterious behavior for health. The objective of this study was to measure the correlates, including normative beliefs, associated with waterpipe and cigarette prevalence and dependence.

Methods

Population and sampling

A cross-sectional study was carried out; using a proportionate cluster sample of Lebanese students in the public and private universities. A list of universities in Lebanon, provided by the Center for Pedagogic Researches, was used to adjust the sample size *[22]*. A sample size of at least 3000 individuals was targeted to allow for adequate power for bivariate and multivariate analysis to be carried out on several factors; this sample size is powerful enough for any factor prevalence and association OR above 2.

Most universities' administrative offices in Lebanon that we approached did not allow drawing a random sample of their enrolled students to participate in the study: they did not provide us with the lists of students and permission was not granted to enter classrooms and search for students nominatively. Thus our research group had to work with a nonrandom sample of students outside their classes. Students were approached on campus during break times between courses by a field worker.

The latter explained the study objectives to the student; and after obtaining oral consent, the student was handed the anonymous and self-administered questionnaire. On average, the questionnaire was completed by participants within approximately 20 minutes. At the end of the process, the completed questionnaires were placed in closed boxes and sent for data entry. During the data collection process, the anonymity of the students was guaranteed, to allow for lower information bias. Out of 4900 distributed questionnaires, 3384 (69.1%) were returned to the field worker; the sample included students from 17 universities (the public university of Lebanon that accounts for half the university students in Lebanon and 16 private ones which account together for the other half). Further methodological details are presented in more details elsewhere *[3]*.

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Questionnaires

The questionnaire used in this study was composed of several parts, including the socio-demographic part, and a detailed active and passive smoking history, in addition to items of the tobacco dependence questions. Socioeconomic status of students was defined using their mean monthly income per family divided by the number of family members; afterwards, quartiles were calculated and used to classify individuals into four levels.

Current WP smoking was defined as smoking at least one WP per month, while current cigarette smoking was defined as smoking at least one cigarette per day. For cigarette dependence, we used the Young Adults Cigarette Dependence (YACD) scale *[23]*, and for waterpipe dependence, the LWDS-11 *[13],* both of which were developed by our team for the Lebanese population. The YACD has been developed for university students; it is composed of sixteen items, loading over six factors: nicotine dependence, craving intensity; positive reinforcement and negative reinforcement *[23]*. The LWDS-11 is composed of a 11 items, loading on a 4 factors structure in adults: nicotine physiological dependence, positive reinforcement, negative reinforcement, and psychological craving [*13*]; its validity and reliability had to be confirmed in this young adults' sample before use.

Moreover, normative beliefs questions were taken from a study performed on cigarette smokers by Primack and collaborators: measures of students' perceptions of smoking among successful people, cool people and idols, and disapproval by parents and peers were evaluated by Likert scale questions *[16]:* 0 indicated strongly disagree; 1, disagree; 2, maybe, 3, agree; and 4, strongly agree. These were further collapsed in bivariate analysis into yes (3 & 4), maybe (2), and no (0&1).

Statistical analysis

Data entry was performed by independent lay persons that were unaware of the objectives of the study; these were masters' students that were not involved in data collection process. Data cleaning was performed by researchers, and a sample of 50 questionnaires was completely

checked for errors. The error rate was lower than 1%; thus, data entry was considered adequate.

Statistical analysis was performed using SPSS software, version 13.0. A p-value of 0.05 was considered significant. Cluster sampling effect was taken into account according to Rumeau-Roquette and collaborators [24]. Data weighting was performed according to the total number of students per university, as described by the Center for Educational Research and Development – Lebanese Ministry of Education [22].

To confirm the LWDS-11 validity and reliability in the study sample, an exploratory factor analysis was first performed with its items, after ensuring sample adequacy with the Kaiser-Meyer-Olkin (KMO) index, and Bartlett's Chi square test of sphericity. Factors were extracted using the principal component analysis. Items were retained if they loaded 0.4 or more on factors. Since factors were found to be correlated, we chose to perform a promax rotation with Kaiser normalization. Afterwards, reliability analysis was performed by Chronbach's alpha values for factors and the total scale.

Comparison of means was performed using ANOVA in bivariate analysis, with Bonferoni correction on post-hoc tests. Non parametric tests were used in case of small subgroups (Kruskall-Wallis and Wilcoxon tests, respectively).

To decrease confounding bias, we performed multivariate analyses: multiple regressions were carried out using a stepwise backward method, after ensuring sample adequacy, linearity of the model, residual normality, and non collinearity of retained items (Variance Inflation Factor < 2). We took WP dependence and cigarette dependence as dependent variables in respective models, using socio-demographic characteristics normative beliefs and other forms of smoking (i.e. WP smoking among cigarette smokers and cigarette smoking among WP smokers) as independent variables. Both dependent variables were normally distributed. A p-value <0.05

was considered significant; missing data was not replaced for this analysis due to their low percentage (<10%).

For indicative purposes, we also conducted multiple logistic regressions, using current waterpipe and cigarette smoking as dichotomous dependent variables respectively, and socio-demographic characteristics, other forms of smoking and normative beliefs as independent variables. After ensuring non colinearity and sampling adequacy by Hosmer-Lemeshow test, we reported adjusted odds ratios (aOR).

Results

Among 3384 university students, 779 (23%) reported they were current WP smokers, and 649(19.2%) that they were current cigarette smokers. Among WP smokers, 760 (97.6%) answered to all questions of the LWDS-11 scale, while among cigarette smokers, 595 (91.7%) answered to the complete YACD scale questions.

Description of the current WP and cigarettes smokers' subsamples

Among WP smokers (n=779), the mean number of waterpipes smoked per week was 4.12 (SD=4.76), while the mean duration of smoking was 6.96 years (SD=2.33). The mean age of the first waterpipe intake was 16.46 years (SD=2.43). Among WP smokers, 35% declared having the intention to stop smoking later, and 20% declared wanting to stop smoking immediately. Moreover, 28.7% ever tried to stop smoking but did not succeed. LWDS mean was 10.23, its median was 9, and standard deviation 6.03. The minimum was zero and maximum 30. Its distribution was almost normal, with a skewness of 0.1.

Among cigarette smokers (n=649), the mean number of cigarettes smoked per day was 17.23 (SD=9.3), while the mean duration of smoking was 4.32 years (SD=2.25). The mean age of the first cigarette intake was 15.89 years (SD=2.35). Among cigarette smokers, 43.2% declared having the intention to stop smoking later, and 27.2% declared wanting to stop smoking immediately. Moreover, 48.7% ever tried to stop smoking but did not succeed. YACD mean was 13.92, its median was 14.04, and standard deviation 5.95. The minimum was 2.5 and maximum 29. Its distribution was almost normal, with a skewness of 0.6.

We note that 234(6.9% of the total students sample) were currently dual smokers of both cigarettes and WP. They constituted 36.4% of cigarette smokers and 30% of current WP smokers.

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Validity and reliability of the LWDS-11 in Lebanese university students

The Kaiser-Meyer-Olkin Measure of sampling adequacy was 0.79 (p<0.001). All communalities were higher than 0.35, and the extracted principal component sums of squared loadings explained 66.58% of the total variance.

The Promax rotation with Kaiser normalization gave a four factors solution with the following pattern (Table 1): factor 1 (physiological dependence; 33.14% of the variance explained), factor 2 (psychological craving; 13.08% of the variance explained), factor 3 (negative reinforcement; 11.59% of the variance explained) and factor 4 (positive reinforcement; 8.78% of the variance explained). Reliability measured by Cronbach's alpha for the total score was 0.77. We note that the structure is highly similar to the one found in adults, with one difference: the income item which originally loaded on physiological dependence, now loaded on psychological craving. For the rest of psychometric properties, the scale gave almost identical results.

Factors were correlated with each others: factor 1 correlated with factors 2 ($r_{12}=0.42$), 3 ($r_{13}=0.39$) and 4 ($r_{14}=0.09$), factor 2 correlated with factors 3 ($r_{23}=0.40$) and 4 ($r_{24}=0.02$), and factor 3 correlated with factor 4 ($r_{34}=0.14$).

Waterpipe and cigarette dependence variation with socio-demographic characteristics

In table 2, we firstly present the characteristics of the whole sample of university students, for descriptive purposes. Waterpipe dependence was significantly higher in widow or divorced individuals, and among individuals who have higher numbers of smokers at home (table 2). However, cigarette dependence was higher in males, lower socioeconomic status individuals, the 20-21 years age class, the public university, and among individuals who have higher numbers of smokers at home; it was also lower in South Lebanon versus other regions (table 2).

Normative beliefs influence on waterpipe and cigarette dependence

Waterpipe dependence was higher in case individuals believed that successful people smoke, rich people smoke, their idols smoke; it was lower in case individuals knew it was important for their parents, their friends and people of their age that they do not smoke (table 3). Nearly

similar results were found for cigarette dependence, except for an additional significant higher

dependence in case individuals believed that cool people smoked, and a lower trend for

significant for the peers' opinion about smoking (table 3).

Multivariate analysis of WP and cigarette current smoking

Studying in a private university and ever smoking cigarettes were correlated to current

waterpipe smoking; moreover, thinking that successful and cool people smoke increased the

odds of being a current waterpipe smoker, while having friends who disagree with smoking was

correlated with lower waterpipe smoking (table 4). On another hand, being of male sex, not

single, higher age, residing in Mount or North Lebanon, studying in a private university, and

ever smoking waterpipes increase the odds of being a current cigarette smoker; thinking that

successful people or idols smoke was correlated to increased cigarette smoking probability,

while having parents who disagree with smoking was correlated with lower cigarette smoking

(table 4).

Multivariate analysis of WP and cigarette dependence

In multiple regression of WP dependence, parents and friends' opinion against smoking were

inversely associated while belief that idols smoke were positively associated with WP

dependence; moreover, higher age class was also associated with higher WP dependence

(Table 4). For cigarette dependence, parents' opinion against smoking was strongly and

inversely associated, while the perception that idols, rich and successful people smoked were

positively associated with cigarette dependence (Table 4).

We note that performing the analysis among dual smokers gave similar results of dependence

correlates for both WP and cigarettes with normative beliefs, except for a visible association of

dual dependence with male gender versus females (OR=5.10[2.83; 9.19]; p<0.001) (other

results not shown).

Discussion

In this study, we found that correlates of current WP smoking were studying in a private university (representing access to money), ever smoking cigarettes, and clear friends' and societal influence, as found in other studies [17-19; 25]. Moreover, friends' disagreement with smoking decreased WP dependence: in the latter case, smoking for conviviality during social gatherings is absent, and this component of positive reinforcement and cue for smoking in many individuals would be expected to affect individuals' dependence to WP [13]. Idols' smoking of university students increased the risk of WP dependence, which may also be considered the reverse side of the medal of the societal influence.

Age increased the risk of WP dependence; this may be explained by the establishment of this habit with time during life in university and more frequent exposure, or due to its possible insidious nature of dependence that may only appear after repeated exposures. The nature of WP dependence installation may differ from cigarette dependence that seems to install in young people after only a few cigarettes [26-28]. Indeed, Asfar et al have shown the existence of beginners and established WP smokers, the latter being less willing to quit WP smoking and more hooked on the habit [29].

Although the role of parents was not visible in decreasing the risk of smoking WP, their protective influence seemed more important on WP dependence; the latter behavior has been shown to be more deleterious for health [7, 8]. A social tolerance of WP smoking by parents may explain this finding [17], who may intervene with their offspring in case of dependence only; additional studies are necessary to evaluate whether parents are able to differentiate between occasional WP smokers and dependent WP smokers among their children.

As for cigarette smoking, numerous socio-demographic factors were found to correlate with the behavior: male sex, high age, married/widow/divorced marital status, residing in Mount and North Lebanon, studying in a private university and ever smoking waterpipes. Parents' disagreement with smoking had a protective effect on cigarette smoking and dependence,

while thinking that idols and successful people smoke increased the risk of both cigarette smoking and dependence, similarly to other researchers' findings *[16; 30]*. Friends influence was also visible, as with other studies *[16; 30-31]*.

The idea of dual smoking deserves to be noted: smoking one kind of tobacco is associated with higher odds of smoking the other, and being dependent to one kind of tobacco increases the risk of dependence to other kinds. Similar results were found in British university students, where cigarette smoking was a major motive for waterpipe smoking *[32]* and in US students, where the majority of WP smokers were also cigarette smokers *[33]*. The fact that dependence to cigarettes and to waterpipe includes nicotine dependence components clearly explains this finding *[11; 34-35]*. This may also biologically be confirmed with results found by Rastam and collaborators, where cigarette and WP both decrease nicotine craving symptoms in dual smokers, and WP may interact with cigarette smoking cessation *[36]*.

One more conceptual issue deserves our attention: the LWDS-11 was of adequate validity and reliability in university students of Lebanon; the structure was highly similar to the one found in adults *[13]*, with one difference: the income item which originally loaded on physiological dependence in adults, now loaded more adequately on psychological craving among students. One explanation could be that may adults adapt their smoking frequency and agree to pay portions of their incomes according to usual physiological nicotine needs, while younger university students would be ready to pay higher portions of their incomes only in case of extreme psychological craving (which is considered a more compelling urge than usual physiological dependence). Access to money being more limited for university students than for working adults may clarify this issue; in parallel, it is worth noting that in the YACD, the money item had also loaded on the psychological craving factor, not on the nicotine dependence factor *[23]*. Additional qualitative studies would be necessary to confirm this finding; nevertheless, the LWDS-11 demonstrated adequate validity and reliability, and could thus be used for the current study.

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Limitations of the study

Our study, as with any, has its limitations: a selection bias could have been possible since the sample is not a random sample and may not be representative of the young adults and students' population in Lebanon. This non random sampling could lead to an overrepresentation of students who skip classes and may have higher risky behaviours, such as smoking. There could also be a possibility of respondent and information bias, since the results of our study are based on a self-administered questionnaire. Despite the fact that we ensured anonymity and confidentiality of all data that has been collected, respondents may have underreported some of their behaviours that lead to missing values. Furthermore, we have not taken into account all factors that may predict nicotine dependence, since it has been shown that background factors, psychological characteristics and genetic variation in nicotinic cholinergic receptors contribute independently or interactively to smoking initiation and to severity of nicotine dependence in young people *[37].* We suggest that further research be carried taking into account these limitations; we also suggest prospective studies to thoroughly evaluate the effect of parents and friends on future smoking behaviours, in addition to qualitative research that can explore the knowledge, attitudes, and values behind these behaviours.

Conclusion

In conclusion, WP smoking and dependence are influenced by parents' and friends' opinions, and idols' smoking status; these results suggest the potential possibility of establishing peer education and help parents advising their young offspring about the importance of non smoking WP. Future research is necessary to further improve our understanding of motives for WP smoking and dependence.

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Table 1 – Validity and reliability of the LWDS-11 among university students of Lebanon

Items	Factor 1 Physiological dependence	Factor 2 Psychological craving	Factor 3 Negative reinforcement	Factor 4 Positive reinforcement
How many times were you able to stay 7 days without smoking waterpipe?	0.877			
How many days could you stay without smoking waterpipe?	0.871			
Number of smoked waterpipes per week?	0.798			
Would you smoke waterpipe even if you are ill/ bedridden?		0.836		
Are you ready not to eat in exchange for a waterpipe?		0.827		
Would you smoke waterpipe alone?		0.547		
How much of your income are you ready to pay for waterpipe smoking?		0.426		
Smokes waterpipe to relax his nerves			0.868	
Smokes waterpipe to improve his morale			0.862	
Smokes waterpipe to please others (conviviality)				0.910
Smokes waterpipe for pleasure				0.573
Cronbach's alpha reliability measure	0.806	0.659	0.671	0.527

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Table 2 –LWDS-11 and YACD means in different socio-demographic categories of smokers

Characteristic†	Total n=3384	LWDS-11 Mean (SD)	p-value	YACD (SD)	p-value
Sex			0.082		0.006
Male	1980(58.5%)	10.62(6.21)		14.22(5.95)	
Female	1399(41.3%)	9.86(5.84)		12.70(5.98)	
Marital status			0.006*		0.664
Married	115(3.4%)	10.00 (4.85)		14.76(7.65)	
Single	3243(95.8%)	10.19(6.02)		13.84(5.99)	
Widow or divorced	9(0.3%)	17.50 (6.17)		11.5(0.00)	
Socio-economic status quartiles¶			0.35		0.051
Quartile 1	736(21.7%)	9.69(5.51)		15.61(6.09)	
Quartile 2	746(22.0%)	10.67(5.78)		14.11(6.11)	
Quartile 3	632(18.7%)	9.68(6.04)		13.51(5.65)	
Quartile 4	746(22.1%)	10.47(6.90)		13.70(5.95)	
Age classes			0.053**		<0.001*
17-19 years	958(28.3%)	9.42(5.86)		11.69(5.37)	
20-21 years	1424(42.1%)	10.75(5.88)		14.93(5.90)	
22 years and more	982(29.0%)	10.14(6.36)		13.27(6.07)	
Private university	1754(51.8%)	10.21(6.03)	0.422	13.33(5.88)	0.005
Public university	1630(48.2%)	9.86(6.07)		14.77(6.09)	
Region			0.135		<0.001†
Beyrouth	526(15.5%)	10.72(6.62)		13.21(5.99)	
Mount Lebanon	1606(47.5%)	9.55(6.03)		14.05(5.89)	
North Lebanon	505(14.9%)	10.91(4.87)		15.47(6.43)	
South Lebanon	474(14.0%)	10.55(6.21)		9.99(3.47)	
Bekaa plain	221(6.5%)	9.95(6.07)		12.28(6.31)	
Number of smokers at home			<0.001*		<0.001‡
No smokers	896(26.5%)	9.00(5.51)		11.98(5.19)	
One smoker	1022(30.2%)	8.87 (5.65)		11.68(5.44)	
Two smokers	722(21.3%)	10.21(5.75)		12.46(5.45)	
Three and more	604(17.8%)	12.28(6.42)		16.21(5.92)	

*†ANOVA was used in all comparisons, with Bonferoni adjustment; Kruskall-Wallis non parametric test was used for marital status due to small subgroup size, with further Wilcoxon two-by-two comparison. ¶ Socioeconomic status of students was defined using their mean monthly income per family divided by the number of family members; afterwards, quartiles were calculated and used to classify individuals into four levels; we note that 524(15.5%) gave no valid answer for socio-economic status *All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ‡Difference significant between third category and others is significant; †South Lebanon significantly different from other regions*

Table 3 – LWDS-11 & YACD means bivariate analysis with societal influence

Characteristic†	LWDS-11 Mean (SD)	p-value	YACD Mean (SD)	p-value
Successful people smoke		<0.001*		<0.001¶
Yes	9.93(5.80)		12.81(5.91)	
Maybe	9.61(5.61)		12.50(5.39)	
No	11.92(6.90)		16.43(5.66)	
Cool people smoke		0.163		0.002#
No	9.93(6.30)		12.79(5.91)	
Maybe	9.91(5.99)		13.88(5.95)	
Yes	10.79(5.91)		14.76(5.94)	
Rich people smoke		0.002*		<0.001¶
No	10.04(6.21)		12.71(5.89)	
Maybe	9.55(5.60)		13.72(5.89)	
Yes	11.79(5.86)		16.69(5.35)	
My idols smoke		0.030#		<0.001¶
No	10.03(6.09)		12.49(5.78)	
Maybe	9.90(5.69)		12.86(5.96)	
Yes	11.43(6.58)		16.77(5.65)	
For my parents, it is important not to smoke		<0.001*		<0.001¶
No	13.25(6.88)		16.99(5.24)	
Maybe	10.28(6.17)		16.18(5.51)	
Yes	9.78(5.78)		12.57(5.77)	
For my friends, it is important not to smoke		<0.001**		<0.001‡
No	12.22(6.50)		15.49(5.79)	
Maybe	10.00(5.65)		13.26(5.52)	
Yes	9.34(5.81)		13.05(6.19)	
For people of my age, it is important not to smoke		0.009*		0.088
No	11.33(6.31)		14.53(6.04)	
Maybe	9.37(5.69)		13.45(5.70)	
Yes	9.79(6.03)		13.39(6.06)	

†ANOVA was used in all comparisons, with Bonferoni adjustment; *All two by two differences were significant; ** Difference significant between the first two categories; # Difference between first and third categories was significant; ¶Difference was not significant between categories 1 & 2; ‡Difference was not significant between categories 2 & 3

Table 4 – Multivariate analysis tobacco use and dependence

Binomial dependent variable	Logistic regression Independent variables	Adjusted OR	[95% of CI]	p-value
Current waterpipe smoking†,‡	Studying in a private university	1.50	[1.26;1.79]	<0.001
	Successful people smoke	1.46	[1.29;1.65]	<0.001
	Cool people smoke	1.25	[1.12;1.39]	<0.001
	Friends think it is important not to smoke	0.86	[0.78;0.96]	0.006
	Ever smoking cigarettes	1.80	[1.44;2.26]	<0.001
	Female sex versus male	1.00	[0.83;1.21]	0.969
	Higher age class	1.01	[0.90;1.13]	0.871
Current cigarette smoking†,‡	Female sex versus male	0.24	[0.19;0.29]	<0.001
	Other than single marital status	2.63	[1.20;5.76]	0.016
	Higher age class	1.37	[1.19;1.57]	<0.001
	Mount Lebanon versus Beirut	1.37	[1.03;1.82]	0.029
	North Lebanon versus Beirut	1.46	[1.00;2.13]	0.053
	South Lebanon versus Beirut	0.48	[0.30;0.78]	0.003
	Bekaa plain versus Beirut	0.61	[0.36;1.02]	0.057
	Studying in a private university	1.96	[1.58;2.43]	<0.001
	Successful people smoke	1.75	[1.52;2.01]	<0.001
	My idols smoke	1.13	[0.99;1.30]	0.074
	Parents think it is important not to smoke	0.81	[0.70;0.93]	0.002
	Ever smoking waterpipes	1.56	[1.22;1.99]	<0.001
Continuous dependent variable	Multiple regression Independent variables	Adjusted standardized beta values	Adjusted Beta values [95% CI]	p-value
LWDS-11 among WP smokers*,‡	Parents think it is important not to smoke	-0.124	-1.09[-1.79;-0.28]	0.002
	Friends think it is important not to smoke	-0.117	-0.87[-1.46;-0.28]	0.004
	My idols smoke	0.079	0.63[0.06;1.21]	0.031
	Higher age class	0.069	0.58[-0.01;1.17]	0.053
	Female sex versus Male	-0.019	-0.23[-1.09;0.64]	0.609
YACD among cigarette smokers**,‡	Parents think it is important not to smoke	-0.24	-1.87[-2.45;-1.29]	<0.001
	My idols smoke	0.16	1.18[0.56;1.80]	<0.001
	Rich people smoke	0.13	0.97[0.37;1.57]	0.002
	Successful people smoke	0.08	0.56[-0.02;1.14]	0.059
	Higher age class	0.07	0.58[-0.06;1.21]	0.075
	Female sex versus male	-0.06	-0.77[-1.77;0.24]	0.136

†Performed on whole university students sample; Conditions for sample adequacy satisfied; stepwise backward model; all other variables were not retained in the model. *Gender and age class were forced in the models.*

*R=0.255; Adjusted R square=0.065; Stepwise model; VIF<2; residuals are normal; all other variables were not retained in the model. *Gender and age class were forced in the models.*

**R=0.426; Adjusted R square=0.175; Stepwise model; VIF<2; residual are normal; all other variables were not retained in the model. *Gender and age class were forced in the models.*

‡Variables included in all models: marital status, socioeconomic classes, region of residence, private university (versus public), successful people smoke, cool people smoke, rich people smoke, my idols smoke, parents think it is important not to smoke, friends think it is important not to smoke, people of the same age think it is important not to smoke, smoking other type of tobacco. *Gender and age class were forced in the models.*

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported on page
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7-8
Bias	9	Describe any efforts to address potential sources of bias	6-7
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7-8
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	NA

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	9
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	*NA*
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	*NA*
		Cross-sectional study—Report numbers of outcome events or summary measures	*9*
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-10
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-13
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007; **370**:1453-7