FACTORS RELATED TO TOBACCO USE AMONG MIDDLE SCHOOL STUDENTS IN CHINA

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Abstract. The objectives of this study were to determine the status of tobacco use among middle school students in China, and to identify factors related to tobacco use. The study was conducted in December 2009. An ecological model was used to formulate the conceptual framework of the study. Three thousand two hundred twenty-one middle school students aged 12-17 years were selected by three stage stratified cluster sampling. Data were collected by self-completed questionnaires and interviews. The prevalence of current smoking was 10.6%; 16.2% among males and 4.3% among females. The prevalence of ever having smoked was 19.7%, 25.3% among males and 13.4% among females. Zero point seven percent of middle school students used other forms of smoked tobacco products other than cigarettes. Multinomial logistical regression analysis found gender, age, knowledge, attitude, life skills, self-concept, parental smoking, friends smoking, friends attitudes toward smoking, peer pressure, family rules, availability of cigarettes, tobacco-free school environment, smoking intervention program, community tobacco control activities, and tobacco control policies had significant associations with smoking behavior. Structural equation modeling (SEM) analysis found intrapersonal factors had direct relationships with smoking behavior among smoking middle school students. Interpersonal factors, organizational factors and policies had indirect relationships with smoking behavior, and through intrapersonal factors affected smoker behavior among middle school smoking students.

Keywords: tobacco use, ecological model, middle school students

INTRODUCTION

Tobacco use is an important public health problem. Tobacco use is a risk factor for six of the eight leading causes of death in the world (WHO, 2008). Tobacco kills more than AIDS, legal drugs, illegal drugs, road accidents, murders and suicides combined (WHO, 2004). China is the world's largest tobacco producer and consumer. Tobacco production has continued to grow along with the number of young people who are smoking (Ministry of Health, 2007, 2008). China has the largest smoking problem of any nation on earth. Nearly 30% of the world's smokers

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live in China (WHO, 2004, 2008). Studies estimate that by 2025, deaths caused by tobacco will increase to 2 million each year (Ministry of Health, 2008).

Most people begin using tobacco before the age of 18 years (US Department of Health and Human Services, 1994; WHO, 2004). In China, the rates of experimentation and current smoking among young people are increasing every year. It is estimated 15 million young people are current smokers (Ji, 2007; Ministry of Health, 2008).

Ecological models are comprehensive health promotion models. The models propose behaviors are influenced by intrapersonal factors, interpersonal factors, organizational factors, community factors, societal factors and public policy (Mcleroy *et al*, 1988; Glanz *et al*, 2008). According to ecological models, multiple factors influence tobacco use among youth. These factors are likely to interact with each other. Few studies have been able to use ecological analysis and fewer still have been able to understand ecological levels well enough to create interventions to change them (Valente, 2002).

Since the World Health Organization (WHO) Frame work Convention of Tobacco Control (FCTC) was adopted in China, tobacco policies and other ecological factors affecting youth tobacco use have varied greatly. Despite increasing tobacco use, little attention has been paid to factors influencing tobacco use among middle school students in China, especially in Anhui Province. Identifying the level of tobacco use and the factors affecting tobacco use among youth is important for prevention. The objective of this study was to study tobacco use and the factors influencing it among middle school students in China using an ecological model.

MATERIALS AND METHODS

Study area and population

Anhui Province is located in the northwestern part of eastern China. The Province covers an area of 139,600 km^2. The population of Anhui was 66.76 million at the end of 2007. Anhui has 17 main cities and 56 counties. The study population in this study was students aged 12-17 years from two cities of Anhui Province. Three thousand two hundred and thirty-one students were randomly selected by three stage stratified cluster sampling. During the first stage, two cities were randomly selected. During the second sampling stage, eight schools were randomly selected. In the third sampling stage, two classes were randomly selected for each grade at each school. All enrolled students in the selected classes were eligible to participate in the survey. Student participation was voluntary.

Study variables and data analysis

Data collection took place 3-15 December 2009 using quantitative and qualitative methods. Demographic characteristics, general information, intrapersonal factors, interpersonal factors and tobacco use were obtained with a structured questionnaire. Organizational factors, community factors and public policies were collected by interviews with people of different ecological groups.

Intrapersonal factors included age, gender, academic performance, knowledge, attitude, life skills, self-esteem and self-concept. Ten items were administrated to measure smoking-related knowledge. The answer format was dichotomous (true or false). Attitudes towards tobacco use were measured by six items. Responses were recorded; there were 3 options: agree, uncertain and

disagree. Life skills included critical thinking, communication skills, coping with stress and interpersonal relationship skills. Thirty items were administrated to measure critical thinking and communication skills. Sixteen items were administrated to measure stress coping skills and interpersonal relationship skills. Self-esteem was measured using the Rosenberg Self-Esteem Scale (Murphy *et al*, 1988) with answers being given according to a four-point Likert scale from strongly agree to strongly disagree. Self-concept was measured using the Taiwan Ling Jia Ping Self-Concept Scale which was adapt from the Tennessee Self Concept Scale (Fitts *et al*, 1996). The scale has a sixty items. Respondents were asked to report how true each statement was using a six-point Likert-scale. The questionnaires were tested on 223 tried students as a preliminary survey. The Cronbach's alpha coefficient was 0.839. Interpersonal factors included parental tobacco use, parental attitudes, family rules, teachers' tobacco use, teachers' attitudes, friends' tobacco use and friends' attitudes. Organizational factors included a tobacco-free school policy, a tobacco-free school environment, school health education and a tobacco intervention program. Community level factors and public policy included community tobacco control activities, availability of cigarettes and tobacco-control policies.

For tobacco use, the respondents were classified into current use of tobacco, ever used tobacco and never used tobacco, following the Global Youth Tobacco Survey (GYTS) core questionnaire (CDC, 2008).

The data were analyzed with SPSS and AMOS. Descriptive statistics, the chi-square test, multinomial logistic regression and structural equation modeling (SEM) were used in this study. The multinomial logistic regression factors are showing in Table 1.

Table 1
Factors for multinomial logistic regression.

Variable	Variable coding
Smoking history	0=Never smoked, 1=Ever smoked, 2=Current smoking
Gender	1=Male, 2=Female
Parental smoking	1=Yes, 2=No
Friends smoking	1=Yes, 2=No
Friends attitude	1=Favorable, 2=Unfavorable
Peer pressure	1=Yes, 2=No
Access to cigarettes	1=Yes, 2=No
Family rules	0=No, 1= Yes
Knowledge	1=Low, 2=Moderate, 3=High
Attitudes	1=Favorable, 2=Moderate, 3=Unfavorable
Life skills	0=Low, 1=High
Self-concept	0=Low, 1=High
Tobacco-free school environment	0=No, 1=Yes
Intervention program	0=No, 1=Yes
Community activity	0=No, 1=Yes
Tobacco policy	0=No, 1=Yes

RESULTS

Three thousand two hundred thirty-one questionnaires were completed, a response rate of 100.0%. Of the 3,231 students, 55.2% lived in a rural area and 44.8% lived in an urban area. Females comprised 47.1% and males comprised 52.9%. Subjects were aged 12 to 17 years old: 16.6% were aged 12 years, 17.2% were 13 years old, 17.5% were 14 years

Table 2
Type of tobacco use classified by gender.

Tobacco use	Total		Male		Female	
	Number	Percent	Number	Percent	Number	Percent
Cigarette						
Never smoked	2,253	69.7	1,000	58.5	1,253	82.3
Ever smoked	636	19.7	432	25.3	204	13.4
Current smoker	342	10.6	277	16.2	65	4.3
Cigar or pipe						
Yes	24	0.7	18	1.1	6	0.4
No	3,207	99.3	1,691	98.9	1,516	99.6

Table 3
Age that smokers first tried a cigarette by gender.

Age (years)	Total		Male		Female	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
≤7	326	33.3	241	34.0	85	31.6
8 - 9	270	27.6	188	26.5	82	30.5
10-11	265	27.1	189	26.7	76	28.3
12-13	60	6.1	45	6.3	15	5.6
14-15	38	3.9	30	4.2	8	3.0
≥16	19	1.9	16	2.3	3	1.1
Total	978	100.0	709	100.0	269	100.0

old, 18.0% were 15 years old, 16.3% were 16 years old and 14.4% were 17 years old.

Patterns of tobacco use and smoking prevalence

The prevalence of ever having smoked was 19.7%, 25.3% of males and 13.4% of females. The prevalence of current smokers was 10.6%, 16.2% of males and 4.3% of females. Of the 3,231 students, 24 had used some other tobacco products (*eg*, cigars or pipe) than cigarettes (Table 2). No students were found to use smokeless tobacco products (*eg* chewing tobacco, snuff, dip).

Sixty point five percent of the males smoked their first cigarette before age 10; 62.1% of females smoked their first cigarette before age 10 years (Table 3).

Of the 342 current smokers, 47.1% smoked six or more cigarettes per day (Table 4); 36.0% smoked cigarettes at home, at friends' houses (18.7%) or in public spaces (15.8%). Only 2.3% of current smokers smoked at school (Table 5). Seventy point seven percent of current smokers, bought their cigarettes themselves. Sixty-seven point five percent of current smokers bought cigarettes at a store, 3.2% bought cigarettes from a vender (Table 6).

Table 4
Number of cigarettes smoked per day among current smokers.

Number	Frequency	Percent
Less than 1 cigarette	53	15.5
1 cigarette	32	9.4
2 to 5 cigarettes	96	28.1
6 to 10 cigarettes	92	26.9
11 to 20 cigarettes	69	20.2

Table 5
Location where smoked.

Place	Frequency	Percent
At home	123	36.0
At a friend's house	64	18.7
In a public place	54	15.8
At social events	42	12.3
At school	8	2.3
Other	51	14.9

Table 6
Source of cigarettes.

Source	Frequency	Percent
Bought at a store	231	67.5
Bought from a vender	11	3.2
Bought through someone	18	5.3
Borrowed from someone	16	4.7
An adult gave it	22	6.4
Took from family	21	6.1
Other	23	6.7

Factors related to smoking behavior of students

The factors related to smoking among students are shown in Tables 7, 8, 9, 10.

Multinomial logistical regression (forward stepwise) was used to analyze relationships between smoking behaviors

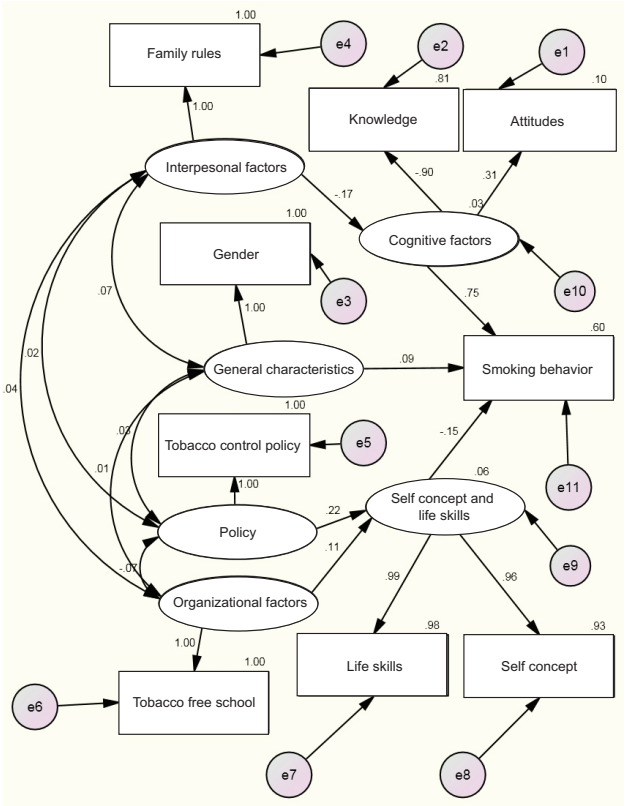

Fig 1–Standardized estimate of smoking behavior model among smoking students.

of students and ecological factors. The dependent variable was smoking behavior (never smoked, ever smoked and current smoking). Entry probability = 0.05, removal probability = 0.1 (Table 11).

Structural equation modeling (SEM) with analysis of moment structures (AMOS) was utilized to analyze the hypothesized relationships between ecological factors and the numbers of cigarettes smoked by students during the past 30 days (Fig 1). The measures of fit indices suggest the ecological model fit the data well (Chi-square = 25.958, Df = 20, P = 0.167; GFI = 0.983; AGFI = 0.963; RESEA = 0.03; CFI = 0.983; TLI = 0.992 and IFI = 0.995).

Table 7
Intrapersonal factors related to smoking.

Intrapersonal factors	Number	Cigarette use			*p*-value
		Never (%)	Ever (%)	Current (%)	
Knowledge					<0 .001
Low	637	193 (30.3)	288 (45.2)	156 (24.5)	
Moderate	909	564 (62.0)	209 (23.0)	136 (15.0)	
High	1,685	1,496 (88.8)	139 (8.2)	50 (3.0)	
Attitude					<0.001
Favorable	330	210 (63.6)	83 (25.2)	37 (11.2)	
Moderate	463	292 (63.1)	113 (24.4)	58 (12.5)	
Unfavorable	2,438	1,751 (71.8)	440 (18.0)	247 (10.1)	
Life skills					<0.001
Low	765	453 (59.2)	185 (24.2)	127 (16.6)	
High	2,466	1,800 (73.0)	451 (18.3)	215 (8.7)	
Academic performance					<0.001
Failure	224	119 (53.1)	17 (7.6)	88 (39.3)	
Poor	1,068	624 (58.4)	310 (29.0)	134 (12.5)	
Moderate	1,422	1,076 (75.7)	240 (16.9)	106 (7.5)	
Good	517	434 (83.9)	69 (13.3)	14 (2.7)	
Gender					<0.001
Male	1,709	1,000 (58.5)	432 (25.3)	277 (16.2)	
Female	1,522	1,253 (82.3)	204 (13.4)	65 (4.3)	
Age (years)					<0.001
12	537	438 (81.6)	66 (12.3)	33 (6.1)	
13	555	421 (75.9)	92 (16.6)	42 (7.6)	
14	565	404 (71.5)	107 (18.9)	54 (9.6)	
15	581	405 (69.7)	114 (19.6)	62 (10.7)	
16	527	331 (62.8)	133 (25.2)	63 (12.0)	
17	466	254 (54.5)	124 (26.6)	88 (18.9)	
Self-concept					<0.001
Low	656	222 (33.8)	280 (42.7)	154 (23.5)	
High	2,575	2,031 (78.9)	356 (13.8)	188 (7.3)	
Self esteem					<0.001
Low	289	137 (47.4)	42 (14.5)	110 (38.1)	
Moderate	1,556	907 (58.3)	494 (31.7)	155 (10.0)	
High	1,386	1,209 (87.2)	100 (7.2)	77 (5.6)	

DISCUSSION

This study showed the prevalence of ever having smoked was 19.7%, 25.3% of males and 13.4% of females. The prevalence of current smokers was 10.6%, 16.2% of males and 4.3% of females. The ever having smoked rate and current smoking rate in males were significantly higher than in females ($p<0.001$). The smoking prevalence in this study was higher than in a study from Huzhou City (Yu *et al*, 2007), and Zhuhai City (Chen *et al*, 2006). In this study, 60.9% of middle school students

Table 8
Interpersonal factors related to smoking.

Intrapersonal factors	Number	Cigarette use			*p*-value
		Never (%)	Ever (%)	Current (%)	
Parental smoking					<0.001
No	2,243	1,791 (79.8)	391 (17.4)	61 (2.7)	
Yes	988	462 (46.8)	245 (24.8)	281 (28.4)	
Parental attitude					<0.001
Favorable	547	140 (25.6)	152 (27.8)	255 (46.6)	
Unfavorable	2,684	2,113 (78.7)	484 (18.0)	87 (3.2)	
Family rules					<0.001
Prohibit smoking	227	203 (89.4)	19 (8.4)	5 (2.2)	
Do not prohibit smoking	3,004	2,050 (68.2)	617 (20.5)	337 (11.2)	
Friends smoke					<0.001
No	2,201	1,676 (76.1)	348 (15.8)	177 (8.0)	
Yes	1,030	577 (56.0)	288 (28.0)	165 (16.0)	
Friends attitudes					<0.001
Unfavorable	2,313	1,658 (71.7)	441 (19.1)	214 (9.3)	
Favorable	918	595 (64.8)	195 (21.2)	128 (13.9)	
Peer pressure					<0.001
No	1,826	1,383 (75.7)	295 (16.2)	148 (8.1)	
Yes	1,405	870 (61.9)	341 (24.3)	194 (13.8)	<0.001
Teachers smoke					
No	2,794	2,010 (71.9)	530 (19.0)	254 (9.1)	
Yes	437	243 (55.6)	106 (24.3)	88 (20.1)	

Table 9
Organizational factors related to smoking.

Organizational factors	Number	Cigarette use			*p*-value
		Never (%)	Ever (%)	Current (%)	
Tobacco-free school policy					<0.001
No	2,010	1,339 (66.6)	452 (22.5)	219 (10.9)	
Yes	1,221	914 (74.9)	184 (15.1)	123 (10.1)	
Tobacco-free school environment					0.011
No	2,845	1,959 (68.9)	573 (20.1)	313 (11.0)	
Yes	386	294 (76.2)	63 (16.3)	29 (7.5)	
School health education					<0.001
No	535	331 (61.9)	125 (23.4)	79 (14.8)	
Yes	2,696	1,922 (71.30)	511 (19.0)	263 (9.8)	
Smoking intervention program					0.007
No	2,235	1,531 (68.5)	473 (21.2)	231 (10.3)	
Yes	996	722 (72.5)	163 (16.4)	111 (11.1)	

Table 10
Community factors and public policies related to smoking.

Community factors	Number	Cigarette use			*p*-value
		Never (%)	Ever (%)	Current (%)	
Community tobacco control activity					0.021
No	2,461	1,688 (68.6)	510 (20.7)	263 (10.7)	
Yes	770	565 (73.4)	126 (16.4)	79 (10.3)	
Access to cigarettes					<0.001
Yes	2,911	1,995 (68.5)	593 (20.4)	323 (11.1)	
No	320	258 (80.6)	43 (13.4)	19 (5.9)	
Tobacco-control policy					<0.001
No	1,646	1,090 (66.2)	372 (22.6)	184 (11.2)	
Yes	1,585	1,163 (73.4)	264 (16.6)	158 (10.0)	

smoked their first cigarette before age 10. The WHO Global Youth Tobacco Survey (GYTS) for China found 32.5% of male students and 13% of female students had tried smoking and the average age of smoking initiation was 10.7 years (Warren *et al*, 2000). Compared with the results of the China GYTS, the smoking rates in our study show an increase in students who smoked before age 10 years (Ministry of Health PRC, 2008; WHO, 2008).

In our study, 0.7% of middle school students used other forms of smoked tobacco (*eg*, cigars and pipe). No students reported using smokeless tobacco products (*eg*, chewing tobacco, snuff, dip). Although standard cigarettes are the most commonly used form of smoked tobacco, other smoked tobacco products, such as bidis, kreteks and shisha, are gaining popularity (Guindon *et al*, 2003). In our study cigarettes were the most common tobacco product used by middle school student smokers in Anhui Province, China.

The intrapersonal factors related to smoking behavior in our study were gender, age, knowledge, attitudes, life skills and self-concept. Similar results were seen in some previous studies. In the GYTS for Indonesia, the prevalence of smoking among boys was significantly higher than among girls (Aditama *et al*, 2008). In China, the current smoking rate increased with age (Ji, 2007). Poor knowledge about the hazards of smoking and positive attitudes to smoking were independently associated with adolescent smoking (Zhang *et al*, 2000). Life skills were associated with smoking among girls (Epstein *et al*, 2003). The life skills can enhance personal competence and decrease motivations to use tobacco and vulnerability to social influences that support tobacco use (Botvin and Griffin, 2002). Self-concept was also associated with student tobacco use (Smith *et al*, 2004).

Interpersonal factors related to smoking behavior were parental smoking, friends smoking, friends attitudes toward smoking and family rules. A previous study of students in Zhejiang Province, eastern China (Hesketh *et al*, 2007) found parental smoking was the strongest predictor of adolescent smoking. Another study of junior middle school students in China (Fang *et al*, 2000) revealed

Table 11
Multinomial logistical regression of ecological factors related to smoking behavior.

Smoking status	Factor	B	SE (B)	*p*-value	OR	95% CI
Ever smoked	Community activity =0	0.815	0.292	0.005	2.258	1.274-4.002
	Community activity =1				1	
	Tobacco-free school =0	0.746	0.264	0.005	2.108	1.256-3.540
	Tobacco-free school =1				1	
	Life skills =0	1.102	0.177	<0.001	3.012	2.127-4.255
	Life skills =1				1	
	Knowledge =1	2.440	0.155	<0.001	11.470	8.467-15.538
	Knowledge =2	0.919	0.145	<0.001	2.506	1.888-3.328
	Knowledge =3				1	
	Friends attitude =1	0.393	0.165	0.017	1.481	1.071-2.049
	Friends attitude =2				1	
	Age =17	1.395	0.226	<0.001	4.036	2.590-6.289
	Age =16	1.170	0.219	<0.001	3.221	2.096-4.952
	Age =15	0.675	0.220	0.002	1.964	1.276-3.025
	Age =14	0.948	0.220	<0.001	2.581	1.675-3.976
	Age =13	0.687	0.226	0.002	1.989	1.278-3.095
	Age =12				1	
	Gender =1	0.679	0.126	<0.001	1.973	1.538-2.525
	Gender =2				1	
	Parental smoking =1	0.788	0.158	<0.001	2.197	1.612-2.994
	Parental smoking =2				1	
	Friends smoking =1	2.230	0.277	<0.001	9.259	5.405-16.129
	Friends smoking =2				1	
	Peer pressure =1	2.227	0.294	<0.001	9.250	5.208-16.393
	Peer pressure =2				1	
	Family rules =0	1.095	0.305	<0.001	2.985	1.642-5.434
	Family rules =1				1	
	Attitude =1	1.402	0.213	<0.001	4.062	2.676-6.166
	Attitude =2	0.690	0.236	0.004	1.993	1.254-3.168
	Attitude =3				1	
	Self-concept =0	2.433	0.169	<0.001	11.395	8.180-15.874
	Self-concept =1				1	
	Intervention program =0	1.566	0.355	<0.001	4.784	2.386-9.615
	Intervention program =1				1	
	Access to cigarettes =1	0.363	0.232	0.117	1.438	0.913-2.264
	Access to cigarettes =2				1	
	Tobacco policy =0	0.498	0.122	<0.001	1.645	1.294-2.090
	Tobacco policy =1				1	
Current smoker	Community activity =0	0.549	0.409	0.180	1.731	0.777-3.857
	Community activity =1				1	
	Tobacco-free school =0	1.146	0.330	0.001	3.147	1.647-6.013
	Tobacco-free school =1				1	

Table 11 (Continued)

Smoking status	Factor	B	SE (B)	*p*-value	OR	95% CI
	Life skills =1	0.723	0.245	0.003	2.061	1.275-3.333
	Life skills =2				1	
	Knowledge =1	3.048	0.223	<0.001	21.067	13.605-32.622
	Knowledge =2	1.668	0.215	<0.001	5.299	3.475-8.081
	Knowledge =3				1	
	Friends attitude =1	0.084	0.215	0.694	1.088	0.714-1.657
	Friends attitude =2				1	
	Age =17	1.652	0.295	<0.001	5.216	2.926-9.296
	Age =16	1.029	0.300	0.001	2.798	1.553-5.041
	Age =15	0.648	0.297	0.029	1.911	1.069-3.418
	Age =14	0.641	0.311	0.039	1.899	1.032-3.494
	Age =13	0.300	0.313	0.337	1.350	0.732-2.491
	Age =12				1	
	Gender =1	1.582	0.194	<0.001	4.878	3.333-7.092
	Gender =2				1	
	Parental smoking =1	3.151	0.204	<0.001	23.255	15.625-34.482
	Parental smoking =2				1	
	Friends smoking =1	1.363	0.294	<0.001	3.906	2.197-6.944
	Friends smoking =2				1	
	Peer pressure =1	1.106	0.306	<0.001	3.021	1.661-5.494
	Peer pressure =2				1	
	Family rules =0	1.419	0.515	0.006	4.132	1.508-11.363
	Family rules =1				1	
	Attitude =1	1.552	0.280	<0.001	4.720	2.725-8.177
	Attitude =2	0.480	0.318	0.131	1.616	0.867-3.012
	Attitude =3				1	
	Self-concept =0	2.330	0.236	<0.001	10.278	6.476-16.310
	Self-concept =1				1	
	Intervention program =0	1.969	0.477	<0.001	7.142	2.808-18.181
	Intervention program =1				1	
	Access to tobacco =1	0.754	0.340	0.026	2.126	1.093-4.136
	Access to tobacco =2				1	
	Tobacco policy =0	0.307	0.165	0.062	1.360	0.984-1.878
	Tobacco policy =1				1	

maternal smoking had a significant effect on student smoking behavior. The likelihood of tobacco use was significantly higher among students whose mothers smoked (Zhang *et al*, 2000). The GYTS in Addis Ababa, Ethiopia showed having smoking friends was strongly associated with smoking after controlling for age, gender, parental smoking status, and perceptions about risks of smoking (Rudatsikira *et al*, 2007).

Organizational and community factors related to smoking behavior were a tobacco-free school environment, smoking intervention programs, community tobacco control activities and the student's

access to cigarettes. Tobacco control policies were also associated with smoking behavior. The school environment was an influential factor in smoking behavior of students. A low-risk student (no family or friends who smoked) was more than twice as likely to smoke if he or she attended a high-risk school. (Leatherdale and Manske, 2005). School smoking prevention programs and a tobacco-free school environment had the potential to influence adolescent smoking in several ways. The implementation and enforcement of smoke-free school policies limited the opportunity for teens to smoke. The existence and enforcement of these policies promote a norm against smoking as an acceptable behavior. Antismoking curricula provide vital information on health dangers and the addictive nature of cigarettes (Peter Boyle *et al*, 2004). Youth living in towns that have local tobacco sales ordinances (no selling to minors) are significantly less likely to become smokers than youth living in towns without such ordinances (Siegel *et al*, 1999). It is unrealistic to protect students from smoking only by vendor and shop self-regulation without concrete legal enforcement and punishment. At present, students have easy access to cigarettes in China (Ministry of Health, 2008). Policies of smoke free public places make tobacco less socially acceptable, which may prevent or reduce tobacco use by youth (Hopkins *et al*, 2001).

A hypothesis model of smoking behavior among middle school smoking students adequately fit the data. Cognitive factors had a significant, positive influence on smoking behavior. Self-concept and life skills had a significant negative influence on smoking behavior.

Ecological models have been proposed as a way to structure health problems with complex etiologies. Accoding to the ecological model, behavior is viewed as being determined by: (1) intrapersonal factors, such as knowledge, attitudes, behavior, self-concept, skills, etc; (2) interpersonal factors, including the family and friendship networks; (3) organizational factors: including social institutions with organizational characteristics; (4) community factors, including relationships among organizations, institutions, and informal networks within defined boundaries; and (5) public policy, local, state, and national laws and policies (Mcleroy *et al*, 1988; Glanz *et al*, 2008). A previous study of smoking youth supported the principle of multi-level influences (Leatherdale *et al*, 2006).

There were a number of limitations in this study. First, the student questionnaire relied on self-reporting by middle school students and is subject to self-reporting bias. Second, the ability to generalize these findings to the other middle school student populations or other geographic locations in China is limited, because the study was done in Anhui Province; smoking rates vary substantially across different populations and geographic locations in China. Third although the questionnaire was formatted to make it easy for adolescents to understand, some student may not answer all the questions. Fourth, as with any cross-sectional data, causality cannot be inferred from the observed associations in the current study.

The ecological factors influencing middle school student tobacco use are complex. The results from multinomial logistical regression analysis showed school health education and tobacco-free school policies had no significant association with smoking behavior of students. Further research with in-depth and focus group discussions is needed to explain these findings. The research evaluating

these measures and policies should be carried out. The organizational factors (tobacco-free schools, smoking intervention programs), community factors (community tobacco control activities, student access to cigarettes) and tobacco-control policies had influence on smoking behavior among students. A follow-up study to evaluate the change in smoking behavior is needed to better understand these factors and to evaluate causality.

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