RESEARCH COMMUNICATION

Multiphasic Epidemiological Analyses on Smoking Habits among Undergraduate Students in Japan

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Abstract

Little is known about the prevalence and dynamics of smoking habits among university students in Japan, and their association with other lifestyle parameters and biological markers. Data on undergraduate students were here extracted from the questionnaire and laboratory tests of the periodic health checkup of Kyoto University in 2000 and 2001. In addition to simple statistics, longitudinal analyses were performed using logistic regression, and the odds ratio (OR) and its 95% confidence interval (CI) were calculated for each item. Among 11,203 subjects, 12.1% had a smoking habit. The smoking rate was higher in men than in women (14.4% vs 2.4%, P<0.001) and increased from 2.5% (freshmen) to 18.3% (seniors) with advance in year. During one year of follow-up, 5.8% of students newly acquired a smoking habit, and 12.4% of smokers abandoned the habit. Compared with students majoring in natural sciences, the majors in humanities or social sciences were more likely to begin smoking (OR=1.32, 95% CI=1.06-1.65). Taking up smoking was more common among those who consumed alcohol (OR=1.98, 95% Cl=1.56-2.51), and skipped breakfast and dined out more frequently (trend P<0.001 for both), but less common among regular exercisers (OR=0.71, 95% Cl=0.56-0.90). Smoking habits tended to be associated with subsequent proteinuria (adjusted OR=1.39, 95% Cl=0.96-2.00) and subsequent cough or phlegm (adjusted OR=1.56, 95% Cl=0.91-2.67). This study revealed that the proportion of student smokers increases with the year in university, in association with several other lifestyle parameters. Measures should be taken against smoking behavior focusing on freshmen and considering their lifestyle.

Key Words: Undergraduate students - smoking - lifestyle - health checkup - logistic regression

Asian Pacific J Cancer Prev, **4**, 141-145

Introduction

Cigarette smoking is well known to increase the risk of neoplasms, coronary heart disease, and chronic obstructive pulmonary disease (U.S. Department of Public Health Service, 1964; Hirayama, 1990; Japan Health Promotion & Fitness Foundation, 1993). Excess death of Americans and Japanese from cigarette smoking is estimated to reach 400 and 100 thousand per year, respectively (web data by the Center for Disease Control and Prevention, USA, and unpublished data by Dr. K. Ozasa, Japan). Increased risk of lung cancer, heart disease, and low birth weight due to passive smoking (Hirayama,1983; Steenland,1992; Rubin DH et al., 1986) has also drawn public attention. Nowadays, cigarette smoking is considered to be a social issue, and governments of many countries are taking measures against it. The Ministry of Health, Labor and Welfare of Japan is also pushing on with the Policy of Health Japan 21 (The Ministry of Health, Labor and Welfare of Japan, 2000) as a national strategy.

Although many studies on smoking habits of adults and high school pupils have been carried out, there have been few systematic investigations focusing on university students in Japan. Since smoking is legally allowed at the age of 20, the dynamics of smoking habits in adolescence would presumably yield clues for health policy making. Thus, we conducted a large survey of undergraduate students at Kyoto University, Japan.

Methods

Study Population

Among 11,707 undergraduate students (9481 males and 2226 females) from freshmen to seniors at Kyoto University,

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11,251 underwent a periodic health checkup in April (the beginning of the first semester) 2000. Excluding 48 students with missing data on smoking habits, the remaining 11,203 undergraduates (9065 males and 2138 females) with a mean age of 20.9 years were enrolled in the study (response rate, 96.0%). Out of the study subjects, 7973 (6433 males and 1540 females) from freshmen to juniors were re-examined at the subsequent health checkup in April 2001. Data on lifestyle and laboratory tests were collected at periodic health checkups as essential information for students' health promotion. Hence, individual informed consent was not obtained. Results of the analyses were, however, presented in the university gazette and web page for the subjects to be aware that their health data were used in the study.

The national ethical guidelines for epidemiological research published in June 2002 do not require an ethical review, when clinicians use their institutional clinical data for the improvement of their daily practice. Therefore, this study was not submitted in particular to the ethical committee.

Questionnaire

The self-administered health- and lifestyle-related questionnaires were sent to the students before the health checkup and collected at the examination site. Sophomores, juniors, and seniors were inquired about present conditions, and freshmen about those before they entered college.

The questionnaire covered demographic or academic characteristics, lifestyles, and symptoms of life-threatening diseases. Demographic/academic factors included sex, age, year (freshman to senior), and student majors (natural sciences, humanities or social sciences, and unclassified liberal arts). As a lifestyle factor of major interest, students were asked about any smoking habits, and if they smoked, the number of cigarettes per day ('only a few cigarettes,' 'around 10,' 'around 20,' 'around 30,' or 'more than 30'). They were also asked about their desire to quit smoking ('no desire to stop smoking whatsoever,' 'would like to, but no plans to stop soon,' or 'would like to stop right away'). Other lifestyle items in the survey included residential environments (categorized as 'home,' 'rooming house,' 'dormitory,' or 'other'), physical activities (exercise regularly or not), drinking habits (drink alcoholic beverages regularly, occasionally, or not at all), sleeping hours ('less than 6 hours,' '6-7 hours,' '7-8 hours,' '8-9 hours,' or '9 hours or more'), dietary habits (frequency of skipping breakfast and dining out categorized as 'once or less,' '2-4 times,' or '5 times or more' per week), and dietary restrictions ('calorie restriction,' 'other,' or 'nothing in particular').

Symptoms included 'blackouts,' 'persistent cough or phlegm,' 'feeling that someone is watching or talking about me,' and 'despair or suicide attempt.'

Laboratory Procedures

Midstream urine samples collected after fasting in the morning were immediately examined for protein and glucose in a semiquantitative fashion, i.e., '-,' '+-,' '+,' '++,' and '+++,' using a chemical reagent strip (Uropiece S, Fujisawa Pharmaceutical Co.). Weight and height were simultaneously obtained with an automatic scale (THP-LA, Ogawa Iriki Co.). Body mass index (BMI) was defined as weight (kg) divided by height (m) squared.

Data Analyses

Statistical analysis was carried out using SPSS software (version 8.0, SPSS, Inc.). All categorical variables were expressed as frequencies (in percentages). Age and BMI were dichotomized, i.e., 'less than 20 years' or '20 years or more,' and 'less than 25 kg/m^2' or '25 kg/m^2 or more,' respectively, considering smoking legislation and WHO criteria for obesity (WHO, 1998). For both urine protein and glucose, the test results of '+,' '++,' and '+++' were considered uniformly positive. Differences in frequencies of categorical variables between groups were verified by χ^2 test. To examine independent associations between smoking habits and lifestyles, a multivariate analysis was performed using logistic regression, where ordinal variables were treated as continuous, and nominal variables were transformed into dummy variables. Then, odds ratios (ORs) and 95% confidence intervals (CIs) or trend P were calculated for each item. When examining the association of laboratory test results or symptoms with smoking habits,

Table 1. Prevalence of Cigarette Smoking by Academic Factors

	Men		Women		All	
	%	N	%	N	%	N
Total	14.4%	(1303/9065)	2.4%	(52/2138)	12.1%	(1355/11203)
Year in school						
Freshmen	3.0%	(68/2289)	0.6%	(3/538)	2.5%	(71/2827)
Sophomores	12.7%	(283/2230)	1.7%	(9/519)	10.6%	(292/2749)
Juniors	20.3%	(461/2274)	3.7%	(21/561)	17.0%	(482/2835)
Seniors	21.6%	(491/2272)	3.7%	(19/520)	18.3%	(510/2792)
Major						
Natural sciences	13.1%	(791/6051)	0.9%	(8/917)	11.5%	(799/6968)
Humanities or social sciences	17.1%	(448/2625)	3.5%	(39/1100)	13.1%	(487/3725)
Liberal arts	16.2%	(63/388)	4.9%	(6/122)	13.5%	(69/510)

Table 2. Frequency Matrix of Smoking Status Over a 2-year Period by Sex.

Males		2001					
		Smokers		Nonsmokers		Total	
	Smokers	671	(88.3%)	89	(11.7%)	760	(100.0%)
2000	Nonsmokers	385	(6.8%)	5288	(93.2%)	5673	(100.0%)
	Total	1056	(16.4%)	5377	(83.6%)	6433	(100.0%)
Females		2001					
		Smokers		Nonsmokers		Total	
	Smokers	19	(67.9%)	9	(32.1%)	28	(100.0%)
2000	Nonsmokers	34	(2.2%)	1478	(97.8%)	1512	(100.0%)
	Total	53	(3.4%)	1487	(96.9%)	1540	(100.0%)

ORs were adjusted for sex and year in school. In addition, the McNemar test was used for the differences in smoking rates between paired groups. Differences were considered statistically significant at $P<0.05$.

Results

Cross-Sectional Study

Table 1 shows the prevalence of cigarette smoking by academic factors. Among 11,203 subjects, 1355 (12.1%) had smoking habits. The rate was markedly higher in men than in women (14.4% vs 2.4%, $P<0.001$). Smoking rates in freshmen before entrance were as low as 3.0% and 0.6% in males and females, respectively. In sophomores, however, smoking rates increased sharply to 12.7% and 1.7% in males and females, respectively. Finally, in seniors, smoking rates reached 21.6% and 3.7% in males and females, respectively (trend $P<0.001$ for both sexes). Compared with students majoring in natural sciences (11.5%), majors in humanities or social sciences (13.1%) and those in liberal arts (13.5%) were more likely to smoke ($P=0.031$). The rate ratio was greater in females than in males.

The number of cigarettes smoked per day was higher among male than female smokers; 31.2% of men smoked a few cigarettes per day, 31.4% approximately 10 per day, 32.8% approximately 20 per day, 3.8% approximately 30 per day, and 0.8% more than 30 per day, against 53.8%, 38.5%, 7.7%, 0%, and 0%, respectively, among females.

As for quitting smoking, 25.7% of male students had no desire to do so, 60.7% were only interested in it, and 13.6% wanted to quit smoking immediately. For females, the proportions were 26.9%, 67.3%, and 5.8%, respectively.

In the multivariate analysis, sex, age, year and major were all significaltly and independently associated with present smoking.

Longitudinal Study

Table 2 shows the frequency matrix of smoking status over a 2-year period by sex. Among nonsmokers in 2000, 6.8% (385/5673) of men and 2.2% (34/1512) of women began smoking. Among smokers in 2000, 11.7% (89/760) of men and 32.1% (9/28) of women gave up smoking. Among those who had wanted to quit smoking in April 2000, only 20.4% (22/108) actually quit in the following year.

One-year changes in net smoking rates among the same subjects were from 2.9% to 10.0% (freshman year), from 12.3% to 17.3% (sophomore year), and from 20.3% to 22.0% (junior year) for males. The rate changes were from 0.6% to 2.7%, 1.6% to 3.4%, and 3.2% to 4.1%, respectively, among females. These changes were statistically significant ($P<0.05$), except for female juniors.

Independent associations of baseline demographic/academic factors and lifestyles with subsequent acquisition of smoking habits are shown in Table 3. Male students (OR=3.05, 95% Cl=2.08-4.46), humanities or social science majors (OR=1.32, 95% Cl=1.06-1.65), and those who drank alcohol beverages (OR=1.98, 95% Cl=1.56-2.51), skipped breakfast more frequently (trend $P<0.001$) and dined out more frequently (trend $P=0.014$) were significantly associated with the risk of beginning to smoke. Exercisers were less likely to begin to smoke (OR=0.71, 95% Cl=0.56-0.90). The year in school was negatively associated with subsequent acquisition of smoking habits: i.e., beginning to smoke was most remarkable during the freshman year with a decreasing trend with advancing years.

Association of baseline smoking habits with subsequent emergence of abnormal laboratory findings and symptoms were also studied (Table 4). Smoking tended to increase the risk of proteinuria (adjusted OR=1.39, 95% Cl=0.96-2.00), and persistent cough or phlegm (adjusted OR=1.56, 95% Cl=0.91-2.67).

Discussion

Since periodic health checkups are mandatory for all Kyoto University students, the response rate was as high as 96.0%. In addition, a questionnaire on smoking habits was generally acceptable as a measure, as found in previous studies of the relationship between questionnaires and salivary cotinine levels (Prokhorov et al., 2000; Etter et al., 2000). These findings validate the present survey and allow it to be a fundamental database for student health promotion.

Compared with the results of the Japan Tobacco annual survey (Japan Tobacco, Inc, 2000) (54.0% for male and 14.5% for female adults), the National Nutrition Survey in Japan (The Ministry of Health, Labor and Welfare of Japan,

Table 3. Association of Baseline Demographic/academic Factors and Lifestyles with Subsequent Acquisition of Smoking Habits: Multivariate Analysis by Logistic Regression.

Factor	Odds ratio (95% CI*)	P value
Demographic/academic factors		
Sex (men vs women)	3.05 (2.08-4.46)	<0.001
Age (=20 years old vs <20 years old)	1.05 (0.79-1.39)	0.759
Year (vs freshman)		
Sophomore	0.52 (0.38-0.71)	<0.001
Junior	0.31 (0.22-0.44)	<0.001
Major (vs natural sciences)		
Humanities or social sciences	1.32 (1.06-1.65)	0.013
Liberal arts	1.16 (0.71-1.89)	0.564
Lifestyles		
Residential environment (vs home)		
Rooming house	1.20 (0.91-1.57)	0.195
Dormitory	0.48 (0.22-1.05)	0.067
Other	1.16 (0.26-5.07)	0.846
Physical activities (regular vs not)	0.71 (0.56-0.90)	0.004
Drinking habits (regular, occasional vs not)	1.98 (1.56-2.51)	<0.001
Skipping breakfast (for 1 increment of category)	1.53 (1.31-1.79)	<0.001
Dining out (for 1 increment of category)	1.26 (1.05-1.51)	0.014
Sleeping hours (for 1 increment of category)	0.96 (0.86-1.09)	0.551
Dietary restrictions (vs none)		
Calorie	1.26 (0.57-2.82)	0.566
Other	0.46 (0.06-3.36)	0.443

*CI: confidence interval.

1999) (62.5% and 23.1%, respectively, in their twenties), and Rigotti's study for US college students (Rigotti et al., 2000) (37.9% and 29.7%, respectively), the proportion of student smokers at Kyoto University was relatively low. The problem is that smokers increased in number with each year in school, especially during the freshman year, although they were receiving higher education.

Majors in humanities or social sciences and liberal arts were more prone to smoke compared with natural science majors. Interest or knowledge regarding natural science might predispose students towards health consciousness. Age and year in school, closely connected, were independently associated with the risk of smoking in multivariate analyses. Legislation banning smoking until age 20 presumably suppresses teenager smoking.

Students who consumed alcohol, dined out, and skipped breakfast were more likely to begin smoking, whereas those who participated in regular physical activities were less likely to acquire the habit. Thus an unfavorable lifestyles may be cobined to have an adverse impact on students' health (Yamamoto et al., 1999) On this point, education for total lifestyle modification should be emphasized.

Smoking habits were here found associated with a risk of subsequent proteinuria. In our previous study of the general population (Wakai et al., 1995), smoking tended to increase the risk of newly developed proteinuria. Dales et al

Table 4. Association of Baseline Smoking Habits with Subsequent Emergence of Abnormal Laboratory Test Results and Symptoms: Multivariate Analysis by Logistic Regression.

Factor	Odds ratio* (95% CI)**	P value
Laboratory findings		
BMI (>=25 kg/m^2 vs <25 kg/m^2)	0.73 (0.41-1.32)	0.302
Urinary protein (positive vs negative)	1.39 (0.96-2.00)	0.080
Urinary glucose (positive vs negative)	1.39 (0.46-4.24)	0.560
Symptoms		
Blackouts	N.A. ***	
Persistent cough or phlegm	1.56 (0.91-2.67)	0.104
Feeling that someone is watching or talking about me	N.A. ***	
Despair or suicide attempt	1.50 (0.65-3.45)	0.343

*Odds ratios is adjusted for sex and year.
**CI: confidence interval.
***N.A.: Not analyzed due to small number of complainers.

(1978) also reported that proteinuria was commoner in smokers irrespective of race or sex. These results suggest that smoking has a harmful effect on the kidney, probably through vasoconstriction (Sarin et al., 1974).

Unfortunately, nearly 90% of student smokers did not wish to quit smoking. They may have been ignorant of the harmful effects of smoking not only on their future health but also on their present condition including their physical endurance capacities (Cooper et al., 1968; Dressendorfer et al., 1983). Systematic education for healthy behavior should be promoted.

This study has some limitations. First, since our survey was conducted in only one rather academia-oriented university, the results could not be immediately generalized. However, the students of Kyoto University are regarded as among those leading the way to the future Japan, and their behavior presumably reflects the general population for good or for bad. Second, the questionnaire did not cover all aspects of lifestyles, and some unknown factors might confound the results. Further detailed investigations are therefore warranted.

The present study revealed that smokers increased with each year they spent in the university. Ironically, the time of higher education is when students develop smoking habits. We suggest the necessity of countermeasures against smoking focusing on freshmen, taking into account other lifestyle parameters.

Acknowledgement

We thank the staff of Kyoto University Center for Student Health for their generous assistance in collecting the data.

References

Cooper MK, Gey CGO, Bottenberg RA (1968). Effects of cigarette smoking on endurance performance. *JAMA*, **203**, 189-92.

Dales LG, Friedman GD, Siegelaub AB, et al (1978). Cigarette smoking habits and urine characteristics: urinalysis abnormalities are more common in smokers, but the reasons are unclear. *Nephron*, **20**, 167-70.

Dressendorfer RH, Amsterdam EA, Odland TM (1983). Adolescent smoking and its effect on aerobic exercise tolerance. *Physician and Sportsmedicine*, **11**, 109-19.

Etter JF, Vu Duc T, Perneger TV (2000). Saliva cotinine levels in smokers and nonsmokers. *Am J Epidemiol*, **151**, 251-58.

Hirayama T (1983). Passive smoking and lung cancer: consistency of association. *Lancet*, **2**, 1425-6.

Hirayama T (1990). Lifestyle and mortality: a large-scale census based cohort study in Japan. Contributions to Epidemiology and Biostatistics Vol. 6, Kargar: Basel.

Japan Health Promotion & Fitness Foundation (1993). Health and smoking: a report on smoking and health problem. Japan Health Promotion & Fitness Foundation: Tokyo.

Japan Tobacco, Inc (2000). Japan Tobacco's annual survey. Tokyo, Japan Tobacco, Inc.

Prokhorov AV, De Moor C, Pallonen UE, et al (2000). Validation of the modified Fagerstrom tolerance questionnaire with salivary cotinine among adolescents. *Addict Behav*, **25**, 429-33.

Rigotti NA, Lee JE, Wechsler H (2000). US college students' use of tobacco products: results of a national survey. *JAMA* , **284**, 699-705.

Rubin DH, Krasilnikoff PA, Leventhal JM, et al (1986). Effect of passive smoking on birth weight. *Lancet*, **2**, 415-17.

Sarin CL, Austin JC, Nickel WO (1974). Effects of smoking on digital blood-flow velocity. *JAMA*, **229**, 1327-8.

Steenland K (1992). Passive smoking and the risk of heart disease. *JAMA*, **267**, 94-9.

The Ministry of Health, Labor and Welfare of Japan (1999). National Nutrition Survey. Tokyo, The Ministry of Health, Labor and Welfare of Japan.

The Ministry of Health, Labor and Welfare of Japan (2000). Health Japan 21. Tokyo, Japan Health Promotion & Fitness Foundation.

U.S. Department of Public Health Service. Health consequences from smoking: a report of the Advisory Committee to the Surgeon General of the Public Health Service. PHS Publication: Washington, 1964.

Wakai K, Kawamura T, Ohno Y, et al (1995). Lifestyles and renal damage: association of smoking, drinking, and physical activity with subsequent proteinuria. *Nippon Koshu Eisei Zasshi*, **42**, 243-8.

WHO (1998). Obesity: preventing and managing the global epidemic. Report of a WHO consultation on obesity, June 1997. WHO: Geneva.

Yamamoto R, Kawamura T, Wakai K, et al (1999). Favorable lifestyle modification and attenuation of cardiovascular risk factors. *Jpn Circ J*, **63**: 184-8.