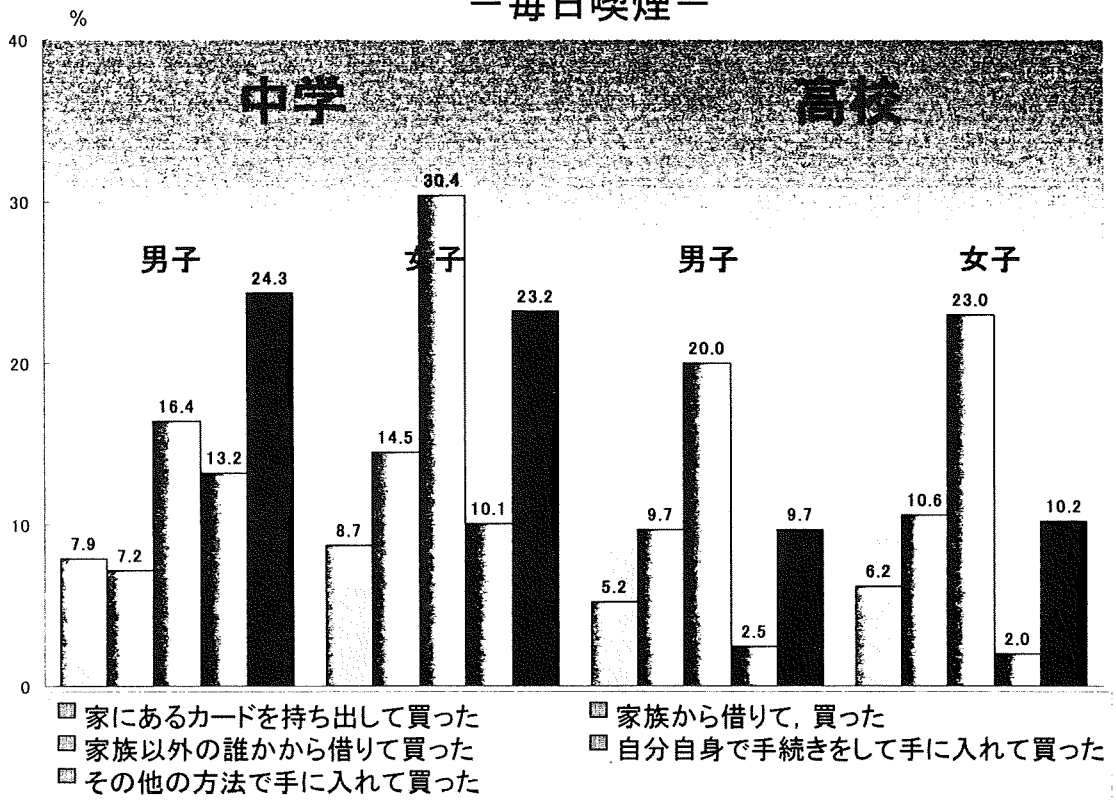


タスポを使ったタバコ購入方法

— 毎日喫煙 —



II. 研究成果の刊行に関する一覧表

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別 冊

Decrease in the Prevalence of Adolescent Alcohol Use and its Possible Causes in Japan: Periodical Nationwide Cross-Sectional Surveys

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Background: Trends in alcohol drinking prevalence were assessed among Japanese adolescents, and possible reasons for a decrease in drinking prevalence observed in 2004.

Methods: Cross-sectional nationwide surveys were conducted periodically. High schools were randomly sampled from throughout Japan in 1996, 2000, and 2004. All enrolled students in sampled schools were subjects of the surveys. Self-reporting anonymous questionnaires were collected from 115,814 students in 1996, 106,297 in 2000, and 102,451 in 2004. Questions about drinking prevalence of students and family members, proportion of students who have no friends, and sources of alcohol were included. Students who drank at least one day of the 30 days preceding the survey were defined as the current drinkers.

Results: The drinking prevalence in 2004 was decreased in comparison to that in 1996 and 2000 in both sexes and in all school grades. The current drinking rate (monthly drinker) among junior high school boys was 29.4% in 1996, 29.0% in 2000, and 20.5% in 2004, while that among senior high school boys was 49.7%, 48.7%, and 36.2%, respectively. The respective prevalence among junior and senior girls was 24.0%, 25.5%, and 20.0% and 40.8%, 42.1%, and 34.1%. The prevalent sources of alcohol beverages were searching in home, stores (convenience store, supermarket, or gas-stand), liquor shops, and bars. An analysis of the reasons for this decrease identified a decrease in drinking prevalence in students' families, especially by fathers and older brothers, and an increase in the proportion of students who had no friends.

Conclusions: A decrease in drinking prevalence of male family members and a limitation of sources of alcoholic beverages may contribute to the decrease in adolescent drinking prevalence.

Key Words: Drinking Behavior, Alcohol Use, Adolescent Behavior, Japan.

CONSUMPTION OF ALCOHOL is one of the most important risk factors for noncommunicable diseases (A Joint WHO/FAO Expert Consultation, 2003; Hara et al., 2002; Inoue et al., 2005; Iso et al., 2004; Tsugane et al., 1999; Wakai et al., 2005). The drinking behavior of minors is not only a health concern due to the effects of the alcohol, but is also a major social issue related to a variety of health and

social problems, including delinquency, traffic accidents, and sexually transmitted disease (Suzuki, 1995, 2001).

Traditionally, Japanese society has been relatively tolerant of alcohol consumption by adult males, while disapproving of such behavior among young people and women (Higuchi et al., 2006). However, these norms have been changing in recent years. Although Japan has the Act to Prohibit Minors from alcohol use enacted in 1990 prohibiting the consumption of alcohol by minors under age 20, it is thought that many adolescents nevertheless often drink before reaching 20 years of age (Osaki et al., 2003; Suzuki et al., 2003). Alcohol use is one of most important health-related behaviors among adolescents as well as cigarette smoking [Centers for Disease Control and Prevention (CDC), 2006a; Currie et al., 2004]. In Western countries, health-related behaviors including alcohol use among adolescents have been monitored periodically for several decades (CDC, 2006a,b; Currie et al., 2003; Hibell et al., 1996, 2000, 2004). Monitoring adolescent drinking behavior is necessary for establishing and evaluation of the national policy to prevent adolescent drinking. A nationwide survey was conducted on adolescent alcohol use in Japan in 1996, 2000, and 2004. In order to reveal trends in adolescent alcohol use in Japan, the results from the surveys were compared. This comparison revealed the actual situation of the

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drinking behavior among adolescents and related factors of alcohol use and possible causes of the change in drinking prevalence observed in 2004 survey. In addition, the results from the surveys will provide the baseline and mid-term values for adolescent drinking prevalence for "Healthy People Japan 21," i.e., national health plan for the 21st century. These data are expected to contribute to the development of the national policy on preventing drinking by minors.

MATERIALS AND METHODS

Subjects

The survey was a cross-sectional random sampling survey which used the single-stage cluster sampling methodology (Cochran, 1977). The survey targeted junior and senior high school students from schools selected throughout Japan using the National School Directory. The number of schools sampled for the 1996 survey was 122 of 11,274 junior high schools (selection rate: 1.1%) and 109 of 5,501 senior high schools (2.0%). The survey period was December 1996 to the end of January 1997. Respective values for the 2000 and 2004 surveys were 132 of 11,200 junior (1.2%) and 102 of 5,315 senior high schools (1.9%) from December 2000 to the end of January 2001; and 131 of 11,060 junior (1.2%) and 109 of 4,627 senior high schools (1.9%) from December 2004 to the end of January 2005. All students enrolled in the sampled schools were subjects of the study.

Procedures

The cooperation of the principals of these schools was requested and questionnaires were sent to each. The students' teachers were instructed to inform them of the voluntary nature of their participation and to urge them to answer honestly. Anonymous questionnaires and envelopes were handed to the students for completion during school time. Upon completion, the questionnaires were sealed in envelopes by the students themselves, collected by their teachers, and returned unopened. This survey was approved by the Ethics Committee of the National Institute of Public Health.

Measures

The questionnaire focused on their experience, frequency of alcohol use, drinking with peers, age (by school grade) when the respondent first tried drinking, amount of alcoholic beverages consumed by drinkers, sources of alcoholic beverages, alcohol-related problems, and drinking status of the student's family. Experimenting drinkers, current drinkers, and weekly drinkers were defined as those who had tried drinking at least once, those who had drunk at least once during the previous 30 days, and those who had responded as "every weekend," "several times a week," and "every day" in the question asking for the average frequency of alcohol use. Daily drinkers were defined as those who had drunk every day during the previous 30 days.

Response Rate

For the 1996 survey, responses were obtained from 80 junior (response rate 65.6%) and 73 senior high schools (67.0%), with a total of 115,814 responses accounting for 64.1% of all junior and 62.5% of all senior students enrolled in the sampled schools. Respective values for 2000 were 99 (75.0%) and 77 schools (75.5%), with 106,297 responses accounting for 66.1% and 59.3% of enrolled students; and for 2004, 92 (70.2%) and 87 schools (79.8%), with 102,451 responses accounting for 60.7% and 67.7% of students. The proportion of responded students by school grade among junior high school was not significantly different. The number of responded stu-

dents of third grade of senior high school was less than that of other grades, however, the proportion of third grade students did not change significantly over the surveys. We compared subtotal prevalence of junior or senior high schools after combining each grade's data without weighting. The characteristics of the responding schools, such as the proportion of private schools, vocational schools, or general schools were chosen to be representative of the study population. The average number of enrolled students in responding schools was not significantly different from that of nonresponding schools. The urban junior high schools were less likely to respond to these surveys, but this trend was not observed in senior high schools.

Data Analysis

The percentages and 95% confidence intervals in the tables were calculated by a weighting method based on one-stage stratified cluster sampling (Cochran, 1977). The proportions in tables were compared using statistical testing for rate differences. Multiple logistic analyses were applied to calculate relative risks and population attributable risk percent of students' current drinking with family's (father, mother, senior brother, and senior sister) drinking or those of current drinking without friend. The data were analyzed using the SPSS for Windows (version 13.0) software program (SPSS Inc., Chicago, IL).

RESULTS

Prevalence of Alcohol Use

Lifetime drinking rate, current drinking rate, and weekly drinking rate increased with age. Although the prevalence of daily alcohol use was quite low, more than half of junior high school students had already experienced drinking alcohol. The current drinking rate of junior high school students already exceeded 20% for both boys and girls. The proportion of habitual drinking, such as current and weekly drinking, for senior high school students was found to be about 2 times more prevalent in comparison with that for junior high school students. The prevalence of lifetime, current, and weekly alcohol use decreased in 2004 survey in comparison to the 1996 and 2000 surveys for both sexes and type of school (junior or senior high school). Since the degree of decrease was greater in boys than in girls, the lifetime drinking experience rate was rather higher in girls than that in boys in the 2004 survey (Table 1).

Type of Alcoholic Beverage Consumed by Current Drinkers

Popular alcohol beverages among current drinkers were alcopop (ready mixed soft drinks containing 4% to 7% alcohol by volume), beer, and shochu (a rough Japanese spirit distilled from sake dregs and other ingredients). The prevalence of alcopop increased whenever surveyed and became the top 1 type of beverage for both sexes and type of school (junior or senior high school) in the 2004 survey. The proportion was much higher among junior high school students in comparison to senior high school students for boys, whereas the proportion was rather high in senior high school for girls. In contrast, the prevalence of beer, Japanese-sake, and spirits decreased (Table 2).

Table 1. Prevalence of Alcohol Use (1996, 2000, 2004)

Gender	High school	Year	Lifetime alcohol use	Experience drinking with peer	Experience drinking alone	Current alcohol use	Weekly alcohol use	Daily alcohol use	Sample size (n)
Boy	Junior	1996	73.5 ± 0.2	16.7 ± 0.1	10.3 ± 0.1	29.4 ± 0.2	6.4 ± 0.1	0.6 ± 0.0	21,471
		2000	64.5 ± 0.2	13.5 ± 0.1	8.5 ± 0.1	29.0 ± 0.2	5.9 ± 0.0	0.3 ± 0.0	25,348
		2004	53.3 ± 0.2	9.1 ± 0.1	5.8 ± 0.1	20.5 ± 0.2	3.9 ± 0.0	0.4 ± 0.0	20,679
	Senior	1996	87.2 ± 0.1	59.5 ± 0.3	28.7 ± 0.2	49.7 ± 0.3	13.8 ± 0.1	0.8 ± 0.0	35,645
		2000	83.5 ± 0.1	56.2 ± 0.2	27.0 ± 0.1	48.7 ± 0.3	14.4 ± 0.1	0.6 ± 0.0	29,228
		2004	75.3 ± 0.2	42.0 ± 0.2	32.6 ± 0.2	36.2 ± 0.3	10.0 ± 0.1	0.5 ± 0.0	35,319
Girl	Junior	1996	71.5 ± 0.2	14.2 ± 0.1	6.9 ± 0.1	24.0 ± 0.1	3.9 ± 0.0	0.4 ± 0.0	21,327
		2000	64.3 ± 0.2	12.2 ± 0.1	6.1 ± 0.0	25.5 ± 0.2	4.1 ± 0.0	0.2 ± 0.0	21,898
		2004	56.7 ± 0.2	9.8 ± 0.1	6.3 ± 0.1	20.0 ± 0.2	2.9 ± 0.0	0.2 ± 0.0	18,706
	Senior	1996	86.7 ± 0.1	54.5 ± 0.4	16.7 ± 0.1	40.8 ± 0.3	6.3 ± 0.1	0.3 ± 0.0	37,371
		2000	84.1 ± 0.2	51.2 ± 0.3	15.6 ± 0.1	42.1 ± 0.3	7.8 ± 0.1	0.2 ± 0.0	29,823
		2004	77.3 ± 0.2	39.6 ± 0.4	27.9 ± 0.3	34.1 ± 0.3	6.5 ± 0.1	0.3 ± 0.0	27,747

Values given are percentages (mean ± SE).

SE, standard error.

Lifetime alcohol use = students who had tried alcohol drinking at least once.

Current alcohol use = students who had drunk ≥1 day of the 30 days preceding the survey.

Weekly alcohol use = students who drink every weekend, several times a week, or every day.

Daily alcohol use = students who had drunk every day for the 30 days preceding the survey.

Sources of Alcohol Beverages

The major sources of alcohol beverages among current drinkers were in home, stores (convenience store, supermarket, gas-stand), and they received them from someone. Those among senior high students were in home, stores, and bars. The proportion of stores, liquor shops, vending machines, and bars decreased with the year of survey. In the 2004 survey, the proportion of current drinkers who drank at bars was higher for girls than boys (Table 3).

Characteristics of Drinking Behavior

The proportion of students who drank alcohol before age 13 decreased with the year of survey, and the figure in girls became higher than that in boys after the 1996 survey. The proportion of students who drank with friends before age 13 also decreased, whereas the proportion was still higher in boys except for in junior high school in 2004. The proportion of

current drinkers who drank 3 drinks more in a drinking occasion decreased for senior high school students in the 2004 survey in comparison to that in the 2000 survey, whereas that for junior high school students slightly increased. A "binge drink" was defined as current drinkers who drank 6 drinks or more in a drinking occasion. The prevalence of binge drinking was much higher among senior students, and the figure decreased in 2004 in comparison to 2000 for senior students, whereas it tended to increase among junior boys and girls (Table 4).

Alcohol-Related Problems

Alcohol-related problems, namely vomiting, fighting, blacked out, trouble with police, and scolding by parents were assessed from the first survey. The prevalent problems were blacking out, vomiting, and scolding by parents for junior high drinkers. Prevalent problems among current drinkers in senior high school were also vomiting and blacking out, but the prevalence was much

Table 2. Modality of Alcohol Beverages Consumed by Current Drinkers

Gender	High school	Year	Beer	Japanese sake	Wine	Shochu	Alcopop	Spirits	Current drinker (n)
Boy	Junior	1996	66.7 ± 0.2	25.3 ± 0.2	28.6 ± 0.2	21.6 ± 0.2	53.3 ± 0.2	15.9 ± 0.1	6,332
		2000	56.9 ± 0.2	21.7 ± 0.2	33.8 ± 0.2	28.7 ± 0.2	49.8 ± 0.2	8.2 ± 0.1	7,215
		2004	44.0 ± 0.2	19.4 ± 0.1	24.2 ± 0.2	36.4 ± 0.3	68.9 ± 0.5	4.7 ± 0.1	4,246
	Senior	1996	79.4 ± 0.2	26.6 ± 0.2	21.6 ± 0.2	30.7 ± 0.4	47.6 ± 0.3	22.5 ± 0.2	17,942
		2000	68.4 ± 0.2	23.7 ± 0.2	25.3 ± 0.2	44.9 ± 0.3	54.0 ± 0.2	13.3 ± 0.1	14,245
		2004	53.3 ± 0.2	19.3 ± 0.1	18.3 ± 0.1	48.5 ± 0.2	57.2 ± 0.2	10.0 ± 0.1	12,783
Girl	Junior	1996	54.3 ± 0.2	18.6 ± 0.2	30.5 ± 0.2	24.8 ± 0.2	72.3 ± 0.2	12.0 ± 0.1	5,139
		2000	42.4 ± 0.2	14.0 ± 0.1	34.7 ± 0.2	33.4 ± 0.2	67.6 ± 0.2	6.2 ± 0.1	5,617
		2004	30.2 ± 0.2	12.9 ± 0.1	23.0 ± 0.2	36.4 ± 0.3	68.9 ± 0.3	4.7 ± 0.1	3,733
	Senior	1996	56.5 ± 0.3	15.5 ± 0.2	24.7 ± 0.2	34.8 ± 0.4	75.0 ± 0.2	11.5 ± 0.1	15,132
		2000	43.8 ± 0.3	12.6 ± 0.2	26.1 ± 0.2	47.9 ± 0.3	75.9 ± 0.3	5.7 ± 0.1	12,428
		2004	30.1 ± 0.2	10.7 ± 0.1	20.2 ± 0.3	50.9 ± 0.4	75.3 ± 0.1	5.7 ± 0.1	9,471

Values given are percentages (mean ± SE).

Percentages add up to more than 100%, as some students mentioned more than 1 type of alcoholic beverage.

Table 3. Sources of Alcoholic Beverages Among Current Drinkers

Gender	High school	Year	Searched in home	Received from someone	Convenience store, super market	Liquor shop	Vending machine	Bar	Other	Current drinking (n)
Boy	Junior	1996	70.5 ± 0.2	10.5 ± 0.1	25.4 ± 0.2	12.0 ± 0.2	18.5 ± 0.2	9.5 ± 0.1	11.7 ± 0.1	6,332
		2000	72.4 ± 0.1	10.5 ± 0.1	19.4 ± 0.2	8.6 ± 0.1	12.2 ± 0.1	7.9 ± 0.1	11.6 ± 0.1	7,215
		2004	72.0 ± 0.2	10.9 ± 0.1	12.0 ± 0.2	7.6 ± 0.2	9.7 ± 0.2	6.8 ± 0.1	12.6 ± 0.1	4,246
	Senior	1996	57.5 ± 0.3	20.1 ± 0.1	64.9 ± 0.3	38.0 ± 0.3	40.0 ± 0.3	37.4 ± 0.4	4.5 ± 0.0	17,942
		2000	58.7 ± 0.2	21.7 ± 0.1	65.9 ± 0.2	32.7 ± 0.2	28.2 ± 0.2	35.9 ± 0.4	5.0 ± 0.1	14,245
		2004	60.7 ± 0.2	21.7 ± 0.1	48.5 ± 0.3	31.2 ± 0.2	20.0 ± 0.2	27.9 ± 0.3	6.3 ± 0.1	12,783
Girl	Junior	1996	75.8 ± 0.2	9.1 ± 0.1	27.0 ± 0.3	11.6 ± 0.2	114 ± 0.2	11.8 ± 0.2	13.4 ± 0.1	5,139
		2000	76.0 ± 0.1	12.3 ± 0.1	23.7 ± 0.3	9.0 ± 0.1	9.5 ± 0.1	10.7 ± 0.1	9.4 ± 0.1	5,617
		2004	75.2 ± 0.2	13.8 ± 0.2	15.7 ± 0.2	7.5 ± 0.1	8.9 ± 0.2	10.1 ± 0.1	11.2 ± 0.1	3,733
	Senior	1996	61.2 ± 0.3	16.8 ± 0.2	61.7 ± 0.4	30.3 ± 0.3	25.4 ± 0.3	37.5 ± 0.4	3.8 ± 0.1	15,132
		2000	62.4 ± 0.3	19.3 ± 0.1	62.2 ± 0.3	23.2 ± 0.2	15.4 ± 0.2	38.9 ± 0.4	4.4 ± 0.0	12,428
		2004	68.0 ± 0.3	20.9 ± 0.2	45.7 ± 0.4	22.5 ± 0.2	10.9 ± 0.1	34.5 ± 0.4	5.8 ± 0.1	9,471

Values given are percentages (mean ± SE).

Percentages add up to more than 100%, as some students mentioned more than 1 type of alcoholic beverage.

Table 4. Proportion of Students Who Drank Alcohol Before 13 years of Age and of Binge Drinking

Gender	High school	Year	Drank alcohol before age 13	Drank with friends before age 13	3 drink and over ^a	6 drink and over ^a
Boy	Junior	1996	65.4 ± 0.2	16.3 ± 0.1	18.0 ± 0.2	6.4 ± 0.2
		2000	49.0 ± 0.1	11.2 ± 0.1	16.3 ± 0.2	6.0 ± 0.2
		2004	41.3 ± 0.2	9.7 ± 0.1	18.8 ± 0.2	7.2 ± 0.2
	Senior	1996	46.8 ± 0.2	6.9 ± 0.1	55.9 ± 0.1	27.8 ± 0.1
		2000	33.3 ± 0.1	5.6 ± 0.1	55.2 ± 0.1	25.6 ± 0.1
		2004	31.6 ± 0.1	5.5 ± 0.0	50.5 ± 0.2	21.3 ± 0.2
Girl	Junior	1996	63.4 ± 0.2	13.0 ± 0.0	11.3 ± 0.2	4.2 ± 0.2
		2000	51.5 ± 0.1	10.5 ± 0.0	14.9 ± 0.2	4.8 ± 0.2
		2004	44.9 ± 0.2	9.9 ± 0.1	15.8 ± 0.2	5.6 ± 0.2
	Senior	1996	45.2 ± 0.2	6.2 ± 0.1	37.8 ± 0.1	13.4 ± 0.1
		2000	35.9 ± 0.2	4.8 ± 0.0	41.5 ± 0.2	14.4 ± 0.2
		2004	33.6 ± 0.1	4.7 ± 0.1	38.8 ± 0.2	12.1 ± 0.2

Values given are percentages (mean ± SE).

Binge drink: Had ≥ 3 or 6 drinks of alcohol in a drinking occasion.

^aProportion in current drinker (Had at least one drink of alcohol on ≥1 of the 30 days preceding the survey).

higher than that in junior high school. These proportions slightly decreased in the 2004 survey in comparison to the 2000 survey. The rate difference between experience of problems and scolding by parents was small in junior high drinkers, whereas that in senior high drinkers was relatively high (Table 5).

Table 5. Experience Rates of Alcohol-Related Problems Among Current Drinkers

Gender	High school	Year	Vomiting	Fighting	Blacked out	Trouble with police	Scolding by parents	Current drinker (n)
Boys	Junior	1996	10.8 ± 0.1	4.6 ± 0.1	12.8 ± 0.1	2.2 ± 0.0	10.5 ± 0.1	6,332
		2000	10.6 ± 0.1	2.9 ± 0.0	11.8 ± 0.1	1.0 ± 0.0	8.4 ± 0.1	7,215
		2004	10.0 ± 0.1	3.5 ± 0.1	12.3 ± 0.2	1.9 ± 0.0	10.0 ± 0.1	4,246
	Senior	1996	34.3 ± 0.4	6.7 ± 0.1	23.8 ± 0.2	2.7 ± 0.0	9.2 ± 0.1	17,942
		2000	35.9 ± 0.3	5.9 ± 0.1	22.6 ± 0.2	2.3 ± 0.0	7.9 ± 0.1	14,245
		2004	28.4 ± 0.2	4.9 ± 0.1	18.0 ± 0.1	2.0 ± 0.0	7.5 ± 0.1	12,783
Girls	Junior	1996	6.9 ± 0.1	2.6 ± 0.1	9.8 ± 0.1	1.4 ± 0.0	7.7 ± 0.1	5,139
		2000	8.3 ± 0.1	1.7 ± 0.0	12.4 ± 0.1	0.6 ± 0.0	6.7 ± 0.1	5,617
		2004	7.8 ± 0.1	2.8 ± 0.1	13.0 ± 0.2	0.8 ± 0.0	8.7 ± 0.1	3,733
	Senior	1996	20.9 ± 0.3	2.4 ± 0.0	21.2 ± 0.2	1.0 ± 0.0	6.7 ± 0.1	15,132
		2000	23.0 ± 0.3	2.0 ± 0.0	21.4 ± 0.2	0.9 ± 0.0	6.0 ± 0.1	12,420
		2004	20.1 ± 0.2	2.2 ± 0.0	19.5 ± 0.2	0.9 ± 0.0	6.6 ± 0.1	9,471

Values given are percentages (mean ± SE).

Table 6. Prevalence of Family's Alcohol Use Reported by Students and Relative Risks and Population Attributable Risk of Students' Current Drinking With Family's Drinking

Student sex	High school	Family	Prevalence of alcohol use (mean ± SE)				p-value 2000 vs. 2004	Relative risk (95% CI)				Population attributable risk percent	
			1996	2000	2004	2004		1996	2000	2004	2004	2000	2004
Boy	Junior	Father	74.1 ± 0.1	74.2 ± 0.1	70.4 ± 0.1	*	1.27 (1.18-1.37)	1.42 (1.32-1.52)	1.37 (1.26-1.49)	16.7	23.8	20.7	
		Mother	44.8 ± 0.1	49.0 ± 0.2	47.0 ± 0.2	*	1.64 (1.54-1.75)	1.75 (1.65-1.85)	1.72 (1.60-1.85)	22.3	26.9	25.3	
		Older brother	15.2 ± 0.0	14.4 ± 0.1	12.3 ± 0.1	**	1.71 (1.58-1.85)	1.82 (1.67-1.96)	2.06 (1.87-2.25)	9.7	10.6	11.5	
	Senior	Older sister	10.5 ± 0.1	10.7 ± 0.0	10.3 ± 0.1	**	1.81 (1.65-1.98)	2.04 (1.88-2.22)	2.05 (1.86-2.26)	7.8	10.0	9.8	
		No friend ^a	3.4 ± 0.0	2.6 ± 0.0	5.2 ± 0.0	**	0.77 (0.87-1.20)	0.70 (0.58-0.84)	0.85 (0.73-1.00)	-0.8	-0.8	-0.8	
		Father	75.8 ± 0.1	74.8 ± 0.1	70.8 ± 0.1	*	1.27 (1.20-1.33)	1.31 (1.24-1.39)	1.23 (1.17-1.30)	17.0	18.8	14.0	
Girl	Junior	Mother	45.7 ± 0.1	49.1 ± 0.2	48.5 ± 0.1	*	1.63 (1.56-1.70)	1.65 (1.57-1.73)	1.78 (1.70-1.87)	22.4	24.2	27.4	
		Older brother	23.8 ± 0.1	23.0 ± 0.1	22.2 ± 0.1	**	1.45 (1.38-1.52)	1.44 (1.36-1.52)	1.53 (1.45-1.61)	9.7	9.2	10.5	
		Older sister	18.2 ± 0.1	18.8 ± 0.1	18.6 ± 0.1	*	1.53 (1.45-1.62)	1.57 (1.47-1.66)	1.56 (1.48-1.65)	8.8	9.7	9.4	
	Senior	No friend ^a	3.3 ± 0.0	3.1 ± 0.0	5.1 ± 0.0	**	0.38 (0.34-0.44)	0.30 (0.26-0.35)	0.35 (0.31-0.39)	-2.1	-2.2	-3.4	
		Father	76.7 ± 0.1	75.4 ± 0.1	72.1 ± 0.1	*	1.14 (1.05-1.24)	1.11 (1.03-1.20)	1.09 (1.00-1.19)	9.7	7.7	6.1	
		Mother	51.2 ± 0.1	53.8 ± 0.1	52.5 ± 0.2	*	2.11 (1.97-2.26)	1.96 (1.83-2.09)	2.09 (1.93-2.27)	36.2	34.1	36.4	
Senior	Junior	Older brother	17.3 ± 0.1	16.5 ± 0.1	14.2 ± 0.0	**	1.63 (1.51-1.76)	2.86 (1.72-2.01)	1.83 (1.66-2.01)	9.8	23.5	10.5	
		Older sister	12.6 ± 0.1	13.3 ± 0.1	12.6 ± 0.1	**	1.94 (1.78-2.12)	2.14 (1.97-2.32)	2.20 (2.00-2.42)	10.6	13.2	13.1	
		No friend ^a	2.0 ± 0.0	1.3 ± 0.0	2.7 ± 0.0	**	0.96 (0.75-1.22)	0.79 (0.59-1.06)	0.72 (0.56-0.92)	-0.1	-0.3	-0.8	
	Senior	Father	76.7 ± 0.1	76.4 ± 0.1	73.9 ± 0.1	*	1.13 (1.07-1.19)	1.15 (1.08-1.22)	1.17 (1.10-1.24)	9.1	10.3	11.2	
		Mother	51.1 ± 0.1	54.0 ± 0.2	54.0 ± 0.1	*	1.75 (1.68-1.83)	1.90 (1.81-1.99)	1.89 (1.79-1.99)	27.7	32.7	32.5	
		Older brother	25.6 ± 0.1	24.8 ± 0.1	24.3 ± 0.1	*	1.37 (1.43-1.58)	1.43 (1.36-1.51)	1.58 (1.49-1.67)	8.7	9.6	12.4	
Senior	Older sister	22.0 ± 0.1	22.2 ± 0.1	21.6 ± 0.1	*	1.50 (1.16-1.22)	1.55 (1.47-1.64)	1.56 (1.46-1.65)	9.9	10.9	10.8		
	No friend ^a	1.1 ± 0.0	1.0 ± 0.0	2.1 ± 0.0	**	0.68 (0.55-0.84)	0.53 (0.41-0.69)	0.47 (0.38-0.57)	-0.4	-0.5	-1.1		

Relative risks were calculated by adjusting with other family members and school grade using multiple logistic regression analysis.

CI, 95% confidence interval.

^aProportion of students who have no friend.

*or ** result of statistical testing between 2000 and 2004, *p < 0.05, **p < 0.01.

Possible Causes for the Decrease in Drinking Prevalence

The data were analyzed to identify reasons for the decrease in drinking prevalence among Japanese adolescents. The reported drinking status of family members showed some decrease in family drinking, especially that by fathers and older brothers, but drinking by older sisters and friends did not show a significant and persistent decrease. In contrast, drinking by mothers of junior high school boys increased (Table 6). In the results of multiple logistic regression analyses, family drinking was detected as an important risk factor for adolescent drinking in every survey. Especially, the magnitude of the relative risk of an older brother's drinking, older sister's drinking, and mother's drinking on adolescent drinking was relatively larger than that of father, and the influence of a mother's drinking on the population attributable risk percent was largest. The population attributable risk percent by a father's drinking for boys decreased in 2004 in comparison to that in 2000 (Table 6).

The proportion of students who reported that they had no friends was initially quite low, but suddenly increased in 2004 (Table 6). In the multiple logistic regression analyses, the factor was observed as a preventive factor for adolescent drinking. Although the magnitude of the population attributable risk percent was low, the relative risks were statistically significant.

DISCUSSION

Although Japan enacted the Act to Prohibit Minors from alcohol use enacted in 1990 prohibiting the consumption of alcohol by minors under age 20 years, some nationwide surveys have observed many adolescent drinkers among high school students (Osaki et al., 2003; Suzuki et al., 2003). On the other hand, the prevalence of alcohol use among adolescents in Japan is at an extremely low level in comparison to that in European and North American countries (CDC, 2006a; Currie et al., 2004; Hibell et al., 1996, 2000, 2004; Johnston et al., 2002; King et al., 1996; National Centre for Social Research, 2006).

This study provides the first evidence of a decrease in drinking prevalence among Japanese adolescents. The 2000 survey showed a decrease in lifetime drinking rate among junior high school boys only, and no decrease was observed in the lifetime drinking prevalence among girls or in regular drinking prevalence among both sexes. This study confirmed a decrease in lifetime, current, and weekly drinking rates in both sexes among junior and senior high school students in the 2004 survey. The results of this study show that the low drinking rate became lower.

Since drinking behavior is closely related to the culture, religion, or other social factors, the prevalence of alcohol use is much different from country to country. In recent years, a decrease in drinking prevalence among adolescents has been observed in some countries, including the United States,

Finland, and Sweden. However, the majority of the world has not observed any decrease in drinking prevalence (CDC, 2006a; Hibell et al., 2004).

In the analyses for the causes of the change in prevalence, some change was observed in the characteristics of drinking behavior. Many researchers have reported a relationship between adolescent drinking behavior and drinking by parents or friends (Latendresse et al., 2008; Scholte et al., 2008; Seljamo et al., 2006; Webb and Baer, 1995; van der Vorst et al., 2006; Yeh, 2006). This study, also observed that family drinking behavior was closely related to students' alcohol use, and the drinking prevalence among male family members (father and senior brother) decreased with survey by survey. Since the population attributable risk percents of family members were high in this study, the decrease in the drinking prevalence among family probably contribute to the change in drinking prevalence among students. Some other surveys observed the decrease in the drinking prevalence of adults in the Japanese general population. The decrease includes an age-effect where the drinking prevalence decreases with aging and a cohort effect where the drinking prevalence of the younger generation is lower at a specific age. The observation on cohort effect indicates the decrease of drinking prevalence among the parents of high school students. Thus, health education on alcohol use toward adult population is continuing important to prevent drinking by minors.

The limitations of sources of alcohol beverages also contributed to the decrease of the drinking prevalence. The proportion of current drinkers who buy their alcohol beverages from a supermarket, convenience store, liquor shop or vending machine, or drink at a bar has decreased survey by survey. According to the revision of the Act to Prohibit Minors from alcohol use in 2000, the penalty for selling alcoholic beverages to minors was reinforced. Besides, the law was revised again in 2001 for the reinforcement of the age confirmation by the liquor distributors. After 2000, the number of alcohol vending machines has decreased by the self-regulation of the alcohol industry (Higuchi et al., 2006). These factors may have contributed to the limitation of the sources of alcohol beverages.

In 2004 survey, the proportion of students who had no friends increased. Since many researchers reported that drinking behavior of friends was strongly associated with adolescent drinking behavior (Epstein et al., 1999; Heeb et al., 2003; Johansen et al., 2006; Scholte et al., 2008), the increase with proportion of students who had no friends may mean the decrease of peer pressure to initiate drinking. This may also contribute to the decrease in the drinking prevalence among students.

This study indicated some encouraging changes in the surveys, however, some remaining problems were also observed. One problem is that the difference in drinking prevalence between fathers and mothers has shrunk survey by survey. Since the relative risk of mother's drinking on adolescent drinking was large, the influence on the adolescent drinking behavior may overcome the influence by other family

members before long. Other problem is the spreading inequity of health related behaviors among adolescents. The smoking prevalence among current drinkers did not change during the surveys, whereas that among nondrinkers decreased. The lifestyle of nondrinkers has become healthier, whereas that of drinkers has not changed in spite of the decrease in the number of adolescent drinkers. Besides, the prevalence of alcohol-related problems among adolescent drinkers has not changed. Problem drinking during adolescence is considered to be an important predictor for the onset of alcoholism. Therefore, both preventing alcohol use among minors and intervention for adolescents with problematic drinking behavior are necessary to improve their lifestyle and to prevent future adult alcohol-related problems and increased rates of alcoholism.

In addition, a rapid change of type of popular alcoholic beverages among adolescents was observed. In other words, the proportion of drinkers who drink alcopop or shochu has increased survey by survey. This may be indirect evidence that adolescents are more likely to be affected by the marketing of alcoholic beverages by the companies.

In Japan, there are still some problematic situations concerning minors drinking, such as the low price of alcohol beverages (less than 1 US\$ for the cheapest beer or alcopop), the popularity of alcopop among both sexes, and many TV commercials for alcoholic beverages. It is expected that the alcohol consumption among adolescents will increase with the reduction in the price of alcohol beverages (Heeb et al., 2003). Periodical nationwide surveys on adolescent drinking and survey of environmental factors (TV CM, drinking scenes in TV drama, comics or movie, advertisements in magazines, and sponsorship of many events by the alcohol industry) are necessary to deal with the social problems of adolescent drinking.

A limitation of this study is the possible biased subjects, namely 30 to 35% of sampled schools did not respond to these surveys. However, characteristics of responding schools did not seriously differ from those of nonresponding schools. It is difficult to estimate the effect of the relatively low response rate in urban schools in the junior high school. Since this tendency was consistent over the surveys, a major problem does not occur to interpret trends in study findings. Moreover, the response rate of these surveys did not have inferiority in comparison with the response rate of surveys in Western countries (CDC, 2006a). It is important and significant to continue conducting the periodical nationwide survey, even if the survey includes some methodological problems.

COMPETING INTERESTS

None declared.

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Decrease in the prevalence of smoking among Japanese adolescents and its possible causes: periodic nationwide cross-sectional surveys

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Abstract

Objectives To assess trends in smoking prevalence among Japanese adolescents and to analyze possible causal factors for the decrease in smoking prevalence observed in a 2004 survey.

Methods Nationwide cross-sectional surveys were conducted in 1996, 2000 and 2004. Survey schools, both junior and senior high schools, considered to be representative of the whole of Japan were sampled randomly. Enrolled students were asked to complete a self-reporting anonymous questionnaire on smoking behavior. The questionnaires were collected from 115,814 students in 1996, 106,297 in 2000, and 102,451 in 2004. School principals were asked about the policy of their respective school on smoking restrictions.

Results Cigarette smoking prevalence (lifetime, current, and daily smoking) in 2004, based on the completed questionnaires, had decreased relative to previous years in both sexes and in all school grades. The most important

trends were: a decrease in smoking prevalence among the fathers and older brothers of the students; an increase in the proportion of students who did not have friends; a decrease in the proportion of current smokers who usually bought cigarettes in stores decreased in 2004, in particular for the oldest boys. An association was found between a lower smoking rate at a school and a smoke-free school policy.

Conclusions Japan has experienced a decrease in the prevalence of smoking among adolescents. A decrease in smoking prevalence among the fathers and older brothers, limitations to minors' access to tobacco, an increase in the proportion of students without friends, and a school policy restricting smoking may have contributed to this decreasing trend.

Keywords Adolescence · Adolescent behavior · Cigarette use · Japan · Smoking behavior

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Introduction

Cigarette smoking increases the risk of many diseases. Given the difficulty of escaping nicotine dependence, the prevention of smoking among adolescents has been identified as a major public health measure [1, 2]. The monitoring of smoking prevalence among adolescents is thus an important means of clarifying the characteristics of this problem, establishing countermeasures, and evaluating public health efforts to reduce smoking prevalence. In the case of Japan, nationwide surveys on cigarette smoking among high school students conducted in 1996 and 2000 [3–5] revealed that many students had started smoking despite the various restrictions to prevent this established by the Act to Prohibit Minors from Smoking, enacted in 1900. To better understand trends in smoking prevalence, we conducted a third nationwide survey in 2004 and found a dramatic decrease in smoking prevalence among Japanese adolescents.

Many articles describe associated factors or predictors of adolescent smoking. Parental or sibling smoking status and peer networks are two well-known factors contributing to smoking among adolescents [6–9]. Therefore, an analysis of the trends in parental or sibling smoking status and peer networks is important for studying factors contributing to the change in smoking prevalence among adolescents. Although it was expected that a school's policy on limiting smoking by teachers would play a positive role in discouraging students from smoking, review papers have summarized that the effect of such school-based smoking control measures is small in Western countries [10, 11].

Here, we describe the trends in adolescent smoking prevalence in Japan and analyze the possible factors contributing to a decrease in smoking prevalence among the adolescent population, including parental or sibling smoking status, peer networks, and school regulations on teachers' smoking.

Methods

Subjects

The survey was a cross-sectional random sampling survey, which used the single-stage cluster sampling methodology [12]. The cluster unit of the sampling was schools. The survey targeted junior and senior high school students from schools selected throughout Japan using the National School Directory. All students enrolled in the sampled schools were subjects of the study.

The number of schools sampled in the 1996 survey was 122 of 11,274 junior high schools (selection rate: 1.1%)

and 109 of 5501 senior high schools (2.0%). The proportion of private schools was 4.9% for junior high schools and 28.4% for senior high schools. The proportion of general, vocational and mixed senior high schools was 38.5, 23.9, and 37.5%, respectively. The survey period was December 1996 to the end of January 1997. Respective values for the 2000 and 2004 surveys were 132 of 11,200 junior (1.2%) and 102 of 5,315 senior high schools (1.9%) from December 2000 to the end of January 2001, and 131 of 11,060 junior (1.2%) and 109 of 4,627 senior high schools (1.9%) from December 2004 to the end of January 2005. The proportion of private schools was 7.6% for junior high schools and 33.3% for senior high schools in 2000 survey; in the 2004 survey, the proportions were 6.9% and 26.6%, respectively. The proportion of general, vocational and mixed senior high schools was 48.0, 13.7, and 38.3%, respectively in the 2000 survey and 45.0, 22.9, and 32.1%, respectively, in the 2004 survey.

Procedures

We requested the cooperation of the principals of these schools and sent these individuals questionnaires for their respective school's student population. The teachers were asked to inform the students of the voluntary nature of their participation and to urge them to answer honestly. Anonymous questionnaires and envelopes were handed to the students for completion during school time. Upon completion, the questionnaires were sealed in the envelopes by the students themselves, collected by their teachers, and returned to our institute unopened. School regulations on smoking by teachers was determined using a school questionnaire completed by the school principal. This survey was approved by the Ethics Committee of the National Institute of Public Health.

Measures

The questionnaire focused on smoking experience, smoking frequency, age (by school grade) when the respondent first tried smoking, number of cigarettes consumed daily by smokers, sources for cigarettes, and smoking status of the student's family. Experimenting smokers, current smokers, and daily smokers were defined as those who had tried smoking at least once, those who had smoked at least once during the previous 30 days, and those who had smoked every day during the previous 30 days, respectively. Students were defined as having no friend who smoked if they responded that "I have no friend" in the question "Do you have a friend who is a smoker?"—yes/no/I have no friend.

School regulations on smoking by teachers was categorized into four groups, namely (1) completely smoke-free throughout the school site, including buildings and

grounds; (2) smoke-free in all school buildings but not the grounds; (3) appropriate separation of smoking (smoking room); (4) insufficient separation of smoking. Appropriate separation was defined as a completely partitioned smoking room with air exhaust facilities to the exterior.

Response rate

For the 1996 survey, responses were obtained from 80 junior (response rate 65.6%) and 73 senior high schools (67.0%), with a total of 115,814 responses accounting for 64.1% of all junior and 62.5% of all senior students enrolled in the sampled schools. In 2000, the respective values were 99 (75.0%) and 77 schools (75.5%), with 106,297 responses accounting for 66.1 and 59.3% of enrolled students, and in 2004, these were 92 (70.2%) and 87 schools (79.8%), with 102,451 responses accounting for 60.7 and 67.7% of students. The defining properties of the responding schools, such as the proportion of private schools, vocational schools, or general schools were chosen to be representative of the study population.

Data analysis

The percentages and 95% confidence intervals (95%CI) in the tables were calculated by a weighting method based on one-stage stratified cluster sampling [12]. Proportions in tables were compared using statistical testing for rate differences. Multiple logistic regression analyses were applied to calculate odds ratios and the population attributable risk percentage for a student's current smoking status with a family member's (father, mother, older brother, and older sister) smoking, and for a student's current smoking status with the absence of a friend. Data were analyzed using the SPSS FOR WINDOWS ver. 13.0 software (SPSS, Chicago, IL).

Results

Smoking prevalence

Lifetime smoking rate, current smoking rate, and daily smoking rate increased with age. Lifetime smoking rate in 2000 among junior high school boys fell compared with that in 1996, whereas the prevalence of regular smoking (current smoking and daily smoking) did not. In 2004, lifetime, current, and daily smoking rates had decreased—relative to 1996 and 2000—in both sexes and in every school grade (Table 1). The magnitude of the decrease was greater in boys than in girls.

Factors accounting for the decrease in smoking prevalence

The data were analyzed to identify the factors for this decreasing trend in smoking prevalence among Japanese adolescents. Reported smoking status of family members showed some decrease in family smoking, especially that by fathers, but smoking by older brothers, older sisters and friends also showed a significant and persistent decrease (Table 2). In contrast, smoking by mothers of junior high school boys and senior high school girls increased. The odds ratios of a student's current smoking status with the smoking by a family member were higher when it was the mother who smoked than when it was the father who smoked. The increasing tendency was observed in the odds ratios when both the father and mother smoked. The odds ratios of father and senior brother among boys were higher than those among girls, whereas the odds ratios of the mother and senior sister among girls were higher than those among boys. The population attributable risks of family's smoking were calculated at 7.7–18.1% in 1996, 8.4–21.7% in 2000, and 6.0–25.3% of the total current smoking rate in 2004; the estimated risk of the father was higher among boys and that of the mother was higher among girls (Table 2).

In our search for factors contributing to the change in smoking prevalence among adolescents, we discovered an increase in the proportion of students who had no friend. In the 1996 and 2000 survey, the proportion of students who reported that they had no friends was quite low; however, this abruptly increased in 2004. Since the smoking prevalence among students who had no friend was lower than that among students who did have a friend, the odds ratios of having no friend were calculated for the values that were smaller than 1.0. The magnitude of the effect was smaller than that of family's smoking but significant for senior high school students (Table 2).

The most common sources of cigarettes for current smokers are cigarette vending machines, stores (convenience store, supermarket, or gas station), and someone else. When the results for 2000 and 2004 were compared, the proportion students getting cigarettes from stores and someone else had decreased in 2004, especially for boys (Table 3).

When the association between the prevalence of smoking among students and the respective school's regulations on smoking by teachers were analyzed, we found that smoking by students in smoke-free schools tended to be lower in both junior and senior high schools. The difference was statistically significant in junior high school girls and in senior high school boys for regular smoking (Table 4). However, smoking prevalence of junior high school students and senior high school girls in the schools

Table 1 Smoking prevalence by sex and school grade (1996, 2000, 2004)

Sex	High school	Year (grade)	Lifetime smoking (%)			Current smoking (%)			Daily smoking (%)			Sample size		
			1996 CI	2000 CI	2004 CI	1996 CI	2000 CI	2004 CI	1996 CI	2000 CI	2004 CI	1996	2000	2004
Male	Junior	1st (7th)	29.9 ± 0.5	22.5 ± 0.4	13.3 ± 0.3	7.5 ± 0.3	5.9 ± 0.2	3.2 ± 0.1	0.7 ± 0.1	0.5 ± 0.0	0.4 ± 0.0	7,211	8,248	6,917
		2nd (8th)	35.1 ± 0.5	28.0 ± 0.4	18.1 ± 0.3	10.8 ± 0.4	8.2 ± 0.3	4.8 ± 0.2	1.9 ± 0.1	1.9 ± 0.1	1.3 ± 0.1	7,152	8,541	6,845
		3rd (9th)	38.7 ± 0.5	35.4 ± 0.5	23.1 ± 0.4	14.4 ± 0.5	14.0 ± 0.4	7.3 ± 0.2	4.6 ± 0.3	5.2 ± 0.2	2.2 ± 0.1	7,108	8,559	6,917
		Subtotal	34.6 ± 0.4	28.7 ± 0.4	18.2 ± 0.3	10.9 ± 0.3	9.4 ± 0.2	5.1 ± 0.1	2.4 ± 0.1	2.6 ± 0.1	1.3 ± 0.1	21,471	25,348	20,679
Senior	1st (10th)	47.7 ± 0.8	45.0 ± 0.6	30.9 ± 0.6	24.7 ± 0.9	24.3 ± 0.7	11.3 ± 0.4	10.8 ± 0.6	12.4 ± 0.6	4.7 ± 0.2	12,079	10,590	12,235	
		2nd (11th)	52.6 ± 0.8	51.3 ± 0.5	35.9 ± 0.7	31.0 ± 1.0	29.5 ± 0.7	15.4 ± 0.5	18.3 ± 0.8	18.0 ± 0.6	8.2 ± 0.4	12,645	9,662	12,241
		3rd (12th)	55.6 ± 0.8	55.7 ± 0.6	42.0 ± 0.7	36.9 ± 1.0	36.9 ± 0.8	21.7 ± 0.6	25.4 ± 0.9	25.9 ± 0.7	13.0 ± 0.5	10,921	8,976	10,843
		Subtotal	51.9 ± 0.8	50.3 ± 0.6	36.0 ± 0.6	30.7 ± 1.0	29.9 ± 0.7	15.9 ± 0.5	18.0 ± 0.8	18.4 ± 0.6	8.5 ± 0.3	35,645	29,228	35,319
Female	Junior	1st (7th)	16.7 ± 0.4	16.0 ± 0.3	10.4 ± 0.3	3.8 ± 0.2	4.2 ± 0.2	2.4 ± 0.1	0.4 ± 0.0	0.4 ± 0.0	0.2 ± 0.0	7,158	7,124	6,229
		2nd (8th)	20.4 ± 0.4	20.5 ± 0.3	14.8 ± 0.3	5.4 ± 0.2	5.7 ± 0.2	3.7 ± 0.1	0.7 ± 0.1	1.0 ± 0.1	0.5 ± 0.0	6,966	7,375	6,234
		3rd (9th)	22.7 ± 0.4	23.5 ± 0.4	16.6 ± 0.4	5.5 ± 0.2	6.9 ± 0.2	4.8 ± 0.2	1.0 ± 0.1	1.8 ± 0.1	1.2 ± 0.1	7,203	7,399	6,243
		Subtotal	19.9 ± 0.3	20.0 ± 0.2	13.9 ± 0.3	4.9 ± 0.1	5.6 ± 0.1	3.6 ± 0.1	0.7 ± 0.0	1.0 ± 0.0	0.6 ± 0.0	21,327	21,898	18,706
Senior	1st (10th)	29.2 ± 0.6	30.6 ± 0.6	20.5 ± 0.5	9.2 ± 0.4	10.9 ± 0.4	6.5 ± 0.3	2.4 ± 0.1	3.0 ± 0.2	1.7 ± 0.1	12,617	10,552	9,580	
		2nd (11th)	33.6 ± 0.7	34.2 ± 0.6	24.6 ± 0.6	13.3 ± 0.5	13.0 ± 0.4	8.5 ± 0.4	4.5 ± 0.2	5.3 ± 0.2	3.3 ± 0.2	12,771	9,938	9,289
		3rd (12th)	38.5 ± 0.7	36.7 ± 0.6	27.0 ± 0.7	15.6 ± 0.5	15.8 ± 0.5	9.7 ± 0.4	7.1 ± 0.3	8.2 ± 0.3	4.3 ± 0.2	11,983	9,333	8,878
		Subtotal	33.5 ± 0.6	33.7 ± 0.5	24.0 ± 0.6	12.6 ± 0.4	13.1 ± 0.4	8.2 ± 0.3	4.6 ± 0.2	5.4 ± 0.2	3.1 ± 0.2	37,371	29,823	27,747

CI, 95% Confidence interval

Lifetime smoking, Students who had tried smoking at least once; Current smoking, students who smoked ≥ 1 day of the 30 days preceding the survey; daily smoking, students who smoked every day of the 30 days preceding the survey

Table 2 Smoking prevalence among family members and prevalence of students who have no friend, as reported by students, and the odds ratio and population attributable risk of a student's current smoking with smoking by a family member

Sex	High school	Family friend	Smoking prevalence (%)		P value	Odds ratio ^a		Population attributable risk (%)								
			1996 CI	2000 CI		2004 CI	2000 vs. 2004	1996 CI	2000 CI	1996	2000	2004				
Male	Junior	Father	55.2 ± 0.3	52.6 ± 0.4	46.2 ± 0.4	**	1.30	1.19–1.42	1.39	1.27–1.52	1.54	1.33–1.74	14.2	17.0	20.0	
		Mother	13.5 ± 0.3	16.1 ± 0.3	16.9 ± 0.3	**	1.62	1.45–1.81	1.91	1.72–2.11	2.20	1.91–2.54	7.7	12.8	16.9	
		Older brother	11.6 ± 0.2	10.8 ± 0.2	7.9 ± 0.1	**	2.72	2.45–3.02	2.80	2.52–3.11	2.90	2.47–3.40	16.6	16.3	13.1	
		Older sister	4.5 ± 0.1	4.5 ± 0.1	3.8 ± 0.1	**	2.85	2.45–3.32	3.03	2.62–3.49	2.69	2.19–3.31	7.7	8.4	6.0	
Proportion of students who have no friend																
Senior	Senior	No friend	3.9 ± 0.1	4.1 ± 0.1	6.5 ± 0.1	**	0.89	0.71–1.11	0.79	0.63–1.00	0.88	0.68–1.14	-0.4	-0.9	-0.8	
		Father	54.7 ± 0.4	53.1 ± 0.4	43.8 ± 0.3	**	1.33	1.27–1.40	1.38	1.31–1.46	1.70	1.60–1.80	15.3	16.8	23.5	
		Mother	14.6 ± 0.5	15.6 ± 0.4	14.5 ± 0.3	**	1.77	1.67–1.89	1.76	1.64–1.88	2.01	1.87–2.17	10.1	10.6	12.8	
		Older Brother	19.0 ± 0.4	17.3 ± 0.3	13.9 ± 0.2	**	2.16	2.05–2.28	2.11	1.98–2.25	2.36	2.20–2.53	18.1	16.1	15.9	
Female	Junior	Older sister	7.7 ± 0.2	8.0 ± 0.2	6.3 ± 0.2	**	2.31	2.13–2.51	2.46	2.25–2.69	2.59	2.36–3.25	9.2	10.5	9.1	
		Proportion of students who have no friend														
		No friend	3.5 ± 0.1	3.5 ± 0.1	6.7 ± 0.1	**	0.43	0.37–0.49	0.31	0.26–0.38	0.36	0.31–0.43	-2.0	-2.5	-4.5	
		Father	56.1 ± 0.3	55.4 ± 0.2	48.9 ± 0.3	**	1.17	1.02–1.34	1.30	1.14–1.47	1.17	0.99–1.80	8.7	14.3	7.7	
Senior	Senior	Mother	14.6 ± 0.3	18.0 ± 0.3	15.4 ± 0.3	**	2.18	1.88–2.52	2.54	2.24–2.89	3.20	1.87–2.17	14.7	21.7	25.3	
		Older brother	11.7 ± 0.2	11.9 ± 0.1	8.7 ± 0.1	**	2.44	2.10–2.83	2.76	2.41–3.17	2.59	2.20–2.53	14.4	17.3	12.2	
		Older sister	5.1 ± 0.1	5.5 ± 0.1	4.7 ± 0.1	**	3.56	2.98–4.25	3.43	2.91–4.04	3.31	2.36–2.86	11.5	11.8	9.8	
		Proportion of students who have no friend														
Senior	Senior	No friend	2.6 ± 0.1	2.8 ± 0.0	4.0 ± 0.1	**	1.81	1.33–2.44	0.70	0.47–1.05	0.85	0.56–1.28	2.1	-0.8	-0.6	
		Father	54.5 ± 0.3	53.9 ± 0.3	45.7 ± 0.4	**	1.23	1.15–1.31	1.38	1.28–1.48	1.49	1.36–1.63	11.1	17.0	18.3	
		Mother	14.0 ± 0.3	15.9 ± 0.3	16.3 ± 0.4	**	2.22	2.06–2.39	2.24	2.07–2.43	2.59	2.35–2.86	14.6	16.5	20.6	
		Older brother	18.6 ± 0.3	17.8 ± 0.2	14.4 ± 0.3	**	1.75	1.63–1.88	1.76	1.62–1.91	1.88	1.70–2.09	12.2	11.9	11.2	
Senior	Senior	Older sister	8.5 ± 0.2	8.8 ± 0.2	6.7 ± 0.2	**	3.02	2.77–3.29	2.80	2.54–3.07	2.87	2.54–3.25	14.7	13.7	11.1	
		Proportion of students who have no friend														
Senior	Senior	No friend	2.3 ± 0.0	2.5 ± 0.0	4.1 ± 0.1	**	0.57	0.44–0.73	0.31	0.22–0.45	0.44	0.32–0.60	-1.0	-1.8	-2.3	

*P < 0.05, **P < 0.01; result of statistical testing between 2000 and 2004

CI, 95% Confidence interval

^a Odds ratios were calculated using multiple logistic analysis to make adjustments with other family members and with school grade

Table 3 Usual sources of cigarettes reported by current smokers

Sex	High school	Year	Searching in house (%) CI	Getting from someone CI	Tobacconist shop CI	Stores CI	Vending machine CI	Number of current smokers
Male	Junior	1996	24.2 ± 0.3	33.4 ± 0.2	17.0 ± 0.2	17.8 ± 0.3	60.3 ± 0.4	2,453
		2000	21.4 ± 0.2	37.1 ± 0.2	13.4 ± 0.2	21.3 ± 0.2	64.6 ± 0.2	2,389
		2004	22.1 ± 0.5	30.6 ± 0.8 **	12.0 ± 0.2	13.5 ± 0.2 **	61.1 ± 0.4	1,049
	Senior	1996	15.1 ± 0.1	30.9 ± 0.2	27.3 ± 0.3	42.6 ± 0.5	84.3 ± 0.1	11,869
		2000	14.0 ± 0.1	33.1 ± 0.1	26.2 ± 0.3	49.4 ± 0.3	85.8 ± 0.1	8,818
		2004	13.2 ± 0.4	29.2 ± 0.4 **	20.8 ± 0.2 **	41.5 ± 0.3 **	82.5 ± 0.1 **	5,625
Female	Junior	1996	39.4 ± 0.4	41.6 ± 0.3	11.7 ± 0.2	16.1 ± 0.3	54.0 ± 0.4	1,048
		2000	27.8 ± 0.3	47.5 ± 0.3	9.0 ± 0.1	17.9 ± 0.3	60.7 ± 0.3	1,206
		2004	31.5 ± 1.3	40.8 ± 1.6 **	8.9 ± 0.3	12.7 ± 0.3 *	59.4 ± 0.4	677
	Senior	1996	18.5 ± 0.2	35.1 ± 0.2	13.2 ± 0.3	28.4 ± 0.5	76.6 ± 0.2	4,696
		2000	15.4 ± 0.1	35.8 ± 0.2	10.2 ± 0.1	36.2 ± 0.3	80.3 ± 0.2	3,824
		2004	17.0 ± 0.6	32.6 ± 0.8 **	9.9 ± 0.2	34.2 ± 0.3	77.8 ± 0.2	2,263

CI, 95% Confidence interval

* $P < 0.05$, ** $P < 0.01$; result of statistical testing between 2000 and 2004

Percentages add up to more than 100% as some students mentioned more than one source of cigarettes

Table 4 Association between variables of students' smoking and school smoking regulation

Sex	High school	School policy	Number of schools	Lifetime smoking		Current smoking		Daily smoking		Number of students
				OR	CI	OR	CI	OR	CI	
Male	Junior	Insufficient separation of smoking	23	1.0		1.0		1.0		5,380
		Separate smoking areas	23	1.04	0.94–1.14	1.05	0.88–1.26	1.09	0.77–1.55	4,992
		Smoke-free in school buildings	19	0.99	0.89–1.09	1.23	1.03–1.47	1.44	1.02–2.02	4,275
		Smoke-free throughout school site	27	0.94	0.85–1.03	1.01	0.85–1.20	0.98	0.69–1.38	6,032
	Senior	Insufficient separation of smoking	19	1.0		1.0		1.0		8,569
		Separate smoking areas	28	0.91	0.86–0.96	0.89	0.82–0.96	0.88	0.80–0.97	10,649
		Smoke-free in school buildings	13	0.80	0.74–0.86	0.70	0.63–0.77	0.64	0.56–0.73	4,590
		Smoke-free throughout school site	27	0.87	0.79–0.89	0.76	0.70–0.82	0.69	0.63–0.77	11,511
Female	Junior	Insufficient separation of smoking	23	1.0		1.0		1.0		4,606
		Separate smoking areas	23	1.15	1.02–1.29	1.06	1.02–1.29	1.69	1.02–2.81	4,558
		Smoke-free in school buildings	19	1.16	1.03–1.31	1.31	1.03–1.31	1.33	0.76–2.32	3,882
		Smoke-free throughout school site	27	0.87	0.78–0.98	0.75	0.78–0.98	0.84	0.48–1.48	5,660
	Senior	Insufficient separation of smoking	19	1.0		1.0		1.0		5,222
		Separate smoking areas	28	0.81	0.75–0.88	0.92	0.81–1.04	0.83	0.68–1.00	10,139
		Smoke-free in school buildings	13	1.12	1.01–1.23	1.30	1.12–1.50	1.05	0.84–1.32	3,782
		Smoke-free throughout school site	27	0.87	0.81–0.95	0.93	0.82–1.06	0.85	0.69–1.03	8,604

OR, Odds ratio; CI, 95% confidence interval adjusted by school grade and school policy on teachers' smoking in school

of smoke-free buildings was rather higher than that in the schools who had an insufficient separation of smoking-free/smoking areas.

Discussion

This study provides the first evidence of a dramatic decrease in smoking prevalence among Japanese adolescents. The

2000 survey showed a decrease in lifetime smoking rate among junior high school boys only and no decrease in prevalence among girls or in regular smoking prevalence among boys. In recent years there has been a trend towards a decreased prevalence of smoking among adolescents in a number of western countries, including the USA [13], England [14], Australia [15], Canada [16], and in adolescent boys in Sweden and Finland [17], but not in a number of other European countries, such as Italy, Russia [18],

Hungary, and Latvia [17]. The magnitude of decrease found in our 2004 survey was one of the largest reported to date and is the first decrease reported in an Asian country.

In our analysis of the possible factors accounting for the decrease, we identified a decrease in smoking prevalence among family members and an increased proportion of students who had no friends. Parent and sibling smoking is one of the most important predictors of adolescent smoking [6–9, 19, 20]. We observed considerably high odds ratios and population attributable risk of a student's current smoking status with smoking by a family member: the reported decreases in the prevalence of smoking by a father and older brother probably contributed to the decrease among students. However, the prevalence of smoking by mothers of junior high school boys has increased significantly, and this influence on students' smoking behavior should be monitored by periodic surveys. We also observed that having no friend was a protective factor on smoking behavior among senior high school students. Peer smoking is a well-known predictor of adolescent smoking [20]. The increased proportion of students who reported having no friends indicates a decrease in the human network of students. This may also have contributed to a decrease in peer pressure to start smoking [21].

A governmental measure, called the Act to Prohibit Minors from Smoking, was enacted in 1990 in Japan. According to this law, adults who sell a cigarette to a minor will be punished. However, the number of arrests made under this law has been extremely low, and the law has not had the intended effect. The proportion of current smokers who bought their cigarettes in a store decreased in the 2004 survey, especially for senior high school boys. This may be due to the governmental obligation for sellers to confirm a customer's age (from December 2001, due to a revision of the Act to Prohibit Minors from Smoking). However, a significant number of adolescent smokers still buy their cigarettes in stores, and most of the current smokers purchase their cigarettes using cigarette vending machines. The proportion of smokers who buy their cigarettes from vending machine is much higher than that in other countries [22]. Since the number of cigarette vending machines has not decreased [5], banning vending machine and enforcement of age confirmation in stores are important measures to prevent smoking by minors in Japan.

This study also identified the possible efficacy of school regulations on smoking by teachers. Based on the Health Promotion Law issued in 2002, there is a movement by local governments to encourage a smoke-free school site policy with the aim of preventing passive smoking in schools. We observed that a total ban on smoking at a school (entire school site) can be an effective measure in

preventing adolescent smoking. Some researchers have emphasized the importance of school smoking restrictions [23, 24], whereas review papers have summarized that the effect of school-based smoking control measures is small [10, 11]. For cultural reasons, the magnitude of the effectiveness of school-based smoking control may be greater in Japan than in Western countries. The inappropriate influence of teachers who smoke outside the school buildings in the view of students may contribute to the relatively higher smoking prevalence in the schools with smoke-free buildings only.

One interesting observation was the contrasting relationship between sexes and school categories (junior or senior) in terms of the increase in smoking by mothers and the effectiveness of school policy. We speculate that smoking by the mother may offset the effect of a school policy on restricting smoking.

In the period 1996 through 2004, cigarette prices in Japan were raised on two occasions, in 1998 and 2003, each time by 20 yen (US \$ 0.18) per pack (20 cigarettes). It is therefore difficult to explain that the decrease in prevalence after 2000 was the result of higher prices. Since adolescent smoking is also influenced by tobacco industry promotions, such as advertising [25–27] and smoking in TV programs or movies [28], we plan to assess the role of cigarette advertising and smoking scenes in TV programs or movies in Japan.

A limitation of this study is the possibility of misclassification of the smoking status among students. Although this study is an anonymous questionnaire survey, the respondents may have been reluctant to report their actual smoking status due to the more active anti-smoking policies in recent years. However, we considered that the influence of misclassification of reported smoking status was not large because the number of questionnaires with an invalid answer or a contradictory answer did not increase during this study period. Confirmation of the persistence of this decrease in prevalence will require periodic monitoring of adolescent smoking prevalence and related factors.

Conclusion

In recent years, a number of Western countries have experienced a decrease in the prevalence of smoking among adolescents. The results of the 2004 survey reported here showed a dramatic decrease in smoking prevalence among Japanese adolescents. The current findings demonstrate that possible factors contributing to this decrease is a decreased prevalence of smoking by a father and older brother, restriction in the access of minors to tobacco, an increase in the proportion of students without friends, and a school policy restricting smoking.