Risk Factors for Cigarette Smoking Among High School Students in Okinawa, Japan

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The purpose of this study was to examine the relationships between risk factors and smoking status among high school students in Okinawa, Japan. We also examined if there is a dose-response relation between the number of risk factors and smoking status. Self-reported questionnaires including smoking status and potential risk factors were conducted using a sample of 1,029 students of a public senior high school in Okinawa.

The percentage of smokers was 40.0% for males and 10.6% for females, and it was significantly higher for males than females. As a result of multivariate analysis, we identified four significant risk factors; peer smoking, attitude of peer toward subject smoking, intention to smoke at the age 20, and alcohol drinking. The number of these risk factors was linearly associated with increased percentage of smokers, and a linear trend was significant for both gender students. Additionally, magnitude of risk for smoking among females became considerably great compared with those of males as the number of risk factors increased.

In conclusion, this study was the first study in Japan to indicate a significant dose-response relationship between the number of risk factors and smoking status among high school students. We also found that females with many risk factors had extremely increased vulnerability to smoking compared to male counterpart. These findings may be useful to identify high-risk students who need more intensive smoking prevention programs and to develop the content of effective interventions.

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smoking, risk factors, adolescents, dose-response relationship

INTRODUCTION

Many epidemiological studies have been conducted to indicate the prevalence and related factors of adolescent smoking in Western countries. These studies have found that a large number of psychosocial factors have been strongly associated with adolescent smoking behavior 1-8. On the other hand, some researchers have paid attention to the amount of risk as well as the various types of risk for smoking and other drug use 4,6. Farrell et al. 8, for instance, proposed a risk factor approach that involvement of drug use was related to the total number of risk factors for a given individual, rather than any specific combination of risk factors. Bry et al. 4 also mentioned that "drug abuse is a general instead of specific coping mechanism, that its likelihood is dependent on how much rather than exactly what there is cope with", and they indicated that extent of drug use was a function of number of risk factors. In fact, it was found there was substantial linear relationships between the number of different risk factors and specific measures of drug use 4,6. Epidemiologists generally use the term risk factor to indicate a variable that is related to the probability of an individual's development the disease 6. Recently, this term is

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also considered a variable that is associated with a higher likelihood of engaging in problem behavior that can compromise health or well-being 19. Although the analogy between a disease and drug use is not perfect, it provides an important technique and conceptual tool to understand the multiple causes and predictors of drug use 6. The application of risk factors to drug use hypotheses that with increased exposure to those factors known to promote drug use, there is an increased chance of drug use. Many studies cited above have adopted this hypothesis and have shown the relationship between risk factors and drug use 44. Therefore, it is evidently meaningful to take the number of risk factors into consideration in the research of adolescent smoking and other drug use 10. Using this approach is a salient concern of the present study, although we also examine the effect of each risk factor.

In Japan, a few study on adolescent smoking have examined multiple factors simultaneously by using multivariate analyses and adjusted for confounding factors 11,12. Moreover, no studies have attempted to use a risk factor approach and to show a dose-response relationship between the number of risk factors and smoking behavior among Japanese adolescents to our knowledge to date.

In addition, Okinawa Prefecture is well known as one of the world longevity regions. However, in recent years, warning signals concerning future longevity of Okinawa were pointed out by many researchers, because the mortality of the middle-age population is higher than the national average 13. Particularly, age-adjusted lung cancer mortality in Okinawa is the highest in Japan. Since lung cancer mortality attributable to smoking is inversely related to the age at onset of smoking 14, smoking prevention in young teenagers is one of the important measures to decrease its mortality. Then, we need knowledge of risk factors of smoking in order to develop effective prevention programs for adolescent smoking in Okinawa.

In this study, we examined the association between many risk factors selected on the previous researches 44 and smoking status among high school students in Okinawa, Japan. We also examined if there is a dose-response relation between the number of risk factors and smoking status.

**METHODS**

**Procedures and Subjects**

The school selected for this study was a public senior high school sited in a suburban area of Okinawa Prefecture, Japan. This school was chosen based upon willingness of school administrator to participate in a school-wide survey. The number of all students enrolled in the 10th through 12th grades at this school was 1,029 (497 males and 532 females). The percentage of graduates who went on to the higher educational institutions from this school in 1997 was 26.1%, which was similar to 26.2% of those in Okinawa as a whole 15. The study sample consisted of all students enrolled all classes in each grade level.

Using self-administered anonymous questionnaire, the survey was conducted in classroom settings in July 1997. The students were informed of the nature and intent of the study, and they were requested to respond the questionnaire and return it sealed in the return envelope. Out of all sample subjects, 979 students returned the questionnaire, the response rate for this study was 94.0%. 49.8% were males and 50.2% were females.

**Measures**

The questionnaire consisted of items concerning self-reported smoking status and potential risk factors selected on the previous researches 44. Quantity of cigarette smoking in the past month was assessed on a 4-point scale ranging from no cigarette (1) to more than 20 cigarettes (4). Smoking status was defined as follows: a smoker is defined as smoked one or more cigarettes in the past month, and a non-smoker as never smoked in the past month 10.

The following variables were categorized into two levels according to whether it was considered to be at risk or not: smoking status of subjects' families and peers (0 = non-smokers, 1 = smokers); Attitudes of parents and peers toward smoking of the subjects (0 = negative or neutral, 1 = non-negative); Attitudes of subjects toward adults' and minors' smoking (0 = negative or neutral, 1 = non-negative); Intention to smoke at the age 20 (0 = no, 1 = yes); Availability of cigarettes (0 = hard, 1 = easy); and Alcohol drinking in the past month (0 = no, 1 = yes).

A series of scales measuring the psychosocial characteristics such as depressive symptoms, self-esteem, social support, knowledge about smoking, and image of cigarette advertisement were also included. Depressive symptoms were measured using the Japanese version 17 of the Center for Epidemiologic Studies Depression Scale (CES-D) 18. Self-esteem was evaluated by the Japanese version 10 of the Rosenberg Self-esteem Scale 20. A junior high school version of the Scale of Expectancy for Social Support (SESS) 20 was used to measure the expectancy of social support. Knowledge about smoking was reflected in one scale, which combined two 15-item scales assessing the information and the accuracy of smoking-related knowledge 20. The knowledge score was computed by summing items that the students were well informed and answered correctly. Image of cigarette advertisement was assessed by a 15-item scale pertaining to the impression of advertisement for tobacco products 20. Each item was scored on a 5-point agree-disagree scale.

All these scales were scored in a dichotomous manner. Dichotomization of scores on each scale was done so as to yield about the extreme 25% of students on that measure. An extreme score was assigned the value of 1, indicating the presence of risk. A score of 0 indicated no risk on each scale. Table 1 shows the potential risk factors and also provides the range, the cut-points, and percentage of the sample at risk for each.
Risk Factors for Adolescent Smoking

Data analysis

Chi-square tests and Cramer’s V measures of association were used to examine the relationship between each risk factor and smoking status. To identify the significant risk factors, we applied a criteria of $p < 0.05$ and Cramer’s V > 0.1 for interpretation of significance levels by each gender. Logistic regression analysis was then conducted to eliminate redundant risk factors. The significant risk factors identified in the preceding section were used as the independent variables, and grade level was the covariate. Finally, we examined the relationships

| Risk factors                                | Category at risk | Variable range | Cut-point for scale | % of sample |
|---------------------------------------------|------------------|----------------|--------------------|-------------|
| Father smoking                              | Yes              |                |                    | 48.3        |
| Mother smoking                              | Yes              |                |                    | 12.1        |
| Sibling smoking                             | Yes              |                |                    | 25.5        |
| Other family member smoking                 | Yes              |                |                    | 28.6        |
| Peer smoking                                | Yes              |                |                    | 46.5        |
| Attitude of father toward subject smoking   | Non-negative     |                |                    | 5.8         |
| Attitude of mother toward subject smoking   | Non-negative     |                |                    | 3.7         |
| Attitude of peer toward subject smoking     | Non-negative     |                |                    | 14.8        |
| Attitude toward adults’ smoking             | Non-negative     |                |                    | 29.3        |
| Attitude toward minors’ smoking             | Non-negative     |                |                    | 16.2        |
| Intention to smoke at the age 20            | Yes              |                |                    | 26.4        |
| Availability of cigarettes                  | Easy             |                |                    | 87.3        |
| Alcohol drinking                            | Yes              |                |                    | 39.8        |
| Depressive symptoms                        | Depression       | 0-60           | $\geq 21$          | 28.8        |
| Self-esteem                                 | Low self-esteem  | 10-40          | $\leq 22$          | 29.9        |
| Social support                              | Low social support| 0-80          | $\leq 17$          | 27.6        |
| Knowledge about smoking                     | Less knowledge   | 0-15           | $\leq 5$          | 31.9        |
| Image of cigarette advertising              | Positive         | 0-60           | $\leq 29$          | 25.5        |

Table 2. Smoking status by grade level and gender.

|                | Non-smokers | Smokers | $\chi^2$ | $p$ |
|----------------|-------------|---------|----------|-----|
|                | n  %        | n  %    |          |     |
| 10th grade     |             |         |          |     |
| Males          | 95 53.1     | 84 46.9 | 37.96    | <0.001 |
| Females        | 132 84.6    | 24 15.4 |          |     |
| 11th grade     |             |         |          |     |
| Males          | 80 56.7     | 61 43.3 | 49.66    | <0.001 |
| Females        | 128 93.4    | 9 6.6   |          |     |
| 12th grade     |             |         |          |     |
| Males          | 110 71.0    | 45 29.0 | 21.88    | <0.001 |
| Females        | 172 90.5    | 18 9.5  |          |     |
| Subtotala      |             |         |          |     |
| Males          | 285 60.0    | 190 40.0| 110.25   | <0.001 |
| Females        | 432 89.4    | 51 10.6 |          |     |
| Total          | 717 74.8    | 241 25.2|          |     |

21 subjects had incomplete data of smoking status.
a : Significant difference across grade levels: males $\chi^2=11.97$, $p=0.003$; females $\chi^2=6.39$, $p=0.04$
Table 3. The relationship between each risk factor and smoking status by gender.

| Risk factors                  | Category | Males |                     | Females |                     |
|------------------------------|----------|-------|---------------------|---------|---------------------|
|                              |          | Non-smokers | Smokers | χ² | p | Cramer | Non-smokers | Smokers | χ² | p | Cramer |
| Father smoking               | No       | 160 | 64.5 | 88 | 35.5 | 4.41 | 0.036 | 0.096 | 222 | 91.7 | 20 | 8.3 | 2.70 | 0.100 | 0.075 |
|                              | Yes      | 125 | 55.1 | 102 | 44.9 |       |       |       | 210 | 87.1 | 31 | 12.9 |       |       |       |
| Mother smoking               | No       | 257 | 61.6 | 160 | 38.4 | 3.78 | 0.052 | 0.089 | 387 | 91.1 | 38 | 8.9 | 9.81 | 0.002 | 0.143 |
|                              | Yes      | 28  | 48.3 | 30  | 51.7 |       |       |       | 45  | 77.6 | 13 | 22.4 |       |       |       |
| Sibling smoking              | No       | 228 | 64.4 | 126 | 35.6 | 11.25 | 0.001 | 0.154 | 327 | 92.4 | 27 | 7.6 | 12.06 | 0.001 | 0.158 |
|                              | Yes      | 57  | 47.1 | 64  | 52.9 |       |       |       | 105 | 81.4 | 24 | 18.6 |       |       |       |
| Other family member smoking  | No       | 203 | 61.0 | 130 | 39.0 | 0.43 | 0.513 | 0.030 | 322 | 91.2 | 31 | 8.8 | 4.39 | 0.036 | 0.095 |
|                              | Yes      | 82  | 57.7 | 60  | 42.3 |       |       |       | 110 | 84.6 | 20 | 15.4 |       |       |       |
| Peer smoking                 | No       | 142 | 82.1 | 31  | 17.9 | 55.28 | 0.000 | 0.341 | 325 | 96.4 | 12 | 3.6 | 57.81 | 0.000 | 0.346 |
|                              | Yes      | 143 | 47.4 | 159 | 52.6 |       |       |       | 107 | 73.3 | 39 | 26.7 |       |       |       |
| Attitude of father toward subject smoking | Negative | 266 | 62.6 | 159 | 37.4 | 11.27 | 0.001 | 0.154 | 428 | 89.9 | 48 | 10.1 | 7.85 | 0.005 | 0.127 |
|                              | Non-negative | 19  | 38.0 | 31  | 62.0 |       |       |       | 4   | 57.1 | 3  | 42.9 |       |       |       |
| Attitude of mother toward subject smoking | Negative | 274 | 62.0 | 168 | 38.0 | 10.51 | 0.001 | 0.149 | 431 | 89.8 | 49 | 10.2 | 10.06 | 0.002 | 0.144 |
|                              | Non-negative | 11  | 33.3 | 22  | 66.7 |       |       |       | 1   | 33.3 | 2  | 66.7 |       |       |       |
| Attitude of peer toward subject smoking | Negative | 248 | 69.7 | 108 | 30.3 | 55.28 | 0.000 | 0.341 | 422 | 92.3 | 35 | 7.7 | 75.62 | 0.000 | 0.396 |
|                              | Non-negative | 37  | 31.1 | 82  | 68.9 |       |       |       | 10  | 38.5 | 16 | 61.5 |       |       |       |
| Attitude toward adults' smoking | Negative | 188 | 66.4 | 95  | 33.6 | 12.07 | 0.001 | 0.159 | 361 | 92.6 | 29 | 7.4 | 20.92 | 0.000 | 0.208 |
|                              | Non-negative | 97  | 50.5 | 95  | 49.5 |       |       |       | 71  | 76.3 | 22 | 23.7 |       |       |       |
| Attitude toward minors' smoking | Negative | 240 | 67.4 | 116 | 32.6 | 32.56 | 0.000 | 0.262 | 409 | 91.9 | 36 | 8.1 | 36.51 | 0.000 | 0.275 |
|                              | Non-negative | 45  | 37.8 | 74  | 62.2 |       |       |       | 23  | 60.5 | 15 | 39.5 |       |       |       |
| Intention to smoke at the age 20 | No       | 236 | 89.1 | 29  | 10.9 | 209.81 | 0.000 | 0.665 | 420 | 96.6 | 15 | 3.4 | 239.88 | 0.000 | 0.705 |
|                              | Yes      | 49  | 23.4 | 160 | 76.6 |       |       |       | 11  | 23.4 | 36 | 76.6 |       |       |       |
| Availability of cigarettes   | Hard     | 37  | 86.0 | 6   | 14.0 | 13.25 | 0.000 | 0.167 | 72  | 94.7 | 4  | 5.3 | 2.72 | 0.099 | 0.075 |
|                              | Easy     | 248 | 57.5 | 183 | 42.5 |       |       |       | 358 | 88.4 | 47 | 11.6 |       |       |       |
| Alcohol drinking             | Not      | 186 | 70.5 | 78  | 29.5 | 28.57 | 0.000 | 0.246 | 297 | 96.1 | 12 | 3.9 | 41.51 | 0.000 | 0.294 |
|                              | Yes      | 96  | 46.2 | 112 | 53.8 |       |       |       | 132 | 72.2 | 39 | 22.8 |       |       |       |
| Depressive symptoms          | ≤ 20     | 213 | 63.8 | 121 | 36.2 | 5.79 | 0.016 | 0.111 | 320 | 92.5 | 26 | 7.5 | 11.97 | 0.001 | 0.157 |
|                              | ≥ 21     | 71  | 51.8 | 66  | 48.2 |       |       |       | 112 | 81.8 | 25 | 18.2 |       |       |       |
| Self-esteem                  | High self-esteem | 211 | 59.8 | 142 | 40.2 | 0.03 | 0.864 | 0.008 | 290 | 90.1 | 32 | 9.9 | 0.40 | 0.530 | 0.029 |
|                              | Low self-esteem | 74  | 60.7 | 48  | 39.3 |       |       |       | 142 | 88.2 | 19 | 11.8 |       |       |       |
| Social support               | High support | 198 | 66.2 | 101 | 33.8 | 13.33 | 0.000 | 0.168 | 351 | 90.0 | 39 | 10.0 | 0.73 | 0.393 | 0.039 |
|                              | Low support | 85  | 49.1 | 88  | 50.9 |       |       |       | 80  | 87.0 | 12 | 13.0 |       |       |       |
| Knowledge about smoking      | More knowledge | 174 | 56.9 | 132 | 43.1 | 3.18 | 0.075 | 0.082 | 302 | 87.5 | 43 | 12.5 | 4.46 | 0.035 | 0.096 |
|                              | Less knowledge | 109 | 65.3 | 58  | 34.7 |       |       |       | 128 | 94.1 | 8  | 5.9  |       |       |       |
| Image for cigarette advertising | Negative | 207 | 67.6 | 99  | 32.4 | 18.46 | 0.000 | 0.199 | 360 | 90.9 | 36 | 9.1  | 6.49 | 0.011 | 0.117 |
|                              | Positive | 76  | 47.2 | 85  | 52.8 |       |       |       | 65  | 81.2 | 15 | 18.8 |       |       |       |
between smoking status and the number of risk factors identified in the preceding analysis. All computations were performed using the SPSS release 8.0 statistical package.

**RESULTS**

*Smoking status of students*

Smoking status of students by grade level and gender was shown in Table 2. Overall, 40.0% of males and 10.6% of females were classified as smokers. The percentage of smokers for males was significantly higher than it was for females in each grade level. There were also significant differences in the percentage of smokers across grade levels for both males and females, and 10th graders were more likely to be smokers than upper graders.

*Identification of risk factors*

Table 3 presents the relationship between each risk factor and smoking status by gender. The 13 risk factors for males and 12 for females were identified, based on our criteria for significance. Common risk factors of smokers for both males and females were following 11 variables; sibling smoking, peer smoking, father's attitude toward subject smoking, mother's attitude toward subject smoking, peer attitude toward subject smoking, non-negative attitude toward adults' smoking, non-negative attitude toward minors' smoking, intention to smoke at the age 20, alcohol drinking, depression, and positive image of cigarette advertisement. In addition, other two variables, such as availability of cigarettes and low social support, were also risk factors of smoking for males. Mother's smoking was another risk factor of smoking for females.

Table 4 shows adjusted odds ratios from logistic regression analysis of smoking status for males and females separately. In this analysis, we excluded two independent variables such as mother's attitude toward subject smoking and attitude toward adults' smoking to avoid multicollinearity problems. Because these variables were highly correlated to father's attitude toward subject smoking (r = 0.58) and attitude toward minors' smoking (r = 0.58) respectively. After controlling the effects of other risk factors and grade level, the 4 risk factors such as peer smoking, peer attitude toward subject smoking, intention to smoke at the age 20, and alcohol drinking were significantly associated with smoking status for both males and females. The strongest relationship between intention to smoke at the age 20 and smoking status was evident. In particular, females predicting to be smokers at the age 20 had a 41-fold increased risk for smoking.

**Effects of total risk factors**

The total number of four risk factors identified in the preced-

| Variables                                         | Adjusted Odds Ratio | 95% Confidence Interval |
|---------------------------------------------------|---------------------|-------------------------|
| **Males**                                         |                     |                         |
| Sibling smoking (yes)                             | 1.39                | 0.75 - 2.59             |
| Peer smoking (yes)                                | 2.88                | 1.56 - 5.31             |
| Attitude of father to subject smoking (non-negative) | 1.73                | 0.93 - 3.21             |
| Attitude of peer to subject smoking (non-negative) | 2.60                | 1.35 - 5.02             |
| Attitude toward minors' smoking (non-negative)    | 1.71                | 0.92 - 3.20             |
| Intention to smoke at the age 20 (yes)            | 17.81               | 10.12 - 31.34           |
| Availability of cigarettes (easy)                 | 1.74                | 0.55 - 5.44             |
| Alcohol drinking (yes)                            | 2.02                | 1.17 - 3.50             |
| Depressive symptoms (depression)                  | 1.05                | 0.58 - 1.90             |
| Social support (low support)                      | 1.58                | 0.89 - 2.79             |
| Image of cigarette advertisement (positive)       | 1.42                | 0.80 - 2.51             |
| **Females**                                       |                     |                         |
| Mother smoking (yes)                              | 1.37                | 0.40 - 4.69             |
| Sibling smoking (yes)                             | 2.11                | 0.83 - 5.35             |
| Peer smoking (yes)                                | 3.80                | 1.43 - 10.06            |
| Attitude of father to subject smoking (non-negative) | 1.63                | 0.43 - 6.12             |
| Attitude of peer to subject smoking (non-negative) | 4.95                | 1.08 - 22.67            |
| Attitude toward minors' smoking (non-negative)    | 1.33                | 0.35 - 5.05             |
| Intention to smoke at the age 20 (yes)            | 41.16               | 15.03 - 112.73          |
| Alcohol drinking (yes)                            | 3.06                | 1.16 - 8.08             |
| Depressive symptoms (depression)                  | 1.36                | 0.53 - 3.48             |
| Image of cigarette advertisement (positive)       | 0.80                | 0.25 - 2.53             |

**Bolded odds ratios indicate a statistically significance.**

* : adjusted for grade level and other risk factors
Table 5. Number of risk factors by gender.

| Number of risk factors | Total n | Total % | Males n | Males % | Females n | Females % |
|------------------------|---------|---------|---------|---------|-----------|-----------|
| 0                      | 327     | 34.5    | 84      | 17.8    | 243       | 50.7      |
| 1                      | 253     | 26.5    | 121     | 25.7    | 132       | 27.6      |
| 2                      | 192     | 20.3    | 123     | 26.1    | 69        | 14.4      |
| 3                      | 128     | 13.4    | 105     | 22.3    | 23        | 4.8       |
| 4                      | 50      | 5.3     | 38      | 8.1     | 12        | 2.5       |
| Total                  | 950     | 100.0   | 471     | 100.0   | 479       | 100.0     |

Total number was 950 due to missing data.
Significant difference in gender: $\chi^2 = 159.77, p<0.0001$

Table 6. The percentage of smokers by the number of risk factors.

| Number of risk factors | Non-smokers | | Smokers | | Non-smokers | | Smokers |
|------------------------|-------------|-----|---------|-----|-------------|-----|---------|
|                        | n   | % |       | n   | % |       | n   | % |
| 0                      | 79  | 94.0 | 5      | 6.0 | 242  | 99.6 | 1 | 0.4 |
| 1                      | 104 | 86.0 | 17     | 14.0| 125  | 94.7 | 7 | 5.3 |
| 2                      | 79  | 64.2 | 44     | 35.8| 51   | 73.9 | 18 | 26.1 |
| 3                      | 18  | 17.1 | 87     | 82.9| 10   | 43.5 | 13 | 56.5 |
| 4                      | 2   | 5.3  | 36     | 94.7| 0    | 0    | 12 | 100.0 |

Test for trend: $\chi^2 (p) =$ 120.69 (<0.0001) 72.05 (<0.0001)

* Adjusted for grade level

ing analysis was counted. Table 5 provides the number and percentage of subjects having risk factors by gender. The pattern of risk factors for each gender was significantly different. The modal number of risk factors of males and females were two and zero, respectively. Table 6 indicates the percentage of smokers by the number of risk factors. We found that the percentage of smokers increased consistently as the number of risk factors increased, and a linear trend was significant for each gender. Thus, a dose-response relationship was found between the prevalence of smoking and the number of risk factors students were exposed to.

Magnitude of risk for smoking was calculated by dividing the percentage of smokers for each number of risk factors by the base rate of smokers for each gender in the whole sample. Figure 1 shows the magnitude of risk for smoking by the number of risk factors. Male students with two or fewer risk factors
were less likely to smoke cigarettes than the total sample, whereas those with three or more were over twice as likely to be smokers as the total sample. For females, those with zero or one risk factor were less likely to be smokers than the total sample, on the contrary, those with two or more were more likely to be smokers compared to the total sample. Particularly, the risk for smoking among those with four risk factors was nine times magnitude of that in the female sample as a whole. There was an accelerating curve that magnitude of risk for smoking increased as the number of risk factors increased.

**DISCUSSION**

This study showed that the number of risk factors was linearly associated with increased percentage of smokers for both male and female students, and also indicated a significant dose-response relationship. Previous studies using a risk factor approach for adolescent drug use also found that increasing numbers of risk factors were linearly related to higher levels of general substance use. Bry et al. proposed that the number of factors an individual might cope with was more important than exactly what those factors were. Our finding by using a risk factor approach for adolescent smoking may support the proposal of Bry et al., and our data confirmed previous findings of many other epidemiological studies suggesting that the vulnerability to diseases increased as exposure to risk factors increased.

Our results also demonstrated that as the number of risk factors increased, magnitude of risk for smoking among females became considerably great compared with those of males. Moreover, the relationship between the number of risk factors and magnitude of risk for smoking was an accelerating curve. Similarly, Farrell et al. reported that relationship between total number of risk factors and frequency of drug use was curvilinear and suggested that risk factors produced more than a simple additive effect. However, previous studies of risk factors for drug use including the study by Farrell et al. have not examined magnitude of risk for each gender. It was supposed that there might be no gender difference in the magnitude of risk in Western adolescents because the percentage of current smokers among females was almost equal to those for males. In contrast, it was considered that female students in this study reported greater magnitude of risk for smoking due to a considerably lower smoking prevalence among Japanese female adolescents. According to these findings, we suggest that females with many risk factors extremely increase vulnerability to smoking compared to male counterpart and the female sample in general.

As a result of multivariate analysis, we identified four significant risk factors; peer smoking, attitude of peer toward subject smoking, intention to smoke at the age 20, and alcohol drinking. There was no gender difference in the types of risk factors in this study. Although some previous studies have reported consistent findings, there have also been many conflicting findings with regard to the gender difference of risk factors. It is suggested that these discrepancies may be due to differences in variables used for analysis or analytical methods across studies. We need further to examine the gender difference of risk factors in future research.

In multivariate analysis, we found that intention to smoke at the age 20 was strongly associated with smoking status. This finding was consistent with previous finding of Nishioka et al. who used discriminant analysis in cross-sectional design. Previous longitudinal studies also showed that intention to smoke in the future was the important predictor of smoking. Kawabata et al. pointed out that it might be more useful to measure their prediction of smoking behavior at the age 20 compared to investigation into the actual smoking behavior, because minors are prohibited by law from smoking in Japan. McCaul et al. also suggested that prevention programs might profitably use intentions as a short-term measure of effectiveness. Therefore, it seems that intention to smoke in the future is not only a powerful predictor of smoking but also an alternative measure instead of an actual smoking behavior.

Peer role modeling has been found to be strongly and consistently related to adolescent smoking. In this study, peer smoking and attitude of peer toward subject smoking were also related to smoking status in multivariate models. Adolescents usually try their first cigarette with their peers, and followed by peers' expectation and reinforcement for continuation of cigarette smoking. Accordingly, it is obvious that peer pressure to smoke is an important risk factor of adolescent smoking.

Alcohol drinking was also identified as a significant risk factor of smoking. This finding was consistent with the finding by Farrell et al. who found strong relationship between alcohol and cigarette use. It is worth noting on the stage theory, Kandel proposed, that predicted a pattern of progression from the use of alcohol and cigarettes to marijuana and other illicit drugs. Many researchers also suggested that both alcohol and nicotine could be regarded as gateway drugs. Thus, cigarette smoking and alcohol drinking must be necessary to predict other drug use. Although several studies of patterns of drug involvement in adolescence have reported that alcohol drinking was likely to precede smoking, it was not clear which habit tried first, alcohol drinking or cigarette smoking, in our cross-sectional study design.

Recently, school-based smoking prevention programs that utilize a social influence approach or skill training approach have proven effective to prevent smoking initiation. These approaches focus on training in resisting peer pressures and social pressures to smoke. This training will enhance general decision-making, self-esteem, and social skills. Accordingly, our findings suggest that interventions should include developing skills to resist peer pressures by use of role playing and social reinforcement techniques. Enhancement of decision making and goal setting skills will prevent smoking in future.
Additionally, these approaches can also help to prevent alcohol drinking and other drug use.

Flay et al. examined the psychosocial predictors of different stages of smoking among high school students, and showed that the significant predictors of the transition from trial to experimental use were friends' smoking and approval, cigarette offers by friends, smoking intentions, school grade, and alcohol and marijuana use. Among these predictors, the four significant risk factors found in our study may be necessary to predict experimental smokers among Japanese high school students. The present study showed that the percentage of smokers for 9th female students was higher than those for 10th female students, most of previous studies consistently revealed that smoking rate increased with aging and grade. Therefore, the results of this study must be interpreted cautiously and limited to generalize to adolescents in Japan as a whole. Although random sampling would have been preferable, such data are very difficult to obtain in Japanese school settings.

In conclusion, we identified four significant risk factors of smoking for both gender students, including peer smoking, attitude of peer toward subject smoking, intention to smoke at the age 20, and alcohol drinking. The present study showed that the number of the risk factors of smoking status was linearly associated with increased percentage of smokers and the result indicated a significant dose-response relationship. Additionally, females with many risk factors extremely increased vulnerability to smoking compared to male counterparts. These findings may be useful to identify high-risk students who need more intensive smoking prevention programs. In addition to identifying students at high risk of smoking, information on the significant risk factors will be utilized to develop more practical and effective programs.

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