Smoking Conditions and the Relationships Between Smoking Habits and Such Factors as Exercise Habits and Morning Diet among Male Students Aged 16 to 20 Years.

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Abstract

This article explores the smoking behavior of 307 sixteen- to twenty-year-old students, and examines the relationships between their smoking and such factors as weight, exercise or morning diets. Four-year follow-up data on their physical characteristics, exercise and morning diet, and a five-year retrospective questionnaire on smoking habits were analyzed.

Our longitudinal analysis revealed that: the prevalence of smoking increased from 17.6% to 54.1%, while the semi-annual incidence of smoking decreased from 12.0% to 4.3%. The number of cigarettes smoked per day increased for 3 years after the initiation of smoking, from less than 10 cigarettes per day in the first year to more than 15 in the third year. Although there was no relationship between smoking and exercise habits, smoking habits related significantly to morning diet. In the eighteen- and nineteen-year-old age category, smoking habits affected the weight of the subjects.

Key words: Smoking, Exercise, Breakfast diet, Weight, Young male student

Introduction

Cigarette smoking is the single most preventable cause of morbidity and premature mortality¹⁻³. Impediments associated with smoking rise sharply in inverse relation to the younger the age at which smoking is started⁴. Most smokers begin between the ages of 15 and 20⁵⁻⁷, and more than 75% of adult smokers started as teenagers⁸. Most heavy smokers began to smoke at the age of 13 or 14⁹⁻¹². The likelihood of the successful cessation of smoking is greater among smokers who began after age 13 than those who began earlier¹². Although a longitudinal study on the actual conditions of smoking among young teenagers is necessary, little is known about the changes in the prevalence of such conditions as the number of cigarettes smoked per day among young teenagers with a history of smoking¹¹. Although a great deal of study has attempted to find a correlation between weight and smoking among adults¹³, what is lacking is a study on the effects of smoking on the weight of teenagers. Though a normal

increase in lean body mass corresponding to the increase in height is required in teenagers¹⁴, it has been suggested that young people take up smoking as a means of weight control¹⁵.

The first purpose of this research is three fold: 1) to explore the changes in the percentages of teenage smokers in different age categories, 2) to determine the numbers of cigarettes smoked per day by smokers within these different categories, and 3) to examine the relationships between smoking, exercise and morning diet by looking at retrospective longitudinal data gathered about male students aged 16 to 19. The second purpose is to analyze the relationships between smoking habits, weight, exercise habits and morning diet.

Materials and Methods

Subjects

The subjects were 307 male students, 140 males (19 years of age) and 167 males (20 years of age), respectively, enrolled during March 1995 in their fourth and fifth years at the F. National College of Technology in Japan. The school has five grades and each is comprised of 200 male and female students. Students turn 16 years of age during the first year and 20 during the fifth year. A total of 167 male subjects entered the school in April 1990, and 140 more in April 1991. In order to gather adequate

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Table 1 Methods of acquiring the sample pool for this study.

		Total subjects (n=307) 167 Males	140 Males	Sports test ^a (n)	Smoking questionnaire (n)
1990	April	First (16 yrs.)		Tested (167)	
	May				
1991	April	2 nd. (17 yrs.)	First (16 yrs.)	Tested (307) ^b	
	May				
1992	April	3 rd. (18 yrs.)	2 nd (17 yrs.)	Tested (307)	
	May				
1993	April	4 th. (19 yrs.)	3 rd. (18 yrs.)	Tested (307)	
	May				
1994	April	5 th. (20 yrs.)	4 th. (19 yrs.)	Tested (140)	
	May				
1995	March	Graduation	4 th. (19 yrs.)		Surveyed (307)
	May		5 th. (20 yrs.)		
1996	March		Graduation		Surveyed (134) ^c

^a: The Sports Test is an inquiry into the measurements of physical characteristics, exercise habits and morning diet, laid out in an outline by the Physical Education Bureau of Japan.

^b: For example, data for 307 subjects 16 years of age were comprised of 167 males from 1990 and 140 males from 1991.

^c: The second smoking questionnaire for 140 males had 6 subjects missing.

data, only subjects from 2 grades were used. Sixteen-year-old subjects, for example, were drawn from both groups (Table 1).

The nature and aims of the study were explained to all subjects who consented to take part and the study was performed with the permission of the school administration.

Questionnaire about Smoking Habits

All three hundred and seven subjects were asked to respond to items on a questionnaire administered during March 1995. Relying on the memory of their past smoking histories, the subjects were to retrospectively answer 2 questions: 1) the time which they began smoking and 2) the mean number of cigarettes smoked per day every month since then. The second question was structured as a sheet of paper divided into columns for all the months from April 1985 to March 1996. In this study, the definitions of smoking are as follows: 1) current smoker-a person who smokes at least 1 cigarette per day per month; 2) former smoker-a person who has quit smoking within the previous six months. The term "smokers" designates only current smokers, while the term "non-smokers" designates all other subjects. "Smoking habit" designates a subject as either a smoker (a person who has a smoking habit), or a non-smoker (a person who has no smoking habit).

In order to assure reliability, the same questionnaire was again administered a year later, during March 1996, to the 134 subjects who had moved into their fifth year. Only the data on twenty-year-olds was used in the second questionnaire.

Reliability of the Smoking Questionnaire

The gamma coefficient (γ) of the relationship between the first questionnaire (1995) and the second (1996), as to whether the 134 subjects were non-smokers or smokers, was 0.95 in sixteen-year-olds (May 1991) and more than 0.99 in the other age groups (from May 1992 to 1994). With regard to the number of cigarettes smoked per day, the Pearson coefficients (r) among subjects 16, 17, 18 and 19 years of age were 0.711, 0.825, 0.834 and 0.921, respectively. These results are all significant at $p < 0.01$.

Physical Characteristics, Exercise Habits and Morning Diet

As part of regular yearly routine work in a physical education class, data on the physical characteristics, exercise habits and

morning diet of every subject in this study were recorded by the same teachers every May from 1990 to 1994. This information had been gathered according to the criteria outlined in "The Sports Test" of the Physical Education Bureau of the Japanese Ministry of Education.¹⁶⁾ Data were drawn from these records: height, weight and skinfold thickness of each subject. Then, the lean body muscle and body fat percentages were calculated^{17,18)}. Thus, the physical characteristics, exercise habits and morning diet were current data at the time they were determined.

Exercise habits were classified as follows: 1) persons who exercised almost everyday (more than 3 days per week), 2) persons who sometimes exercised (less than twice a week), 3) persons who seldom exercised (less than twice a month), and 4) persons who never exercised. "Exercise habit" refers to workouts more than three days per week, and "non-exercise habit" refers to exercise less than twice a week.

Morning diets were classified as follows: 1) persons who ate breakfast daily, 2) persons who sometimes did not eat breakfast and 3) persons who never ate breakfast. In this study, "standard morning diet" refers to daily breakfast intake, while and "poor morning diet" refers to irregular breakfast intake.

Analysis

SPSS package version 4.0 was used for statistical analysis (SPSS Inc.)¹⁹⁾. t and χ^2 tests were used to determine the differences between the groups. An ANOVA was performed to evaluate the influence of smoking habits, exercise habits and morning diet (independent variables) on weight (dependent variable). The statistically significant criterion was set at $p < 0.05$.

Results

Physical Characteristics

There were no significant differences in mean height (cm), weight (kg) and lean body muscle (kg) between smokers and non-smokers. Among subjects 18 years of age, the mean body fat percentage of smokers was smaller than that of non-smokers (Table 2).

Percentage and Incidence of Smokers

To establish the most valid system of comparison between

the data collected on smoking habits and physical characteristics, exercise habits and morning diet, we used only data which answered the second item of the questionnaire on smoking habits from the months of May and November, since "The Sports Test" was given in May. In the category of sixteen-year-olds, the May percentage of current smokers was 17.6 %, while the incidence of smoking from May to November was 12.0%. The percentage of smokers increased and the incidence of smokers decreased as the ages of the subjects increased (Table 3).

The Mean Number of Cigarettes Smoked per Day

The mean number of cigarettes smoked per day increased with the years of smoking experience. The mean number of cigarettes smoked per day was less than 10 in the first year of smoking, less than 15 in the second, less than 16 in the third, less than 17 in the fourth and more than eighteen in the fifth. These longitudinal values were almost the same as the cross-sectional values. The mean number of cigarettes smoked per day increased significantly within the first 3 years of smoking ($p < 0.01$) (Table 4).

Table 2 Physical characteristics among 307 male students according to smoking habits.

Age (yrs)	Group	N	Height (cm)	Weight (kg)	Body fat (%)	Lean body muscle (kg)
16	Smokers	51	169.3 (4.7)	58.0 (8.5)	14.6 (5.3)	49.2 (4.7)
	Non-smokers	252	168.1 (5.8)	57.9 (8.5)	14.8 (5.5)	49.0 (5.3)
	Total	303	168.3 (5.7)	57.9 (8.5)	14.7 (5.5)	49.0 (5.2)
17	Smokers	96	170.2 (5.4)	59.8 (7.8)	14.6 (4.8)	50.7 (4.8)
	Non-smokers	204	170.2 (5.7)	60.8 (8.7)	15.1 (5.7)	51.3 (5.3)
	Total	300	170.2 (5.6)	60.5 (8.4)	14.9 (5.4)	51.2 (5.1)
18	Smokers	126	170.9 (5.3)	61.0 (7.3)	13.4 (3.9)	52.6 (4.9)
	Non-smokers	173	170.7 (5.9)	62.2 (9.3)	14.5 (5.7)*	52.7 (5.7)
	Total	299	170.8 (5.6)	61.7 (8.5)	14.0 (5.1)	52.7 (5.4)
19	Smokers	141	172.0 (5.3)	61.5 (8.1)	13.2 (5.1)	53.1 (4.9)
	Non-smokers	158	170.9 (6.0)	62.1 (8.3)	14.1 (5.2)	53.0 (5.7)
	Total	299	171.4 (5.7)	61.8 (8.2)	13.6 (5.2)	53.1 (5.3)

Values are given as mean ($\pm$ SD).

* $p < 0.05$ for differences between smokers and non-smokers.

Table 3 Changes in smoking habits among 307 male students.

Age (yrs)		Current smokers ^a		Incidence of smoking ^b		Former smokers ^c	
		N	%	N	%	N	%
16	May	54	17.6	-	-	-	-
	Nov.	81	26.4	30	12.00	3	5.56
17	May	100	32.6	20	9.09	4	4.94
	Nov.	124	40.4	25	12.50	3	3.00
18	May	131	42.7	7	4.00	2	1.61
	Nov.	142	46.3	13	7.74	3	2.29
19	May	146	47.6	6	3.87	5	3.52
	Nov.	147	47.9	1	0.67	1	0.68
20	May	158	51.5	8	5.41	2	1.36
	Nov.	166	54.1	6	4.29	2	1.27

^a Current smokers: those who regularly smoked more than one cigarette per day.

^b Incidence of smoking: those who started smoking for the first time within the previous six months.

^c Former smokers: those who had stopped smoking within the previous six months.

Table 4 Longitudinal changes in mean numbers of cigarettes smoked per day according to the age of smoking initiation.

Age of smoking initiation ^a (n)	Attained age				
	16	17	18	19	20
16 (48)	9.85(7.07)	14.17(6.19)**	15.98(5.24)** ^{††}	16.77(4.82)** ^{††}	18.17(4.55)** ^{††,‡‡,§§}
17 (38)		9.95(7.03)	13.24(7.68) ^{††}	15.42(7.40) ^{††,‡‡}	16.47(7.32) ^{††,‡‡}
18 (31)			9.03(5.99)	11.81(6.26) ^{††}	15.13(6.06) ^{††,§§}
19 (16)				9.94(6.00)	12.81(6.59) ^{§§}
20 (9)					8.00(4.92)

The values represent means (SD).

^a The subjects of each category were smokers who have smoked up until their present age of 20.

A paired t test was used.

** $p < 0.01$:significance for the values of 16 years of age.

^{††} $p < 0.01$:significance for the values of 17 years of age.

^{‡‡} $p < 0.05$,^{§§} $p < 0.01$:significance for the values of 18 years of age.

^{§§} $p < 0.01$:significance for the values of 19 years of age.

Relationships Between Smoking Habit and Exercise Habit

The percentages of subjects with an exercise-habit during the month of May in all subjects 16, 17, 18 and 19 years of ages were, 71.4%, 56.1%, 44.4%, and 31.1%, respectively. Table 5 shows the percentages of persons with exercise-habits and without exercise-habits among smokers increased with age. Chi-square showed no significant relationship between smoking habits and exercise habits.

Relationships Between Smoking Habit and Morning Diet

The percentages of persons with a standard morning diet during the month of May among all subjects 16, 17, 18 and 19 years of age were 85.3%, 72.2%, 71.4% and 59.6%, respectively. Among smokers, the percentages of persons with poor morning diets during May in the same age groups were 29.5%, 41.7%, 50.6% and 56.7%, respectively. Chi-square showed significant relationships in subjects 16, 17 and 19 years of age during May between smoking habits and morning diets, but showed no significant relationship among eighteen-year-olds (Table 5).

Correlations Between Weight and Smoking Habit, Exercise Habit and Morning Diet

The ANOVA showed that smoking habit, exercise habit and morning diet do not have significant effects on weight, except for exercise habit among eighteen-year-olds. It also showed that there were no significant interactions factors within the categories of sixteen and seventeen-year-olds. Within the category of eighteen-year-olds, there was a significant interaction between smoking, exercise and morning diet and weight. Within the category of nineteen-year-olds, there was a significant interaction between smoking habit and morning diet and weight (Table 6).

Table 5 Smoking prevalence by exercise habit and morning diet.

Age(yrs)	Exercise habit			Morning diet		
	Exercise(%)	Non-exercise(%)	χ^2	Eating(%)	Non-eating(%)	χ^2
16	16.7	17.4	0.02	14.8	29.5	5.75*
17	27.8	37.1	2.96	28.4	41.7	4.87*
18	40.2	44.2	0.50	39.2	50.6	3.25
19	41.3	49.5	1.71	40.7	56.7	7.34**

* $p < 0.05$, ** $p < 0.01$.

Table 6 Results of the ANOVA for the weight*.

Age (yrs)	Source	df	F
18	Smoking habits (S)	1	0.001
	Exercise habits (E)	1	5.810*
	Eating habits (B)	1	0.080
	3-Way interactions (S) $\times$ (E) $\times$ (B)	1	4.313*
	Explained	7	1.609
19	Smoking habits (S)	1	0.112
	Exercise habits	1	0.188
	Eating habits (B)	1	0.368
	2-Way interactions (S) $\times$ (B)	1	5.495*
	Explained	7	1.184

* There is no source which affects the weight in the 16 and 17 age category.

* $p < 0.05$.

Discussion

Conditions of Smoking Among Teenagers

Although recent reports have indicated that the rate of smoking among young adults has generally been declining, the determined percentage of male smokers younger than 24 does not reflect this tendency^{7,20,21}. For example, in the United States the percentage of male smokers between 18 and 24 rose from 26.6% in 1990 to 28.8% in 1993²². In Japan, the rate of smoking among eighteen-year-old high school males was 25.5% in 1991, while the rate of smoking among males from 20 to 29 was 66.3% in 1990²³. The percentage of adult smokers in Japan is among the highest in the world²³. Although Osaki and Minowa²³ have suggested that the percentage of Japanese teenage smokers tends to increase both abruptly and remarkably after graduation from junior high school, follow-up data on young adults from 18 to 20 have not yet confirmed this. Also in Japan, no studies have reported statistics on the numbers of teenagers who have quit smoking. One report states that a reduction in smoking prevalence can more likely be achieved by encouraging addicted smokers to quit smoking, rather than by preventing adolescent nonsmokers from starting²⁴. To discuss smoking conditions, the results of our longitudinal analysis of the data drawn from this group of students, studied together in the same classroom for five years, are highly reliable. In this study, the reliability of the first questionnaire survey was confirmed by the second survey of the presence or absence of smoking and the number of cigarettes smoked per day in the same subjects. The accordance rate of replies between the two surveys was considerably high. This was probably because the subjects replied very carefully by asking friends who knew their smoking history about items on which their memory was uncertain.

Our first conclusion on the conditions of smoking among these subjects is that the percentage of current smokers, contrary to the suggestion by Osaki and Minowa²³, did not increase suddenly at any age. Rather, within the age category of 16 to 20, the percentage of current smokers was found to rise only gradually over the years of smoking. Also, we found that the incidence of smoking within this age group reflected an inverse correlation to the age at which smoking began: an increase in smoking was noted as the onset age of smoking decreased.

Our second conclusion is that the number of cigarettes smoked per day increased significantly for 3 years from the time smoking began. This is the first study to report on any association between the onset age of smoking and the number of cigarettes smoked per day. This finding may explain the report that the gradient relationship between quitting smoking and the onset age of smoking was evident as early as 3 years after daily smoking began. Specifically, the cumulative percentage for quitting in smokers who began at an early age (≤ 13 years) was 4.4 %, whereas, the percentages in smokers who began at intermediate (14 to 16 years) and late (≥ 17 years) ages, were 9.6% and 13.6%, respectively¹². However, the percentages of smokers who quit in this study are markedly smaller than the rates of such smokers in the United States¹². These findings indicate that Japan must strongly encourage young smokers to quit smoking, apprising them of the health dangers associated with smoking, particularly when begun at an early age⁶.

Through the use of the findings in this study, we can estimate, by taking into consideration the number of years

smoked, the number of cigarettes per day a smoker will smoke. That is the number of years of prior smoking can be used to predict the future number of cigarettes smoked per day. Based on the findings of our research, that the number of smokers who quit was less than 5.6 % at all ages, we strongly suggest that once a male, aged 16 to 20, becomes a smoker, he will find it difficult to stop smoking. Therefore it is imperative that teenagers be advised to avoid smoking.

No Association Between Smoking Habits and Exercise Habits

In general, an inverse relationship between smoking and exercise habit has been reported^{11,25)}, though some studies do report that there is, among adults, no association²⁵⁾. Blair et al.²⁶⁾ found virtually no information on interrelationships between exercise or physical activity and other health behaviors in children and youth. Consequently, this discussion has been limited to adults, though Blair et al.²⁶⁾ found that the data only weakly supports the alternative hypothesis that there is a negative association between physical activity and smoking. On the whole, there is little yet known about the relationship between smoking habits and exercise habits among teenagers^{11,27)}. However, the results of our study do indicate that there is no association between exercise habits and smoking habits among teenagers 16 to 19 years of age. This may suggest that, among teenagers, these 2 behavior systems function independently.

Though not yet proven, the theory does exist that smokers intuitively perceive exercise as a method of compensation both for any increase in weight they may experience, and for any other nervous reaction they may undergo, in response to the act of quitting smoking. In this study, weight was affected by the combination of the smoking habit, the exercise habit and the morning diet among eighteen-year-olds. These findings may suggest that it is reasonable to connect the subjects of smoking habits and exercise habits within the discussion of smoking education.

However, even if there is no association between these factors, the singular effects of smoking habits and lack of exercise may impair physical development in teenagers. For example, Valimaki et al.²⁸⁾ reported that the habits of regular exercise and non-smoking are important determinants for adolescents and young adults in achieving a maximal peak bone mass. This is one reason why young adults should not only exercise, but avoid smoking.

The Association Between Smoking Habits and the Morning Diet

Quitting smoking causes a weight increase because a smoker's weight is affected by the physiological metabolic activation of nicotine^{13,29)}. Some smokers intend to continue smoking because they are averse to the weight gain they anticipate if they were to quit. Some former smokers take it up again to deal with the extra weight they gained while quitting¹³⁾. Some non-smokers become smokers as a strategy for losing existing weight¹⁵⁾. The 1990 Surgeon General's report concluded that the health benefits of smoking cessation far exceed the risks associated with weight gain, and that smoking cessation has major and immediate health benefits for men and women of all ages^{13,30)}.

Although the eating habits of drinkers of alcohol, before and after the cessation of drinking, have been reported on, no such reports are available for smokers. This study, though, has examined the morning diet in terms of whether or not subjects have eaten breakfast daily. There is a significant association between the smoking habit and the morning diet, and we found particularly, that the smoking habit and the morning diet did interact to affect weight in nineteen-year-olds. At the age of 18 years, the smoking habit, together with the exercise habit and the morning diet, affects body weight as 3-way interactions. At the age of 19 years, the smoking habit, together with the morning diet, affects body weight as 2-way interactions. This may be primarily because current smokers aged 18 years exceeded 40%. In this study, smoking alone had no significant unfavorable effects such as overweight or underweight, but body weight was slightly lower in the smoker group showing a poor morning diet. In teenagers, a normal increase in lean body weight corresponding to the increase in height is required¹⁴⁾. Unfavorable effects of smoking on bone formation are associated with unfavorable effects on skeletal muscle growth. For formation of the amount of skeletal muscle corresponding to the increase in height, exercise habits and regular ingestion of breakfast, and smoking cessation are important in teenagers.

Although we found no significant difference between the weights of smokers and non-smokers, the findings of this study indicate that it is necessary to study smokers' weight in view of the association between the smoking habit, the exercise habit and the morning diet.

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(Received Jul.25, 1997/Accepted Dec.6, 1997)