Regular Daily Smoking Among 14-Year-Old Adolescents Increases the Subsequent Risk for Suicide: The Northern Finland 1966 Birth Cohort Study

Kaisa Riala, M.D., Ph.D.; Antti Alaräisänen, B.Med.;
Anja Taanila, Ph.D. (Educ.); Helinä Hakko, Ph.D.;
Markku Timonen, M.D., Ph.D.; and Pirkko Räsänen, M.D., Ph.D.

Objective: To investigate the relationship between adolescent regular daily smoking and later suicides in a prospective longitudinal birth cohort setting.

Method: Data from the Northern Finland 1966 Birth Cohort Study (N = 10,934) were linked with national death certificates from Statistics Finland. The information on suicide attempts until the end of 2001 was gathered from the Finnish Hospital Discharge Register (FHDR). The information on adolescent regular daily smoking was gathered via a questionnaire in 1980 and 1981, when the subjects were age 14 years.

Results: Of all cohort males who smoked regularly at age 14 years, 2.6% committed suicide by age 34 years, while the corresponding proportion was 0.8% among experimental smokers and 0.4% among nonsmokers (χ^2 = 15.8, df = 2, p < .001). After adjusting for sociodemographic factors in adolescence and psychiatric morbidity, regular smokers were at a 4.05-fold hazard (95% CI = 1.18 to 13.93, p = .026) for committing suicide at a younger age. Corresponding associations were not found among females. The choice of suicide method was not associated with smoking habits in adolescence. Furthermore, the proportion of suicide attempts was significantly higher among regular daily smokers, among both boys (3.3% vs. 1.2%) and girls (4.2% vs. 1.2%), compared with other adolescents.

Conclusion: At the epidemiologic level, adolescent regular smoking was found to be associated with increased risk for suicide among males before the age of 34 years. Further studies are needed to investigate the effects of smoking on neurobiology of depression, self-damaging aggression, and impulsive behavior.

(J Clin Psychiatry 2007;68:775–780)

Several earlier epidemiologic[1,2] and clinical[3,4] studies have revealed the positive relationship between smoking and suicidality. This relationship seems to be dose related[1,5] and independent of major depression and alcohol or drug disorders.[2] Also, when suicides were studied by using a psychiatric autopsy method, Schneider et al.[6] found that, among males, current nicotine consumption independently predicted suicides (odds ratio [OR] = 2.6; 95% CI = 1.3 to 5.2). Furthermore, Moriya and Hashimoto[7] found high postmortem levels of blood nicotine among smokers who committed suicide compared with smokers who did not commit suicide.

Interestingly, only few earlier studies have focused on early-onset adolescent smoking and its putative association with suicide attempts or committed suicides. In a systematic review of population-based studies, Evans et al.[8] found 8 studies investigating the association between adolescent smoking and suicidal phenomena, and the results strongly indicated a positive association. However, Hemmingsson and Kriebel[9] were able to study suicides and smoking among more than 49,000 male military conscripts aged 18 to 20 years, and they were also able to investigate the confounding effect of psychiatric diagnoses in adolescence and alcohol use diagnoses during the 26-year follow-up period. In their study, the risk of suicide among those smoking greater than 20 cigarettes per day was strongly increased (OR = 3.03, 95% CI = 1.72 to 5.34) during the first 13 years of follow-up. However, the association in their study was almost entirely explained by an increased prevalence of heavy alcohol consumption and low mental well-being among smokers.[9]

To our knowledge, there are no studies so far in which the association between adolescent regular smoking and committed suicides later in life has been studied at the epidemiologic level in birth cohort settings. In addition, some of the earlier studies have investigated only male populations.[1,9] Although it is well known that smoking is associated with increased risk for suicide, it is not yet known whether smoking in adolescence increases the risk to commit suicide at a younger age or whether it also

influences the choice of a more violent method of suicide. We were able to use a prospectively collected general population birth cohort database of 10,934 individuals to study the association between early adolescent regular smoking, suicide attempts, and committed suicides until the age of 34 years.

METHOD

Subjects

The Northern Finland 1966 Birth Cohort Study is an unselected, general population birth cohort ascertained during midpregnancy. The cohort is based upon 12,068 pregnant women and their 12,058 live-born children. Data were compiled from the 24th gestational week onward.[10] A questionnaire was mailed to cohort members at the age of 14 years, and 93.5% returned it. At the age of 16 years, 11,017 cohort members were alive and living in Finland. Further, in the 31-year follow-up survey conducted in 1997, a total of 83 individuals did not consent to the use of their data and were excluded, leaving 10,934 cohort members for the present study. Permission to gather data was obtained from the Ministry of Social and Health Affairs. Our study protocol was approved by the Ethics Committee of the Faculty of Medicine of the University of Oulu in 1996 and was supervised by the Ethics Committee.

Adolescent Smoking

The information on smoking habits was gathered from a questionnaire mailed to the children at the age of 14 years.[11] Smoking habits were assessed by asking "Do you smoke?" The following categories were constructed from the original 8 alternative responses: (1) never, (2) experimental smoking (tried once/tried twice or more/smokes occasionally/smokes about twice a week), and (3) regular smoking (smoking 1–5 cigarettes/6–10 cigarettes/more than 10 cigarettes a day).

Mortality Data and Suicide Attempts

Information about deaths and the causes of death of cohort members before the end of the year 2001 was ascertained from death certificates from Statistics Finland. The causes of death were coded according to the ICD-9 before the year 1996 and according to the ICD-10 from 1996 onward. The subjects were classified into 2 groups according to their survival status at the end of follow-up: subjects who died from a suicide (ICD-10 codes: X60–X84, Y87.0; ICD-9 codes: E950–E959) or live subjects. The method of suicide was classified as violent (hanging, shooting, drowning, wrist-cutting, deliberate traffic accident, or jumping from a high place) or nonviolent (poisoning or gas).[12] The cohort members who had died because of reasons other than a suicide were excluded from this study.

The information on suicide attempts until the end of 2001 was gathered from the Finnish Hospital Discharge Register (FHDR), which covers all mental and general hospitals and health centers nationwide.

Confounding Variables

The following variables were extracted from the 14-year postal questionnaire: (1) primary family type (2-parent family with both biological parents vs. other family types); (2) parental social class (I–II vs. III–IV vs. V); social classes I–II included those with the highest social standing/professional status, classes III and IV were skilled and unskilled workers, respectively, and class V comprised farmers; (3) school performance at the age of 14 years (not in normal grade [grade below age-appropriate level or special school] vs. in normal grade [grade appropriate for age level or above]); (4) alcohol use (assessed by asking, "Do you drink alcohol?"). The following categories were constructed from the original 5 alternative answers: never, experimental use (tried once/tried twice or more often), and regular pattern of alcohol use (alcohol use at some time every month/every week); and (5) other substance use (assessed based on the question "Have you used other substances [e.g., solvents or drugs?]"). The following 2 categories were constructed from the original 4 alternatives because of rarity of regular use: never and occasional/regular use (tried once/tried twice or more often/regular use).

The hospital-treated psychiatric diagnoses were extracted from the 31-year follow-up study as follows: no hospitalizations versus psychoses versus nonpsychotic disorders. All cohort members over age 16 years appearing in the FHDR until the end of 1997 for any mental disorder (i.e., ICD-8 codes 290–309, DSM-III-R diagnoses 290–316, and ICD-10 codes F00–F69, F99) were identified. All case records were scrutinized, and diagnoses were rechecked for DSM-III-R criteria. A more detailed description of the validation process of diagnoses is presented elsewhere.[13,14]

Statistical Methods

Statistical significance of group differences between categorical variables was assessed with Pearson's χ^2 and in continuous variables with the analysis of variance (ANOVA). A Cox proportional hazards regression model was used to test the effect of each characteristic on the hazards for dying from a suicide after the subject's 14th birthday. All analyses were performed using SPSS 13.0 for Windows.[15] Statistical significance was set at $\alpha = .05$, and all tests were 2 tailed.

RESULTS

In Table 1, the survival status at the end of follow-up and other background variables are presented by 14-year

 776

Table 1. Sample Characteristics of Male and Female Adolescent Nonsmokers and Experimental and Regular Daily Smokers From the Northern Finland 1966 Birth Cohort

| Characteristic[a]	Men					Women				
	Nonsmokers	Experimental Smokers	Regular Daily Smokers	Statistic, χ^2 (df)	p Value	Nonsmokers	Experimental Smokers	Regular Daily Smokers	Statistic, χ^2 (df)	p Value
Survival status at end of follow-up, N (%)				15.8 (2)	<.001				1.1 (2)	.564
Alive	1430 (99.6)	3309 (99.2)	295 (97.4)			1863 (99.7)	2846 (99.7)	328 (99.4)		
Suicide	6 (0.4)	26 (0.8)	8 (2.6)			5 (0.3)	8 (0.3)	2 (0.6)		
Family type, N (%)				56.3 (2)	<.001				97.2 (2)	<.001
2-parent family	1235 (86.0)	2727 (82.1)	206 (68.0)			1608 (86.1)	2273 (79.6)	211 (63.9)		
Other	201 (14.0)	598 (17.9)	97 (32.0)			260 (13.9)	581 (20.4)	119 (36.1)		
Social class, N (%)				15.4 (4)	.004				49.8 (4)	<.001
I–II (highest)	449 (31.1)	1051 (31.5)	83 (27.4)			614 (32.9)	820 (28.7)	77 (23.3)		
III–IV (lowest)	785 (54.7)	1881 (56.4)	197 (65.0)			983 (52.9)	1692 (59.3)	234 (70.9)		
V (farmers)	202 (14.1)	403 (12.1)	23 (7.6)			271 (14.5)	342 (12.0)	19 (5.8)		
School performance, N (%)				6.2 (2)	.045				17.2 (2)	<.001
At average level	1343 (93.5)	3159 (94.7)	278 (91.7)			1797 (96.2)	2801 (98.1)	323 (97.9)		
Below average level	93 (6.5)	176 (5.3)	25 (8.3)			71 (3.8)	53 (1.9)	7 (2.1)		
Use of alcohol, N (%)				1611.2 (4)	<.001				2145.4 (4)	<.001
Never	1093 (76.1)	949 (28.5)	17 (5.6)			1414 (75.7)	674 (23.6)	9 (2.7)		
Experimental	343 (23.9)	2356 (70.6)	229 (75.6)			4511 (24.1)	2116 (74.1)	224 (67.9)		
Regular pattern of use	0 (0.0)	30 (0.9)	57 (18.8)			3 (0.2)	64 (2.2)	97 (29.4)		
Use of substances, N (%)				143.6 (2)	<.001				273.9 (2)	<.001
Never	1436 (100.0)	3309 (99.2)	281 (92.7)			1868 (100.0)	2841 (99.5)	301 (91.2)		
Tried/used	0 (0.0)	26 (0.8)	22 (7.3)			0 (0.0)	13 (0.5)	29 (8.8)		
Hospital-treated psychiatric disorders, N (%)				41.4 (4)	<.001				4.1 (4)	.389
None	1384 (96.4)	3168 (95.0)	268 (88.4)			1815 (97.2)	2777 (97.3)	319 (96.7)		
Psychoses	19 (1.3)	44 (1.3)	5 (1.7)			26 (1.4)	25 (0.9)	4 (1.2)		
Nonpsychotic disorders[b]	33 (2.3)	123 (3.7)	30 (9.9)			27 (1.4)	52 (1.8)	7 (2.1)		

[a]Family type, social class, school performance, use of alcohol, and use of substances were assessed at age 14 years, while information on survival status and hospital-treated psychiatric disorders reached up to age 31 years among the cohort members.
[b]Nonpsychotic disorders (N = 272, 186 males) included substance use disorders (N = 109, 87 males), personality disorders (N = 50, 35 males), nonpsychotic mood disorders (N = 53, 28 males), anxiety disorders (N = 46, 26 males), and other nonpsychotic disorders (N = 85, 60 males). Multiple diagnoses were possible in this category, and the number of diagnoses exceeds the number of cases.

Figure 1. Proportion of Male Cohort Members Who Died From Suicide After Their 14th Birthday According to Smoking Status at 14 Years of Age
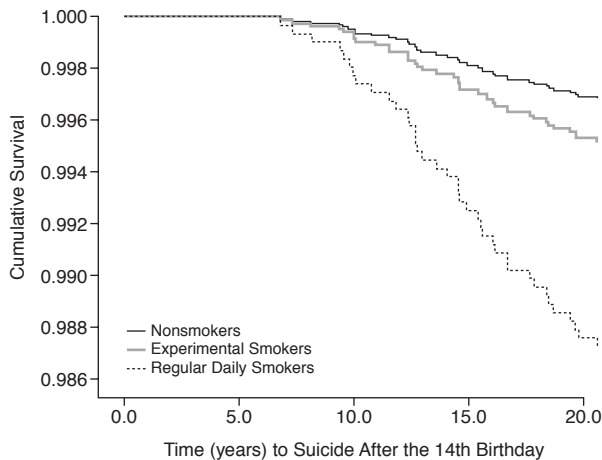
Figure 2. Proportion of Female Cohort Members Who Died From Suicide After Their 14th Birthday According to Smoking Status at 14 Years of Age
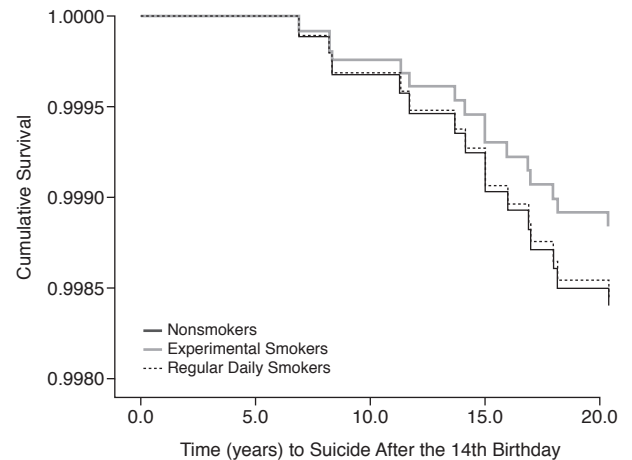
smoking status for males and females separately. Male adolescents with regular daily smoking status at the age of 14 years were more likely to commit suicide by the age of 34 years (χ^2 = 15.8, df = 2, p < .001). A corresponding association was not found among females. There were 66 males and 70 females who had undergone hospital treatment because of suicide attempts until the end of 2001. The proportion of suicide attempts among boys who smoked regularly was 3.3%, while it was 1.3% for experimental smokers and 0.8% for nonsmokers (χ^2 = 11.8, df = 2, p = .003). The corresponding percentages among girls were 4.2% for regular smokers, 1.4% for experimental smokers, and 0.8% for nonsmokers (χ^2 = 24.41, df = 2, p < .001).

The survival estimates according to their smoking status at the age of 14 years are presented for male and female cohort members in Figures 1 and 2, respectively. In males, the mean ± SD survival time after their 14th birthday was statistically significantly lower among regular smokers (21.32 ± 1.36 years) compared with experimental smokers (21.45 ± 0.77) or nonsmokers (21.46 ± 0.62) (F = 3.95, df = 5,073; p = .019), while in female subjects, no difference in survival time was observed. After adjusting for sociodemographic factors in adolescence and psychiatric morbidity, regular smokers were at a 4.05-fold hazard (95% CI = 1.18 to 13.93, p = .026) for committing suicide at a younger age (Table 2). Nonconventional family type (p = .003) and psychiatric hospitalization (psychotic disorders, p < .001; nonpsychotic disorders, p < .001) independently increased the risk of suicide among males as well. Correspondingly, among female cohort members, adolescent smoking status was not associated with the risk to commit suicide at a younger age (Table 2). However, hospital-treated psychiatric

disorders (psychotic disorders, p < .001; nonpsychotic disorders, p < .001) increased the risk of suicide among females.

Of the 40 male suicide victims, 32 (80%) used a violent method. The use of violent suicide method was not statistically significantly more common among those who were regular smokers at the age of 14 years (7 of 8; 87.5%) than among experimental smokers or nonsmokers. Of the female suicide victims, 7 of 15 (46.7%) used a violent method, but their smoking status did not associate with the choice of suicide method.

DISCUSSION

In this prospective longitudinal study, we found that regular smoking in early adolescence independently increased the risk of hospital-treated suicide attempts in both genders, while increasing the risk of committed suicides only among male cohort members during a follow-up period to the age of 34 years. A novel finding is that male cohort members with regular daily smoking in adolescence committed suicide at a younger age compared with victims who were experimental smokers or nonsmokers. However, smoking status in adolescence did not influence the choice of suicide method in either gender. The gender ratio for suicides in this cohort was equal to the rate found in the official statistics of Finland during the period 1980 to 1995 for the whole country. In Finland, 3 of 4 suicides are committed by males.[16]

Smoking is known to be a risk factor for subsequent onset of depression both in adolescent and adult populations.[17,18] Although we were able to control for hospital-treated psychiatric disorders in statistical analyses, it is possible that some suicide victims in this study were

Table 2. Proportional Hazards for Suicide After Their 14th Birthday Among Subjects From the Northern Finland 1966 Birth Cohort

Characteristic	Men			Women		
	Hazard Ratio[a]	95% CI	p Value	Hazard Ratio[a]	95% CI	p Value
Smoking at age 14 years						
Nonsmokers	Reference			Reference		
Experimental smokers	1.53	0.58 to 4.03	.395	0.72	0.20 to 2.59	.615
Regular daily smokers	4.05	1.18 to 13.93	.026	0.97	0.12 to 7.65	.976
Family type at age 14 years						
2-parent family	Reference			Reference		
Other	2.89	1.44 to 5.74	.003	0.63	0.16 to 2.40	.498
Father's social class at age 14 years						
I–II (highest)	Reference			Reference		
III–IV (lowest)	0.84	0.40 to 1.78	.657	3.15	0.70 to 14.29	.137
V (farmers)	1.48	0.51 to 4.32	.472	1.31	0.12 to 14.52	.826
School performance at age 14 years						
At average level	Reference			Reference		
Below average level	0.95	0.33 to 2.77	.926	...[b]	...[b]	...[b]
Use of alcohol at age 14 years						
Never	Reference			Reference		
Experimental	1.19	0.54 to 2.63	.659	2.04	0.54 to 7.72	.296
Regular pattern of use	0.66	0.07 to 6.00	.712	2.09	0.14 to 31.95	.595
Use of substances at age 14 years						
Never	Reference			Reference		
Tried or used at least once	...[b]	...[b]	...[b]	4.71	0.44 to 49.95	.198
Hospital-treated psychiatric disorders in adulthood						
None	Reference			Reference		
Psychotic disorders	13.66	5.18 to 36.05	< .001	19.49	4.18 to 90.77	< .001
Nonpsychotic disorders	6.62	2.99 to 14.65	< .001	17.93	4.71 to 68.30	< .001

[a]The Cox proportional hazards regression model was used to test the effects of each characteristic on the hazards for dying from a suicide after the subjects' 14th birthday.
[b]Not estimable.

suffering from nondiagnosed depression or were treated in outpatient settings. However, the smoking-depression link does not explain our finding of a gender difference. In our study, adolescent smoking increased the risk for committed suicides only among males. It is well known that depression is more prevalent among females,[19] and adolescent smoking in this birth cohort was even more common among females than among males. Therefore, the effect of gender on the smoking-suicide association is important and deserves further study.

At least 2 putative biological mechanisms behind our findings are worth noting. First, Roggenbach et al.[20] suggested that reduced 5-hydroxyindoleacetic acid (5-HIAA) concentrations in cerebrospinal fluid (CSF) might be related to increased depressive symptoms and changes in impulsivity. When measuring CSF 5-HIAA levels in depressed subjects, Malone et al.[21] found that levels were negatively correlated with the amount of cigarette smoking but were not related to suicide attempter status. Furthermore, the number of cigarettes smoked correlated positively with aggression scores. Thus, according to Malone et al.,[21] nicotine may have both biological and behavioral effects in the brain that increase the probability of suicidal behavior in depressed patients.

Second, subjects with a background of frequent impulsive behaviors, alcoholism, and suicide attempts have been found to have higher levels of free testosterone in CSF compared with healthy volunteers.[22] Furthermore, higher levels of serum testosterone and free testosterone were found among male smokers compared with ex-smokers or nonsmokers.[23] The effect of high testosterone levels on impulsive behaviors may be mediated by serotonin, as there exists an inverse relation between testosterone levels and brain 5-HT levels. Furthermore, lack of brain 5-HT is known to lead to increased aggression.[24] However, the direction of causality between smoking and higher levels of serum testosterone remains unclear. For example, men with a high level of testosterone as opposed to a low level have been found to more often engage in health-risk behaviors.[25]

On the basis of the biological discussion above, it would be easy to assume that smokers choose more often violent suicide methods than nonsmokers. In this study, the choice of suicide method did not differ between smokers and nonsmokers. However, a violent method has in general been used in Finland by more than 80% of male suicides for decades.[16] The rather small number of suicides in our database does not allow us to make strong conclusions on the association between smoking and choice of suicide method. Further studies with larger sample sizes are needed, and the association of smoking habits with violent/nonviolent suicide attempts should also be investigated.

The strengths of this study are that it is based on a representative and unselected birth cohort, a genetically

homogenous population, and valid national registers. The participation in the 14-year follow-up was good (94%), and we were able to use prospectively collected information of the family and individual background factors. Furthermore, as far as we know, this is the first study so far to compare the suicide methods between those who are regular smokers in adolescence and those who are experimental smokers or nonsmokers.

The findings of this study should be considered in light of the following weaknesses. First, the information on smoking habits was based on a self-report questionnaire, which may cause bias because of underestimates on smoking habits. Second, the adolescent smoking status was measured at only 1 point in time. Therefore, we lacked information on the temporal development of smoking habits later in adolescence and in adulthood. Third, since our study was mainly epidemiologic and register-based, we were not able to use any biological measurements of serotonergic function or testosterone levels of the cohort members to confirm our biological assumptions. Fourth, we were not able to investigate the putative confounding effect of adult psychiatric disorders treated in outpatient settings or child psychiatric care or with psychotropic medication. Additionally, recognition and adequate diagnostics of attention-deficit/hyperactivity disorder were developed in Finland after the 1990s. It is therefore possible that our result could partly be affected by comorbid lifetime hyperactivity or conduct disorders. It is also well known that the majority of subjects suffering from hazardous alcohol use never end up in inpatient treatment. From a methodological point of view, however, these problem users are likely to be found in both suicidal and nonsuicidal populations as well. Finally, although the main findings are statistically robust, some degree of type II error may have occurred, and some risk of spurious findings (i.e., type I error) also exists.

In conclusion, adolescent regular smoking was found to be associated with increased risk for suicide among male cohort members. We consider our findings important, since as many as 1 of 5 adolescents in the Finnish general population are known to be smokers at the age of 14 years today.[26] The prevalence of suicides of almost 3% among male adolescent regular smokers can thus be considered high at the epidemiologic level. Further studies are needed to investigate the effects of smoking on the neurobiology of depression, self-damaging aggression, and impulsivity.

REFERENCES

1. Miller M, Hemenway D, Rimm E. Cigarettes and suicide: a prospective study of 50,000 men. Am J Public Health 2000;90:768–773
2. Breslau N, Schultz LR, Johnson EO, et al. Smoking and the risk of suicidal behavior: a prospective study of a community sample. Arch Gen Psychiatry 2005;62:328–334
3. Tanskanen A, Viinamaki H, Hintikka J, et al. Smoking and suicidality among psychiatric patients. Am J Psychiatry 1998;155:129–130
4. Mann JJ, Waternaux C, Haas GL, et al. Toward a clinical model of suicidal behavior in psychiatric patients. Am J Psychiatry 1999;156:181–189
5. Iwasaki M, Akechi T, Uchitomi Y, et al. Cigarette smoking and completed suicide among middle-aged men: a population-based cohort study in Japan. Ann Epidemiol 2005;15:286–292
6. Schneider B, Schnabel A, Weber B, et al. Nicotine use in suicides: a case-control study. Eur Psychiatry 2005;20:129–136
7. Moriya F, Hashimoto Y. Do smokers who commit suicide have high blood levels of nicotine? Am J Psychiatry 2005;162:816–817
8. Evans E, Hawton K, Rodham K. Factors associated with suicidal phenomena in adolescents: a systematic review of population-based studies. Clin Psychol Rev 2004;24:957–979
9. Hemmingsson T, Kriebel D. Smoking at age 18–20 and suicide during 26 years of follow-up: how can the association be explained? Int J Epidemiol 2003;32:1000–1004
10. Rantakallio P. Groups at risk in low birth weight infants and perinatal mortality. Acta Paediatr Scand 1969;193(suppl 193):1–71
11. Rantakallio P. Family background and personal characteristics underlying teenage smoking. Scand J Soc Med 1983;11:17–22
12. Maes M, Cosyns P, Melzer HY, et al. Seasonality in violent suicide but not in nonviolent suicide or homicide. Am J Psychiatry 1993;150: 1380–1385
13. Isohanni M, Makikyro T, Moring J, et al. A comparison of clinical and research DSM-III-R diagnoses of schizophrenia in a Finnish national birth cohort: clinical and research diagnoses of schizophrenia. Soc Psychiatry Psychiatr Epidemiol 1997;32:303–308
14. Moilanen K, Veijola J, Laksy K, et al. Reasons for the diagnostic discordance between clinicians and researchers in schizophrenia in the Northern Finland 1966 Birth Cohort. Soc Psychiatry Psychiatr Epidemiol 2003;38:305–310
15. Norusis JE. SPSS for Windows. Advanced Statistics. Release 6. Chicago, Ill: SPSS Inc Corp; 1994
16. Hakko H, Rasanen P, Tiihonen J. Seasonal variation in suicide occurrence in Finland. Acta Psychiatr Scand 1998;98:92–97
17. Wu L-T, Anthony JC. Tobacco smoking and depressed mood in late childhood and early adolescence. Am J Public Health 1999;89: 1837–1840
18. Breslau N, Novak SP, Kessler RC. Daily smoking and the subsequent onset of psychiatric disorders. Psychol Med 2004;34:323–333
19. Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Survey. Arch Gen Psychiatry 1994;51:8–19
20. Roggenbach J, Muller-Oerlinghausen B, Franke L. Suicidality, impulsivity and aggression: is there a link to 5HIAA concentration in the cerebrospinal fluid? Psychiatry Res 2002;113:193–206
21. Malone KM, Waternaux C, Haas GL, et al. Cigarette smoking, suicidal behavior, and serotonin function in major psychiatric disorders. Am J Psychiatry 2003;160:773–779
22. Virkkunen M, Rawlings R, Tokola R, et al. CSF biochemistries, glucose metabolism, and diurnal activity rhythms in alcoholic, violent offenders, fire setters, and healthy volunteers. Arch Gen Psychiatry 1994;51:20–27
23. Trummer H, Habermann H, Haas J, et al. The impact of cigarette smoking on human semen parameters and hormones. Hum Reprod 2002;17: 1554–1559
24. Giammanco M, Tabacchi G, Giammanco S, et al. Testosterone and aggressiveness. Med Sci Monit 2005;11:RA136–RA145
25. Booth A, Johnson DR, Granger DA. Testosterone and men's health. J Behav Med 1999;22:1–19
26. Rimpelä A, Lintonen T, Pere L, et al. Nuorten terveystapatutkimus 2003. Tupakoinnin ja päihteiden käytön muutokset 1977–2003. Stakes. Aiheita 13/2003