Cigarette Smoking and Adolescent Menstrual Disorders

by Phyllis Marie Jensen and Robert B. Coambs

Une étude sur la relation qui existe entre les troubles menstruels et le tabagisme a été menée auprès de la population adulte d'écoles secondaires. À partir des rapports personnels des participantes une corrélation a été établie entre les fumeuses et les non-fumeuses pour ce qui est du syndrome prémenstruel et des douleurs menstruelles. De façon significative, les fumeuses ressentent plus de douleurs.

The negative effects of smoking manifest in disturbances of the menstrual cycle.

Adolescent girls have been adopting smoking at a faster rate than boys, and starting younger than previous generations (Waldron, *et al.*). In 1991, 20 per cent of girls in Canada aged 15 to 19 years were smoking regularly compared to 12 per cent of the boys (Millar 1992). Twenty per cent of girls aged 13 years are estimated to smoke once a week (Health and Welfare Canada). The percentage of adolescent girls in the Northwest Territories smoking in 1991 is among the highest in the world: non-Native girls, 44 per cent, and First Nation girls: Dene, 62 per cent, Metis, 62 per cent, Inuit 73 per cent (Millar 1989). Unless these figures can be reversed, illness in this population will reach epidemic proportions in the future.

Most are aware of the health consequences of long-term smoking: lung cancer, heart disease, and respiratory disorders, but few know about the negative effects of short-term smoking that manifest in disturbances of the menstrual cycle and reproductive functioning. The major cause is nicotine, the addictive substance in tobacco smoke. Toxic to the ovaries, nicotine also interferes with the hypothalamic-pituitary-ovarian axis that controls the menstrual cycle, and interferes with the metabolism of the female hormone, estrogen. The result is that the body of a woman smoker behaves in an estrogen-deficient way (Baron), and shows an increased incidence of ovarian cysts (Wyshak, *et al.*), ectopic pregnancies (Campbell and Gray), infertility (see Baird and Wilcox, Darling *et al.*), spontaneous abortion (Harlap), early menopause (see Adena and Gallagher, Mattison), menstrual disorders (Sloss and Frerichs), irregular periods (Hammond), and menstrual pain (Wood *et al.*, Kauraniemi). The good news is that these can be reversed with stopping smoking.

Given the apparent direct effect of nicotine, it was hypothesized that the relationship between smoking and menstruation would appear even in adolescent girls who had been smoking for a short time. We used high school student health data to investigate this question.

Method

This study is part of a student health and happiness survey collected in the fall of 1993. The sample of girls is from an urban high school in Toronto, the largest metropolitan centre in Canada with a population of nearly three million. This central city high school reflects the wide diversity of ethnicity, social, and economic status in the city. In order to get the best representative sample of students, teachers of English, (a compulsory subject), were asked to contribute one period of student time for completion of the anonymous survey. Ten of the 13 English teachers agreed to use it as a reading comprehension project. Students were asked to cooperate, but not required to do so. None refused, but some declined to answer specific questions or series of questions, such as the ones on menstruation, saying they were too personal. Of the total number of girls in the school 258 (41 per cent) filled out the questionnaire in the fall. Others were scheduled to complete it in the new year. Not all the surveys distributed were fully completed, as class time for the task varied, as did the ability of the students, aged 13 to 25, to read, comprehend, and answer the questions. Six surveys were spoiled by students giving multiple replies to questions asking for a single response. Four girls (one per cent) had not begun their menstrual period. From a total of 268 surveys completed by the girls, 258 were used. In some of the analyses the sample dropped to 211 due to statistical program deletions for missing data.

Smoking status was defined as (1) never smoked, (2) triers (those who had taken an experimental puff at some time but never pursued it beyond this), (3) occasional smokers (those who have smoked on an irregular basis, at parties and special events), (4) former smokers (those who had smoked for a period of time, but claimed to have quit recently), and (5) regular smokers (those who smoke regularly, often daily).

Toxic to the ovaries, nicotine interferes with the metabolism of estrogen.

Menstrual function was measured with a series of self-scored questions where "0" meant not a problem, "1" mild problem, "2" moderate problem, and "3" severe problem. The premenstrual time period was defined as the two weeks before menses, with questions on weight gain, depression, mood changes, irritabil-

ity, bloating, nausea or vomiting, suicidal thoughts, anxiety, leg cramps, anger, breast tenderness, headaches, low back pain, and vaginal discharge. Responses were combined into a single score called premenstrual syndrome. The menstrual period was defined as the days of menstrual flow. Questions included in a simple additive scale labelled period discomfort were frequency of urination, diarrhoea, headaches, bloating, menstrual cramps, the need to lie down for one or two days, craving of sweets, sleep difficulty, breast changes, and heaviness of menstrual flow.

The more cigarettes smoked, the more likely women were to report discomfort.

Results

Over half of the girls in the sample had never smoked (54.6 per cent). Fifteen per cent had taken a puff at some time, but never pursued smoking beyond initial experimentation. Nine per cent reported smoking occasionally. The same number of girls claimed to have smoked regularly, but to have quit recently (nine per cent), and twelve per cent admitted to smoking cigarettes regularly, often daily. Former smokers averaged one cigarette a day when they were smoking, while occasional smokers averaged one cigarette every other day. The number consumed by regular smokers ranged from one to 30 cigarettes a day (average = eleven).

The ages of the girls in the study ranged from 13.0 to 25.0 years, with an average of 16.0 years. Girls who smoked had started between the ages of 6.0 and 20.0 years with an average age of commencement of 12.7 years. Because it usually takes months of occasional smoking before a regular habit is established, it is not surprising that the average age of the non-smokers was half a year younger (15.5 years) than the average age of the smokers (16.0 years).

The start date of menarche ranged from 8.0 to 19.0 years with an average age of 12.3 years. There was no significant relationship between the age the girls started smoking and age of menarche. Scores for premenstrual syndrome ranged from 0 to 45.0, the highest possible, with an average of 10.7 (where the most frequently occurring score was 0). Scores for period discomfort ranged from 0 to 33.0, the highest possible, with an average of 7.6 (where the most frequently occurring score was 3.0). These two scores were added together to create a variable labelled menstrual discomfort, which ranged from 0 to 78, with an average of 18.3 (where the most frequently occurring score was 9).

To examine the relationship between menstrual discomfort and the extent of involvement in smoking, statistical means of the three variables, premenstrual syndrome, period discomfort, and total menstrual discomfort were calculated for "never smoked," "triers," "occasional smokers," "former smokers," and "regular smokers." The never smoked group had the lowest mean scores for all three measures: premenstrual syndrome (9.0), period discomfort (6.5), and total menstrual discomfort (15.5). The regular smokers scored highest for all three measures: premenstrual syndrome (14.2), period discomfort (10.0), and total menstrual discomfort (24.2; see graph).

Smoking status, plus two other unrelated variables, irregularity of period, and age of menarche were combined in a multiple regression model and explained eleven per cent of the total variance of menstrual discomfort (p=.0001).[1]

Discussion

This study shows that the previously found relationship between smoking and menstrual discomfort in adults appears to extend to adolescent smokers. Menstrual disorders were linked to cigarette smoking in Britain as early as 1961, as women over the age of 30 who smoked were found to experience more menstrual irregularity than non-smokers (Hammond). A later Australian study of adult women at a community health clinic found current smokers reported more irregularity of menstrual periods than non-smokers or ex-smokers (Wood). However, in the study reported here, adolescent smokers did not fit the adult pattern. There was no significant relationship between level of involvement in smoking and irregularity of menstrual periods. There are three possible explanations. First, non-smokers were younger, on average, than the smokers, and during menarche irregularity in the menstrual cycle is normal, so a higher degree of irregularity of periods in the older girls who were smokers was not evident. Second, girls who were smoking were much more likely to be using oral contraceptives[2] which have a regulatory effect on the menstrual cycle. Thus, irregularity caused by the toxic effects of nicotine would be corrected by oral contraceptives. Third, for irregularity to be evident in smokers, it may require a higher dose of nicotine than the relatively light smoking of these adolescents, or fourth, irregularity may take more years of smoking to manifest.

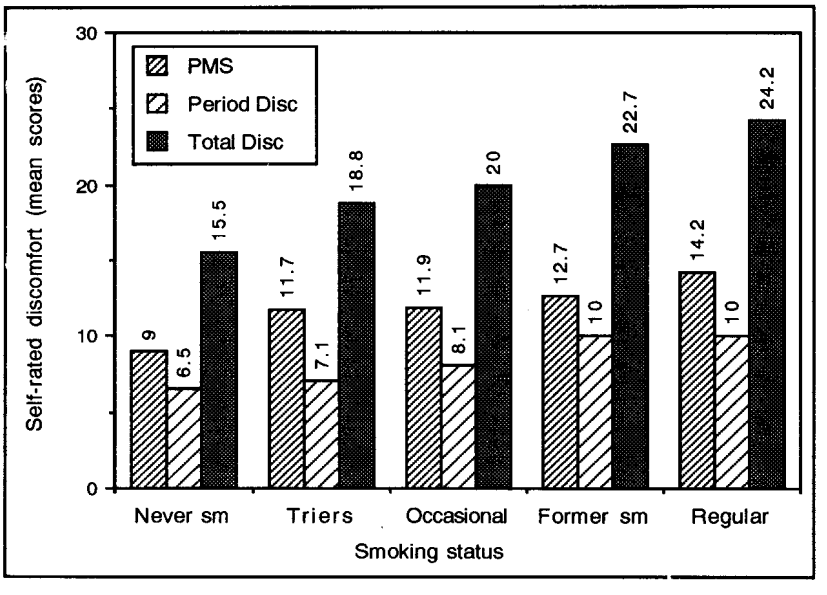
It is disturbing that a higher percentage of young smokers were using oral contraceptives because the combination creates a greater health risk. Both nicotine and oral contraceptives affect lipid metabolism by raising the level of total blood cholesterol and LDL ("bad") cholesterol, and lowering the level of HDL ("good") cholesterol. This increases the risk of pulmonary embolism and strokes, even at young ages (Perlman *et al.*).

An early Finnish study reported that the frequency of period pain increased with the number of cigarettes smoked (Kauraniemi). A 1979 Australian study showed that women who were current smokers had higher rates of menstrual pain than non-smokers or ex-smokers (Wood *et. al.*). A more recent British study found a higher prevalence of menstrual disorders in women smokers (25.1 per cent) compared to non-smokers (18.6 per cent) including menstrual pain, premenstrual staining, missed peri-

ods, and cysts/polyps/fibroid tumours of the reproductive organs. In addition, the more cigarettes the women smoked each day, the more likely they were to report menstrual disorders (Sloss and Frerichs). In the study reported here, a multiple regression model with menstrual discomfort as the dependent variable showed eleven per cent of the variance explained by three predictors: smoking status, irregularity of menstrual period, and age of menarche. In a step-wise regression, smoking status was the first variable brought into the equation. All three variables are related to menstrual function in different ways. Nicotine has toxic effects on the reproductive organs, while irregularity of menstrual periods and age of menarche are markers of endocrine function. This clearly demonstrates that nicotine is so toxic to the reproductive system that measures of menstrual discomfort are high even in adolescents, who are relatively light smokers.

In conclusion, this study shows that the relationship between menstrual difficulty and smoking occurs even in very young smokers. Since there is no obvious reason to suggest that menstrual difficulties cause smoking, or that a mediating factor causes both, it would appear that smoking may cause menstrual difficulties even in young women. Further research is needed on this question. The fact that one Canadian woman dies every 35 minutes from disease due to smoking (National Clearing House on Tobacco and Health) is a remote concept for adolescent girls. However, the reality of the immediate relationship between smoking and menstrual difficulties promises to be useful in influencing adolescent girls not to smoke, and to stop smoking. Given the relationship between smoking and menstrual discomfort, reproductive difficulties, and high rates of mortality, educating our daughters about tobacco use, and helping our sisters to quit need to be made priorities of the women's health movement. In addition to anti-smoking programs in schools, cessation programs are needed which address the interests and special needs of adolescent girls (see Ershler *et al.*, Gordon).

For a copy of the Multiple Regression Model with the Analysis of Variance, Beta Coefficient and Confidence intervals and partial F, please contact the authors.



Self-rated menstrual discomfort and smoking status. PMS= *Premenstrual Syndrome,* Period disc = *period discomfort,* Total disc = *premenstrual syndrome + period discomfort.*

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[1]This $p = .0001$ indicates that there is only one chance in 10,000 that the relationship in this model occurred by chance alone.

[2]The correlation r = .44 says there is a moderately strong relationship between smoking and the use of oral contraceptives.

References

Adena, M.A. and H.G. Gallagher. "Cigarette Smoking and the Age of Menopause." *Annals of Human Biology.* 9 (2) (1982): 121-130.

Baird, D.D. and A.J. Wilcox. "Cigarette Smoking Associated with Delayed Conception." *Journal of the American Medical Association.* 253(2) (1985): 2979-2983.

Baron, J. "Smoking and Estrogen-Related Disease." *American Journal of Epidemiology.* 119(1) (1984): 9-22.

Campbell, O.M. and R.H. Gray. "Smoking and Ectopic Pregnancy." M.J. Rosenberg, ed. *Smoking and Reproductive Health.* Littleton, Massachusetts: PSG Publishing Co., 1987.

Darling, J. *et al.* "Cigarette Smoking and Primary Tubal Infertility." M.J. Rosenberg, ed. *Smoking and Reproductive Health.* Littleton, Massachusetts: PSG Publishing Co., 1987.

Ershler, J. *et al.*. "The Quitting Experience for Smokers in Sixth Through Twelfth Grades." *Addictive Behaviours.* 14 (1989): 365-378.

Gordon, N. P. "Never Smokers, Triers and Current Smokers: Three Distinct Target Groups for School-Based Antismoking Programs." *Health Education Quarterly.* 13(2), 163-180.

Hammond, E.C. "Smoking in Relation to Physical Complains." *Archives of Environmental Health.* 3 (August) (1961): 146-164.

Harlap, S. "Smoking and Spontaneous Abortion." M.J. Rosenberg, ed. *Smoking and Reproductive Health.* Littleton, Massachusetts: PSG Publishing Co., 1987.

Health and Welfare Canada. *The Health of Canada's Youth.* Ottawa: Ministry of Supply and Services, 1992.

Kauraniemi, T. "Gynecological Health Screening by Means of a Questionnaire and Cytology." *Acta Obstetrics Gynaecology Scandinavia.* 48(Suppl. 4) (1969): 111-121.

Mattison, D. R. and P.J. Thomford. "The Effect of Smoking in Reproductive Ability and Reproductive Lifespan." M.J. Rosenberg, ed. *Smoking and Reproductive Health.* Littleton, Massachusetts: PSG Publishing Co., 1987.

Millar, W. J. (1992). "A Trend to a Healthier Lifestyle." *Canadian Social Trends.* 24(Spring): Supplement.

_____(1989). *Tobacco Use by Youth in the Canadian Arctic.* Ottawa: Health and Welfare Canada.

National Clearing House on Tobacco and Health. *Focus on: Women and Tobacco.* Ottawa: Tobacco Programs Unit. Heath Canada, 1993.

Perlman, J.A. *et al.* "Smoking and Oral Contraceptives, and Other Risk Factors for Atherosclerotic Heart Disease." In M.J Rosenberg, ed. *Smoking and Reproductive Health.* Littleton, Massachusetts: PSG Publishing Co.

Sloss, E.M. and R.R. Frerichs. "Smoking and Menstrual Disorders." *International Journal of Epidemiology.* 12(1) (1983): 107-109.

Waldron, L, D. Lye, A. Brandon. "Gender Differences in Teenage Smoking." *Women and Health.* 17(2) (1991): 65-90.

Wood, C., L. Larsen, L. and R. Williams. "Social and Psychological Factors in Relation to Premenstrual Tension and Premenstrual Pain." *Australian and New Zealand Journal of Obstetrics and Gynaecology.* 19(2) (1979): 111-115.

Wood, C. "The Association of Psycho-Social Factors and Gynaecological Symptoms." *Australian Family Physicians.* 7 (3) (1978): 471–478.

Wyshak, G. *et al.*. "Smoking and Cysts of the Ovary." *International Journal of Fertility.* 33(6) (1988): 398-404.