Psychosocial and genetic determinants of tobacco smoking as an addictive disease

Psihosocijalna i genetska uslovljenost pušenja kao bolesti zavisnosti

Dragica Pešut*, Bogdana Bursuc†, Laura Ciobanu‡, Ljudmila Nagorni-Obradović*

School of Medicine University of Belgrade, *Institute of Lung Diseases and Tuberculosis, Research and Epidemiology, Belgrade, Serbia; †’Babes-Bolyai’ University, ‡Expert Centre – Applied Psychology Centre, Bucharest, Romania; University of Medicine and Pharmacy „Gr.T. Popa“, 6th Medical Clinic, Recovery Hospital, Iasi, Romania

Key words: smoking; tobacco use disorder; nicotine; tobacco use cessation; risk factors; behavior; psychology; polymorphism, genetic.

Introduction

Tobacco smoking (and other forms of tobacco use) is a single, the most preventable risk factor for morbidity and mortality in the world. It has been recognized as an addictive disease and not simply a bad choice. Its harmful effects on human health have been evidenced, based both on active and passive smoking. While about a half of current tobacco deaths occurs in developing countries, that number is expected to rise to more than 70% by 2020. Apart from urgent need for increasing people's awareness of tobacco smoke harmful effects on human health, enforcement of health care workers' education in the field of smoking cessation methods and primary prevention of tobacco use are also necessary.

Smoking is a major cause of cardiovascular mortality, chronic obstructive pulmonary disease (COPD) and asthma, low birth weight, reproductive health and many other health disorders including dental and peridental diseases. It is also a potent multisite carcinogen, causing different malignant diseases, such as neoplasms of the lung, oral and nasal cavity, nasal sinuses, pharynx, larynx, esophagus, pancreas, stomach, renal pelvis and bladder, kidney, uterine cervix, and myeloid leukemia. New country-by-country report on tobacco use and control, co-published by the American Cancer Society, the World Health Organization (WHO) and the International Union Against Cancer (UICC), lends further support to the evidence that tobacco use is increasingly targeting women in developing countries, the largest remaining untapped market for cigarettes. Thus tobacco's cancer burden is increasingly being shifted to developing countries.

The number and age of children experiencing environmental tobacco smoke (ETS) exposure vary widely depending on socio-cultural norms. In countries with stronger influences of Orthodox church (tobacco smoking is considered a grief and especially women are discouraged to be seen in public with a cigarette) one can hardly see a mother with the baby in the street smoking a cigarette, a scene not rare in countries where such socio-cultural norms do not exist. The countries of the south-east European region rank among the first in Europe by adult populations' tobacco smoking. Some of them rank first in the world in passive smoking in children.

The important message from epidemiological studies is a strong evidence of a protective effect of quitting smoking at any age. But, tobacco smoking is not a simple biological addiction that can be “cured” with medications. Many smokers, in particular heavy smokers, have great problems with quitting smoking, and even the use of alternative nicotine delivering devices may be not of considerable assistance to promote abstinence. Nicotinism is a complex disease influenced by non-modifiable determinants such as genes, nicotine sensitivity and personality traits, and also by modifiable determinants such as knowledge, perceptions and socio-cultural definitions of tobacco-related behavior provided by the social norms and tobacco control laws and regulations.
Psychosocial determinants of tobacco smoking

The influences on tobacco smoking behavior are diverse, and they involve multiple cognitive, behavioral, and social systems. Relations among these influences may be reciprocal, and each may play a different role in the development of smoking.

Every single smoking episode may be a function of multiple variables that change depending on the context and other factors as the cost and availability of other reinforcers of the behavior. The complexity of smoking behavior is reflected by the range of the factors associated with the initiation and maintenance of smoking. These factors include stress, genotype, peer and parental relations, individual characteristics, expectancies, presence of affective symptomatology and more.

The level of smoking prevalence represents a decline from recent peaks in the mid-1990s. An American National Survey has found that there have been significant shifts over time in the prevalence of adolescent smoking. Adolescent smoking increased in the late 1960s, peaked in mid-1970s and then declined in the late 1970s and 1980s. New increases began in the early 1990s until the mid-1990s, and since then there has been a downturn. These dynamic shifts in smoking prevalence are likely driven by the complex psychosocial factors including changes in the social images of smoking. This means that smoking behavior underlines a more complex motivation than genetic factors.

The review of the psychological researches on smoking behavior emphasizes different influences on the initiation and maintenance of smoking behavior that will be further presented. These studies shed some light on the complex mechanisms of this behavior and draw guideline for the design of smoking prevention programs.

Initiating smoking behavior

A lot of literature has linked adolescent tobacco use to individual and interpersonal characteristics. The most replicated findings are that characteristics that reflect behavioral “under control”, including sensations seeking and impulsivity, rebelliousness, and conduct disorder prospectively predict smoking onset. Less is known about the mechanism that underlines the relation between these characteristics and tobacco use.

A set of cross-sectional studies examined the smoking behavior initiation in adolescence and drawn the explanation of the relationship between individual characteristics and smoking behavior. The findings indicate that tobacco use is associated with the risk taking, low self-esteem, perceived stress, and perceived vulnerability to peer social influence to use tobacco, and trial and current use of alcohol. In both adult and adolescent samples, stress has been shown to be positively correlated with the levels of psychological distress.

Several resources for dealing with the stress have been suggested including social support, mastery, and self-esteem. Although there is some evidence that drugs in general are used for coping, Wills and Shiffman, in their review of the literature, point out that smoking is consistently reported to be such a mechanism. In the samples of both adults and adolescents, smokers report more difficult life events than nonsmokers do. There are some conflicting evidences that nicotine has a direct stress reducing effect.

It is not clear why some individuals choose substance use rather than alternative coping strategies, such as prayer, talking to friends, or exercise. Wills and Shiffman suggest that people low in personal resources such as self-esteem, mastery, or social support may turn to substance use because it is the only means available to deal with the stress. In various studies, cited by Pederson et al., 1997, smokers report lower self-esteem, lower levels of peer and family support, and lower levels of mastery. Furthermore, once smokers adopt smoking as a method for coping, they are less likely to see the need to try to develop other, possibly healthier, coping strategies. Smoking is reinforcing insofar as it reduces distress as well as reducing those symptoms resulting from deprivation from nicotine. These findings lend support to the argument that adolescents may smoke because of the lack of other coping resources.

Given that both high levels of stress and low levels of coping resources have been found to be associated with tobacco use, one might expect the two to interact. That is, specifically, the availability of coping resources might be expected to influence substance abuse during the times of high stress, but not during the times of low stress.

Researches focused on individual psychological factors of smoking behavior shift the individual characteristics in protective factors and risk factors. People who never smoked or who quit smoking have low scores on risk factors as delinquency, coping by taking drugs, and alcohol and marijuana use. They also reported less depression, fewer suicidal thoughts, and fewer suicide attempts.

The findings are consistent with previous research where never smoker appear to have higher scores than smokers on protective factors such as good grades, greater participation in conventional activities, mental health, parental monitoring, parental attachment, parental communication, and attachment to school.

One individual characteristic frequently addressed in relation with smoking behavior is the presence of psychological symptomatology. Researches on psychological disorders found a covariation of smoking with clinical syndromes characterized by a highly negative affectivity, particularly clinical depression. Depressive disorders in adulthood and early depressive symptoms predict smoking onset. Childhood anxiety disorders are associated with a later smoking onset. Tobacco use has been associated with the increased adverse moods such as anxiety. Nicotine has established anxiolytic effects through modulation of central neurotransmitters, including monoamines. Both obsessive–compulsive behaviors and tobacco use have been associated with the dysfunction in orbitofrontal–subcortical circuits. Also, attention deficit hyperactivity disorder (ADHD) is linked with cigarettes smoking above and beyond conduct disorders associated with ADHD.
Smoking shows systematic age-related trends, with the use peaking at ages 18–25. After the mid-20s, declines in smoking occur but these declines are modest in comparison to other forms of substance use, perhaps because cigarette smoking is highly addictive, legal, and not immediately performance impairing. Adolescence is considered as a high vulnerability age for smoking initiation. Some findings on animal samples suggest that processes involved in the central nervous system development and maturation may play a critical role in the etiology of tobacco use and dependence 15.

Other findings emphasize peer influence on smoking uptake in adolescence. A problem which makes it difficult to sort out the temporal sequence of the events is whether smokers select friends who smoke or whether having smoking friends precedes onset of smoking behavior 20. In respect with peer influences, it has long been recognized that life change or life stress may have a substantial effect on emotional well-being, and adolescence is a time during which many dramatic changes occur, including school leaving when friendship networks often change markedly 26. Peer influence may operate through other mechanisms such as an increasing perception that smoking is prevalent and normative, communicating a positive social image of smoking, providing access and opportunities for smoking behavior, or providing a mean for peer bonding 15.

Parent behavior is also linked to smoking behavior in an offspring. A recent review of twin studies concluded that heritability is stronger for tobacco dependence than for smoking initiation 27. Other studies show that the transmission from parent to child may be based on parental drug modeling in which adolescents imitate their parents' drug use behavior 26. New researches found a child-parent relationship and child rearing as mediating the link between parents' characteristics (smoking behavior, low educational or socio-economic status) and offspring smoking. A weak child-parent relationship is critical for child development, including tobacco use. A weak parent–child bond that includes low identification with the parent by the child, a parent–child conflict, including limited warmth and affection, and a low parental educational expectations and aspirations for the child are related to adolescent smoking 26.

Adolescents form beliefs and attitude about smoking before experimenting with it, and these prospectively predict both the onset and escalation of smoking. The existing evidence suggests that both adults and adolescents underestimate the risks involved by smoking and show unrealistic optimism about the personalized risk of smoking 15. New studies emphasize that judgments of risk are greatest in younger adolescents, and greater in adolescents than adults 27. Even if adolescents hold strong beliefs in the negative outcomes of smoking, the influence of these beliefs on behavior may be outweighed by the perceived benefits of smoking: social image of precocity and adult–like status, toughness, sociability, the anticipation of rewarding effects of smoking like pleasure, euphoria, or stress–reduction effect, body weight control effect 15. A belief that smoking can control body weight has been shown to predict prospectively smoking initiation among adolescent girls, but not boys. Other belief that support smoking is that smoking enhances the cognitive processing and maintains a state of alertness and vigilance 15. In fact, laboratory research supports these assertions 28.

Studies of larger macrolevel social influences show that antitobacco social policies such as the increased taxation and restriction on youth access tend to be implemented in communities that also share the antismoking norms and values, so that the effects of the policies are hard to disentangle from the effects of broader community norms 15. Econometric data show that adolescents' tobacco use is price sensitive, as it is for adults 15, and depends on the availability of cigarettes 29. Adolescent smoking is correlated with self-exposure to cigarette advertising 15. An evidence suggests that tobacco advertising can increase smoking onset, and counteradvertising can delay or prevent it 30.

Demographic correlations of smoking suggest a possible influence on smoking development. There are great differences in smoking as a function of race/ethnicity. These may be due to several factors like the cultural norms and values related to smoking, educational or income level 15. New studies show an independent barrier to smoking cessation that may be considered a risk factor for smoking: younger age, female, being no married and employed, and having lower income and education 31. There are some suggestions in the literature that smoking serves different needs for males and females – like a weight control need for girls – and that the mechanisms underlying the development of smoking may be different. Adolescent girls seem to be more susceptible to smoking initiation and less likely to maintain cessation attempts 29.

Maintaining smoking behavior

There are two major mechanisms that explain smoking behavior maintenance: positive reinforcement and negative reinforcement. Like other psychomotor stimulants, nicotine produces subjective sensations evaluated by smokers like pleasant and euphoric. A positive reinforcement effect of nicotine self-administration is one of the motives smokers report for smoking. Also, other environmental or social cues might become rewarding through being paired with nicotine self-administration – classical conditioning 32.

Smokers regularly cite affective control as a principal motive for their tobacco use. Smoking behavior is maintained by negative reinforcement through reduction of stress and withdrawal symptoms 32.

Research limits

Despite prospective studies there are cross-sectional studies on smoking behavior onset and maintenance. It is due to impossibility to conclude a causal relationship between all the factors identified and smoking status. It could be that these factors raised the probability of smoking behavior or smoking behavior facilitated the acquisition of these specific characteristics described. Longitudinal studies on smoking behavior are scarce 27.
Implications for smoking prevention programs

Psychological and social factors are important to take into consideration in the establishment of smoking prevention and intervention programs. It is recommended that primary prevention programs address the main risk factors presented, in order to hamper smoking behavior onset: mental health (low self-esteem, low coping skills, depressive symptoms) and a parent-child relationship (parental communication, parental attachment, parental monitoring). This means that two levels of intervention are recommended: a direct target group and parents if the target group is represented by children 26.

Genetic predisposition to tobacco smoking

Nicotine is a primary compound present in tobacco that is responsible for establishing and maintaining tobacco dependence 31. Most of nicotine is metabolized to cotinine by the genetically variable liver enzyme CYP2A6 with 13 variants identified 34. This enzyme is located on the 19q13.2 chromosome, and is also responsible for the activation of tobacco-smoke procarcinogens to carcinogens 35.

The initiation and continuing of smoking is due to both genetic and environmental factors 30. Approximately 50% of the initiation of smoking is genetically influenced, whereas the maintenance of dependent smoking behaviour and amount of smoked cigarettes have approximately 70% genetic contribution 37. Considering the documented link between olfactory stimuli and smoking in females, and the presence of a cluster of odorant receptor genes close to the MHC class I region, a multicentric study showed a potential role of the MHC-linked olfactory receptor genes in the initiation of smoking 38.

Researchers identified at least four genes factors that contribute to nicotine addiction: the TaqIA1-allele of the D2 dopamine receptor gene (DRD2) 36, 39, the S-allele of the serotonin transporter gene (5-HTTLPR) 40, the CYP2A6*1A, CYP2A6*1B and CYP2A6*1 × 2 alleles of gene CYP2A6 34, 37, 41, and the GABAB2 gene that encodes a subunit of the GABAg receptor for GABA neurotransmitter, located within a region of chromosome 9q22 42.

Nevertheless, there are some genetic factors that decrease the risk of becoming a smoker: the CYP2A6-null alleles (CYP2A6*2 and CYP2A6*3) 35, the SCL6A3-9 variant of the dopamine transporter gene, and the A2 variant of the D2 dopamine receptor gene (DRD2) 43.

Moreover, some genetic factors have already been described that protect smokers from nicotine-dependance: the CYP2A6-null alleles in general 33, and the whole deletion-allele of CYP2A6 (CYP2A6AST; 4C variant) in particular 41, 44, and the gene that encodes α4 subunit of nicotinic acetylcholine receptors (CHRNA4 gene, mapped to 20q13.2-13.3 chromosome) 45.

Individual attempts to quit smoking are enabled by the SLC6A3-9 and the DRD2-A2 variant genes 43 and have small chances in the presence of the DRD2-A1 allele 38 and of a decreased activity variant of the CYP2B6 gene 46.

The appearance of tobacco-related diseases as lung cancer is enabled by the gastrin-releasing peptide receptor gene (GRPR) 37, especially in women, and by the fully functional alleles of CYP2A6 (e.g. the CYP2A6(*1)(*1) genotype): a protective effect has the presence of the CYP2A6-null alleles (e.g. the CYP2A6(*4)(*4) genotype) 48.

Future genetic therapies will try to inhibit in vivo the CYP2A6 gene's activity 33 and to adapt the antidepressant medication to the presence of A1 or A2 allele of the dopamine receptor gene (A1 or A2 DRD2 genotype) 39.

Conclusion

The relationship between tobacco smoking behavior and genetic predisposition to nicotinism remains a challenge for further investigations that could make the more effective therapy, and possibly a primary prevention of tobacco use as the best means for avoiding morbidity and mortality in the world.

REFERENCES


The paper was received on May 16, 2006.