Predictors of smoking during adolescence and options of prevention

PhD Thesis

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INTRODUCTION

Historically, adolescence is a period between childhood and adulthood in the second decade of life in the 10–19 age range. It could be divided into two categories, the 10–14 years of age period is the early- and the 15–19 age range is late adolescence. In addition to the intensive physical, mental and social changes, adolescence is also the period of risk taking behavior for shaping their identity and practicing decision-making skills as a preparation for upcoming adulthood. However, adolescents may overestimate their self-regulating capacities when experimenting with risky behaviors, for instance tobacco smoking, thus, posing real threats to their future health. The majority of adult smokers initiate their harmful habit during adolescence which often leads to life-long addiction therefore not only adults, but youth are also victims of the tobacco epidemic.

Smoking prevalence of Hungarian youth does not indicate clear positive change based on recent national, cross-sectional surveys; and little information is available about the frequency of alternative tobacco product (ATP) use by this age group. ADTs are available in various form, size and flavor and offer an alternative compared to factory-made cigarettes typically by deceptive health-related, convenience or financial considerations. Numerous factors can motivate adolescents to use ATPs. Beside the widespread misperception that ATPs are less harmful than traditional cigarette smoking, many adolescents perceive ATPs attractive and trendy furthermore, flavored products could even be more desirable. Flavored ATPs could be regarded as "introductory tobacco products" for nonsmoker and tobacco experimenter youth and females who became addicted smokers by these products with less unpleasant tobacco-related experiences. Poly-tobacco use may also occur among adolescents, which means that cigarette smoking is occasionally or regularly combined or interchanged with ATPs. Poly-tobacco use could increase the risk of developing heavy nicotine dependence as well as later the likelihood of tobacco-related harmful health consequences. ATP use becomes more and more widespread due to its easy accessibility, targeted marketing and the common false safety perceptions of these products, and finally by lacking or insufficient enforcement of relevant legislation. Thus, monitoring the experimentation and regular use of ATPs could not be ignored.

Adolescent smoking is a complex process which takes place through weeks, months or even years. Currently, there are two theoretical ways to define it: 1) the smoking stage model, which consider changes in smoking as stage process, and indicate that these specific stages are of behavioral or motivational nature while other models combine some of these stages. The other approach operates with 2) smoking trajectories that regard adolescent smoking as a

continuous developmental process over time and assume interpersonal differences in the timing of smoking initiation and the behavioral changes. Consequently, it is plausible to divide persons into subgroups according to homogenous changes in their smoking behavior over time. The determination of homogenous smoking groups based on the frequency and intensity of cigarette smoking. Recently, development of statistical methods made it possible to analyze smoking trajectories in a more detailed way, whereby not only different smoking behaviors (for instance, nonsmokers, experimenters, initiators, smokers, quitters) could be detected, but also individual changes of smoking patterns over time (for instance, early or rapid escalators, late or slow escalators, early or late stabile smokers). Additionally, common characteristics of trajectory group members could also be examined. Identifying homogenous smoking groups by similar longitudinal cigarette smoking patterns could help to explore high risk subgroups. Furthermore, optimal timing of tobacco prevention programs for each subgroup would be possible.

Currently, a wide range of smoking-related risk factors have been identified, from individual factors through social influences to societal effects. All of these have different roles in specific stages of adolescent smoking. Moreover, factors behind tobacco use may differ in the stages of adolescence, i.e. different risk factors may be more pronounced in early adolescence than in middle- or late adolescence. Classic and often examined risk factors of adolescent smoking are for instance, the presence of smoking friends or smoking parents, or academic achievement, family structure and allowance. However, currently it is questionable whether some rarely examined factors like nutritional status, body image, weight and appearance concerns of adolescents and their beliefs about the weight control effect of smoking can influence smoking initiation. Studies targeting these questions are sporadic and their results are contradictory by international comparison, while the situation is even more unfavorable in Hungarian circumstances.

Thus, there are mixed results about nutritional status changes of adolescents who initiated smoking, but it is assumed that smoking has minimal weight reducing effect among them. Positive association between overweight during adolescence and smoking is also likely, especially among girls, but there were only few longitudinal studies with different measurements, and surveys included mostly American youth. Therefore, their results are uncertain and cannot be generalized. Agreement with the weight control effect of smoking among adolescent is clear and its prevalence is estimated between 15–50%, although the role of weight control beliefs in smoking initiation and maintenance is less known due to the limited number of relevant longitudinal studies. Weight concerns and perceived overweight could be moderate predictors of smoking initiation, especially among females. However, due

to the small number of cohort studies and methodological limitations, only careful conclusions could be made for the nature and strength of the association between body image concerns and smoking.

Knowledge of adolescent smoking development processes is necessary to plan efficient tobacco prevention programs and we need to be aware of the real effect of known and less known risk factors of each smoking stages.

OBJECTIVES

Changes of adolescent smoking in Hungary were known only by cross-sectional studies because of the lack of prospective cohort studies. Cross-sectional design is inadequate to investigate smoking trajectories. Furthermore, there is obvious lack of knowledge about the relationship of nutritional status, body image, weight control beliefs of smoking and adolescent smoking development. Our knowledge about the experimentation of ATPs among Hungarian youth is also moderate, like its characteristics in different adolescent groups.

Consequently, aims of the current longitudinal survey started in two age cohorts (6th and 9th school grades at baseline) of metropolitan adolescents were the followings:

1. To explore changes in ever and current use of cigarette over a three-year period among 6th and 9th grader metropolitan adolescent cohorts at baseline.

2. To identify socio-demographic, interpersonal, body- and body image-related factors of smoking trajectories of metropolitan adolescents.

3. To explore changes of nutritional status, body image, body satisfaction, desired body weight control and the agreement with the weight reduction effect of smoking in two age cohorts of adolescents, and to assess the role of body-related variables in smoking trajectories.

4. To analyze the predictive nature of classic individual, interpersonal, and novel body-related variables of ever and current cigarette use during the early- and late adolescence.

5. To determine the prevalence of ever use of ATPs and its covariates among youth who ever tried cigarette smoking, and to identify the patterns of ATP ever use.

6. Based on results, providing recommendations for future development of national adolescent tobacco prevention programs, especially for the timing and methods of targeted and differentiated primary and secondary, age adjusted prevention programs.

METHODS

Participants and procedure

A three-year prospective cohort survey with yearly data collection was started in the 2009–2010 school year in the capital of Hungary (Budapest) and five metropolitan cities (Debrecen, Győr, Miskolc, Pécs, Szeged) in a sample of 6th and 9th grade students at baseline. The sample was stratified by the number of 6th and 9th graders in 2008 and school types using data from the Public Educational Information Office. Altogether, 413, randomly selected schools were invited by electronic (e-mail) and fax messages. Finally, 78 schools (elementary-, vocational- and high schools) agreed to join the longitudinal study. Parents were informed about the survey by a passive consent procedure and based on their consent, 2567 students were invited in the study. Trained data collectors unknown to the students informed them verbally and in written about the voluntary participation, and requested to fill the paper-pencil questionnaire within one teaching hour. This research was approved by the Institutional Review Board of Semmelweis University (IRB No.:104/2009) and supported by the Fogarty International Center, National Cancer Institute and the National Institute of Drug Abuse, USA (Grant Number: 1 R01 TW007927-01).

The first data collection period (Time 1 – T1) was November, 2009 – March, 2010 and 2,208 students responded adequately. The second period (Time 2 – T2) fell between December, 2010 and March, 2011 (n=2,081), and the third one (Time 3 – T3) between January – May, 2012 (n=1,987). Due to the prospective nature of the study, losses to follow-up occurred and 49.5% (n=1,092) of the baseline sample was successfully followed over three years.

Measures

Socio-demographic data: respondents indicated their gender, age and school grade at each waves. Specific grades were 6th, 7th and 8th among elementary school participants (younger cohort, n=467), and 9th, 10th and 11th grades among secondary school students (older cohort, n=625). Participants reported their family structure (people living together with them at home) also at each waves and intact-, restructured and single-parent or other family categories were determined. Students indicated their average weekly allowance and their mean academic achievement in the past semester.

Social influences of smoking: participants indicated the smoking status of their parents they are living in the same household with (none of parents are smoker/one or both parents are smoker), and the number of their smoking best friends on a scale ranging from 0 to 5.

Tobacco smoking: smoking behavior was measured with questions for ever use of cigarette, current smoking (self-reported smoking during the past 30 days; current smokers were qualified as smoking at least 1 day during the past month) and ever daily cigarette smoking. The longitudinal study made it possible to identify changes in smoking behavior, therefore, participants were grouped into 5 smoking trajectories:

1) nonsmokers (did not smoke in the past 30 days at any of the survey waves),
2) experimenters (they initiated and quitted smoking alternately during the survey),
3) initiators (did not smoke at T1, but already smoked at T2 or T3),
4) quitters (smoked at T1, then quitted at T2 or T3) and
5) smokers (smoked at all three survey waves).

Five types of ATPs (roll-your-own cigarette, cigar or cigarillo, waterpipe, pipe, flavored cigarette) were measured at each survey waves among students who ever tried manufactured cigarettes. Computing code numbers of each ATP ever use variables created a binary "any ATP ever use" variable (did not tried/ever tried any of them).

Anthropometric data: based on self-reported body weight (kg) and body height (cm) at each waves, BMI (Body Mass Index, kg/m^2) was calculated.

Perceived body shape: students evaluated their own body image based on a question „How do you perceive your body?" by five response options which were collapsed into two categories (not perceived overweight/perceived overweight).

Weight control behavior: one question measured intention to change current body weight (desire to lose weight/desire to gain weight/would not change) and response options were collapsed into a binary variable (no desire to lose weight/desire to lose weight).

Body Satisfaction Scale (BSS): based on Tiggemann (2005) and Siegel et al (1999), Kiss (2008) adapted for Hungarian a 6-item self-reported scale which measures the satisfaction with several aspects of appearance (body weight, body height, muscularity, face, body shape, in overall the appearance). Responses are marked on a 7-point Likert scale of which higher numbers mean greater satisfaction with the appearance. Reliability of the scale was good: Cronbach's α_{T1}: 0.85 (n=1,001); Cronbach's α_{T2}: 0.86 (n=1,074); Cronbach's α_{T3}: 0.85 (n=1,068), and principal component analysis confirmed its homogeneity because all of the 6 items were included in one principal component.

Appetite- and weight control expectancies of smoking: Myers et al (2003) created the 21-item Short form of Smoking Consequences Questionnaire (S-SCQ) for adolescents that measures four factors of smoking-related expectancies of which only the 5-item appetite- and weight control expectancy scale was included in our questionnaire. Participants marked on a scale ranging from 0 to 9 their agreement with each statement. The appetite- and weight control (AWC) expectancy scale was created by computing point values of each item. Reliability of the scale was high at each survey waves: Cronbach's α_{T1}: 0.91 (n=970); Cronbach's α_{T2}: 0.89 (n=1,063); Cronbach's α_{T3}: 0.90 (n=1,068).

Statistical analysis

IBM SPSS statistical program was used generally for data entry and analyses completed in some cases by ROPstat 2.0 and Mplus 7.11 programs. Significance level was accepted at $p<0.05$ and for multiple comparisons, Bonferroni adjusted p-value was set. Descriptive statistics were calculated by Pearson's χ^2-test and independent sample t-test. Time related changes were explored with Cochran's Q-test, one-way repeated measures ANOVA, Friedman's ANOVA test, and two-way mixed ANOVA. Associations were tested with Pearson's χ^2-test completed by phi-coefficient and Cramer's V, one-way ANOVA with LSD post-hoc test, and Kruskal-Wallis test. Multiple linear regression and multiple binary logistic regression models were used for complex analyses. In the multiple binary logistic regression models, odds ratios (OR) with 95% confidence intervals (95% CI) were calculated. Predictors of ever use and current use of cigarette were explored by this model of which outcome variables were based on T2 and T3 data while covariates on baseline data. Latent class analysis (LCA) was performed to identify patterns of ATP experimentation. Bayesian information criteria (BIC) and Akaike information criteria (AIC) parsimony index, the minimization of cross-classification probabilities, entropy, and the interpretability of clusters were used to determine the number of latent classes. In the final determination, the likelihood ratio difference test (Lo–Mendell–Rubin adjusted LRT test) was also used. Covariates of latent classes were identified in multiple binary logistic regression analysis.

RESULTS

Descriptive characteristics of the sample

Comparison of the follow-up and attrition samples indicated that the longitudinal sample comprised mainly participants from the capital, with better academic achievement, lower weekly allowance, and they lived in socially more favorable family structure at baseline, and had lower ever and current cigarette smoking prevalence. Comparing two cohorts of the longitudinal sample, gender distribution differed significantly ($\chi^2_{(1)}$=10.32; p=0.001) because less females were followed-up in the younger cohort (48.6%) compared to males, while in the older cohort females represented the majority (58.4%). Proportion of capital students was higher among elementary school respondents (68.7%) compared to secondary school ones (51.2%; $\chi^2_{(1)}$=33.91; p<0.001). During the three-year study period, the proportion of students with good academic achievement (≥3.51) decreased significantly among both elementary- ($Q_{(2)}$=14.81; p=0.001) and secondary school participants ($Q_{(2)}$=64.23; p<0.001), and their proportion at all survey waves was higher in the younger cohort (p<0.001). The proportion of respondents with more than 1,000 Forints allowance per week increased significantly among elementary school students ($Q_{(2)}$=43.04; p<0.001), although it was not observed in the secondary school sample ($Q_{(2)}$=5.60; p=0.061). Living permanently in intact family decreased significantly both in the younger ($Q_{(2)}$=9.25; p=0.010) and the older cohort ($Q_{(2)}$=21.69; p<0.001), however, the two cohorts did not differ significantly (p>0.05) at any survey waves. Parental smoking rate was similar over the three-year study period ($Q_{(2)}$=4.91; p=0.086). Mean number of best friends smoking at least weekly was significantly higher (p<0.001) in the older cohort than in the younger one, who showed significant increase in the mean number of smoking friends among both boys ($\chi^2_{(2)}$=51.96; p<0.001) and girls ($\chi^2_{(2)}$=45.78; p<0.001) according to Friedman's test. However, the same phenomenon could not be detected among the older boys ($\chi^2_{(2)}$=3.84; p=0.147) and girls ($\chi^2_{(2)}$=3.03; p=0.220), respectively.

Prevalence of ever cigarette use increased significantly in the younger (T1: 19.7%; T2: 31.3%; T3: 41.5%; $Q_{(2)}$=153.18; p<0.001) and older cohorts (T1: 56.5%; T2: 66.7%; T3: 72.6%; $Q_{(2)}$=155.11; p<0.001). Ever trying a cigarette did not differ significantly by gender at any survey waves. Prevalence of current smoking increased considerably by T3 among elementary- (T1: 3.6%; T2: 6.4%; T3: 13.3%; $Q_{(2)}$=48.76; p<0.001) and secondary school students (T1: 24.8%; T2: 32.8%; T3: 38.6%; $Q_{(2)}$=52.71; p<0.001) as well, but gender differences were not significant. Prevalence of daily smoking more than quadrupled in the younger cohort (T1: 1.1%; T2: 1.5%; T3: 4.7%; $Q_{(2)}$=18.50; p<0.001) and almost doubled in

the older one (T1: 8.5%; T2: 13.4%; T3: 14.6%; $Q_{(2)}$=30.68; p<0.001), and the greater increase was detected among girls.

Smoking trajectories and their relationship with socio-demographic factors and social influences

Regarding smoking trajectories, 67.5% (n=737) of the sample remained nonsmoker, 11.3% (n=123) smoked at all survey waves, 14.3% (n=156) initiated smoking, 3.3% (n=36) were quitter and 3.7% (n=40) were experimenter.

The smokers' rate was similar among males and females, although more females (16.9%) initiated smoking than males (11.2%) over three years. Meanwhile, twice as many boys belonged to experimenters (5.0%) than girls (2.5%) ($\chi^2_{(4)}$=12.86; p=0.012; Cramer's V=0.11). Initiators and experimenters lived mostly in restructured family at baseline, but smokers lived typically in a single-parent or other family structure ($\chi^2_{(4)}$=34.08; p<0.001; Cramer's V=0.13). Significant relationship was detected between weekly allowance and smoking trajectories ($H_{(4)}$=30.59; p<0.001) as smokers had considerably higher amount of allowance compared to that of nonsmokers. Academic achievement and smoking trajectories showed significant association ($H_{(4)}$=103.70; p<0.001). Pairwise comparison of trajectories indicated that nonsmoker had significantly better academic achievement at baseline than all other trajectories. Furthermore, initiators also had better academic achievement at baseline compared to smokers (p=0.001).

Students with nonsmoking parents remained significantly more likely nonsmokers (59.6% vs. 74.0%), while students were smokers almost three-times more if one or both of their parents were smoker (16.8%) compared to those with nonsmoking parents (6.5%) ($\chi^2_{(4)}$=36.56; p<0.001; Cramer's V=0.19). Smoker participants had considerably more at least weekly smoking best friends at baseline compared to nonsmokers ($H_{(4)}$=258.19, p<0.001). Pairwise comparison with post-hoc test demonstrated that nonsmokers had significantly less smoking best friend than all other trajectory groups, and besides, initiators had less smoking friends compared to smokers (p<0.001) and quitters (p=0.014).

Smoking trajectories and nutritional status, body image, weight control

Association between *body mass index* at baseline and smoking trajectories was significant ($F_{(4)}$=4.88; p=0.001). Pairwise comparison of trajectories indicated higher BMI among experimenters (p=0.008), quitters (p=0.038) and smokers (p=0.001) compared to nonsmokers.

Proportion of *perceived overweight* did not differ significantly in both age cohorts at any survey waves (p>0.05), and changes over time were also non-significant among younger ($Q_{(2)}$=4.62; p=0.099) and older respondents ($Q_{(2)}$=2.35; p=0.309), respectively. However, girls in both cohorts perceived themselves overweight in considerably greater proportion than boys. Perceived overweight decreased significantly among younger ($Q_{(2)}$=9.21; p=0.010) and older boys ($Q_{(2)}$=6.24; p=0.044) during the survey. In contrast, elementary school girls perceived themselves overweight increasingly by 8th grade (T3: 40.3%; $Q_{(2)}$=9.00; p=0.011), while about one-quarter of secondary school girls thought similarly at all waves ($Q_{(2)}$=0.15; p=0.928). Those who perceived or not perceived themselves overweight at baseline belonged to all smoking trajectories in similar rate ($\chi^2_{(4)}$=3.30; p=0.509).

Proportion of students *desiring to lose weight* did not differ in the two cohorts during the survey (p>0.05), although more and more participants reported intention to lose weight in the younger cohort ($Q_{(2)}$=9.89; p=0.007), however, it was not typical in the older cohort ($Q_{(2)}$=1.07; p=0.585). Considerably greater proportion of females desired to lose weight in both cohorts than males, who showed continuous decrease in the rate of weight reduction intention. In contrast, desire to lose weight increased by 13.6% among elementary school girls (T3: 59.6%; $Q_{(2)}$=26.12; p<0.001), while among secondary school girls the increase was only moderate (T3: 58.8; $Q_{(2)}$=5.45; p=0.065). Significantly less students remained nonsmoker if they desired to lose weight at baseline and they were more likely to initiate, experiment and quit smoking compared to those who did not intend to reduce their weight ($\chi^2_{(4)}$=11.66; p=0.020; Cramer's V=0.11).

Body satisfaction (BS) tended to decrease between T1 and T3 in the younger cohort, especially among girls ($F_{(2)}$=2.76; p=0.064). Considerable changes of BS over time were not detected in the older cohort, although girls were more dissatisfied with their body than boys ($F_{(1)}$=11.01, p=0.001). Significant association was found between body satisfaction at baseline and smoking trajectories ($F_{(4)}$=5.85; p<0.001). Pairwise comparisons showed that nonsmokers were more satisfied with their body compared to initiators (p=0.001), quitters (p=0.005) and smokers (p=0.006).

Appetite- and weight control (AWC) expectancies of smoking increased significantly during the longitudinal study ($\chi^2_{(2)}$=37.72, p<0.001). Gender difference was not detected in the younger cohort ($F_{(1)}$=0.35, p=0.555), but in the older one, females reported higher expectancies all survey waves ($F_{(1)}$=11.38, p<0.001). Baseline AWC expectancies and smoking trajectories showed significant relationship ($H_{(4)}$=21.37; p<0.001), and pairwise comparisons resulted in higher expectancy among smokers compared to nonsmokers (p<0.001) and initiators (p=0.003).

Predictors of ever and current use of cigarette

Predictor effect of body-related variables for ever and current use of cigarette was analyzed in multiple binary logistic regression models with enter method, controlling for socio-demographic and interpersonal variables. In the younger cohort (n=283), the most important predictor of cigarette ever use at T3 was desire to lose weight at baseline (OR=3.09; 95%CI=1.29–7.41). Lower BMI at T1 also predicted future trying of cigarette, although the association was only tendentious (OR=0.90; 95%CI=0.81–1.01). Furthermore, smoking friends (OR=2.13; 95%CI=1.55–2.93) and worse academic achievement (OR=0.65; 95%CI=0.49–0.87) were considerable predictors as well. In the older cohort (n=477), only the desire to lose weight at baseline had weak predictor effect (OR=1.80; 95%CI=0.92–3.53) out of the body-related variables for cigarette experimentation at T3. Moreover, besides smoking friends (OR=1.36; 95%CI=1.19–1.55) and worse academic achievement (OR=0.67; 95%CI=0.55–0.82), restructured family structure (OR=4.44; 95%CI=1.49–13.22) was detected as a prominent risk factor of cigarette experimentation.

Body-related variables were minor predictors of current cigarette use in both cohorts. In the younger cohort, baseline body satisfaction reduced the likelihood of current smoking two years later (OR=0.67; 95%CI=0.42–1.07), while the presence of smoking friends at T1 predicted future current smoking (OR=1.46; 95%CI=1.15–1.87). Girls (OR=2.37; 95%CI=1.07–5.26) and students who had higher weekly allowance at baseline (OR=1.27; 95%CI=1.03–1.56) reported more likely current smoking at T3. In the older cohort, body-related variables have not predicted future smoking. In contrast, smoking best friends at baseline contributed significantly to current smoking at T3 (OR=1.29; 95%CI=1.15–1.45). Students who reported living in restructured family (OR=2.65; 95%CI=1.32–5.36) and parental smoking (OR=1.70; 95%CI=1.09–2.65) at baseline were more likely to smoke one year later. Better academic achievement at T1 was protective against current smoking at T3 (OR=0.83; 95%CI=0.70–0.98).

Characteristics of alternative tobacco product experimentation

Among students who have ever tried a cigarette, the prevalence of ever trying any ATP was 57% in the 6th grade and 92% in the 11th grade. Any ATP experimentation increased significantly during the three-year study period in both cohorts, by 19.5% in the younger cohort ($Q_{(2)}$=6.42; p=0.040) and by 10.4% in the older one ($Q_{(2)}$=34.94; p<0.001). Waterpipe

experimentation was the most popular in both cohorts at all survey waves, followed by flavored cigarettes, cigar/cigarillo, roll-your own cigarette and pipe.

Based on T3 survey data, multiple binary logistic regression analyses were used to assess the association between socio-demographic factors, social influences and ATP experimentation. Mainly older adolescents experimented with ATPs who tried cigarette smoking after 13 years of age, were ever daily smokers, current frequent smokers, and had better academic achievement.

Latent class analysis was performed to explore the patterns of ATP experimentation at T3 and as a result two classes were identified. The 1st class (n=312; 56.5%) was "selective experimenters" who tried mainly flavored products, especially waterpipe and flavored cigarette. The 2nd class (n=240; 43.5%) was "intense experimenters" who tried almost all ATPs with great likelihood except pipe. Intense experimenters were mostly males, frequent cigarette smokers at baseline, and had more at least weekly smoking best friends compared to selective experimenters.

CONCLUSIONS

1. *Adolescents should not be regarded as homogenous groups in tobacco prevention programs because major risk factors of specific smoking trajectories are different in both early and late adolescence.*

   Merging adolescents in different smoking stages for tobacco prevention programs is not recommended because undifferentiated messages and skills is likely to turn out ineffective. Content of interventions should be differentiated by age groups as well as smoking stages/trajectories. Before the critical age of experimentation and progression of smoking, general approach of tobacco prevention tailored to the specific age group is recommended. From the critical age, secondary prevention, that is, the prevention of smoking progression and cessation support should also be considered beyond the primary prevention. Using innovative methods, smart electronic devices and social websites for prevention is necessary to develop new and exciting interventions for the youth.

2. *Smoking best friends and worse academic achievement are stabile risk factors of adolescents smoking processes. Furthermore, higher amount of allowance may promote to try and experiment cigarette in early adolescence, while restructured family structure is a predominant predictor of experimentation and smoking initiation.*

It should be considered to include peer- and parental-component in tobacco prevention programs. Peer-component should target endorsing and strengthening nonsmoking norms, while parental-component should include improving parent-child relationship, parental monitoring, rule setting of smoking and supporting in parents' cessation if necessary. It is recommended to complete school-based prevention programs with family-based interventions which together could be highly effective to prevent cigarette experimentation and smoking initiation. Family-based interventions should emphasize the importance of controlling the amount of allowance especially in early adolescence, because it seems to be effective to prevent regular smoking.

3. *In early adolescence, youth with normal body shape but dissatisfied with their own body were more likely to try and initiate cigarette smoking, although appetite- and weight control expectancy of smoking did not play any role in these processes.*

Improving self-esteem and raising awareness of healthy body image by health professionals would be necessary especially among girls in early adolescence because they may have considerable body dissatisfaction and weight reduction intention. Additionally, prevention interventions should not ignore healthy weight management methods. Before adolescence, integrating healthy weight management – healthy eating and regular physical activity – in the everyday life of children has long-term protective effect even against smoking initiation and progression. Continuous support of healthy weight management would be necessary for students who intend to quit smoking or already quitted smoking, and emphasizing healthy body image as well as teaching them withdrawal symptoms and customized stress management strategies are also not negligible.

4. *Experimenting with ATPs is typical among students who have ever tried a cigarette. Beside intense, multiple ATP experimenters, a selective, especially flavored ATP experimenter group were also identified.*

Tobacco prevention programs should be extended to all tobacco products with a special focus on those that are the most popular among adolescents. Furthermore, beyond school-based interventions, mass media campaigns covering the whole population are also recommended to fight off the socially increasingly acceptable and trendy ATP use. Revision of tobacco control policy of ATPs should also be considered. Finally, regular monitoring of ATP use among adolescents is necessary in order to have actual information about the current changes.

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