

Original article

## Knowledge about tobacco and subsequent use of cigarettes and smokeless tobacco among Swedish adolescents

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### Abstract

**Purpose:** To investigate whether knowledge of the risks and properties of tobacco among adolescents influences their future use of cigarettes and smokeless tobacco in different directions.

**Methods:** A prospective cohort study of 2581 adolescents whose knowledge of tobacco was assessed in the sixth grade by means of a multi-item scale. Tobacco use was assessed by annual surveys up to the ninth grade.

**Results:** Knowledge level was not associated with future use. Items dealing with addictive properties of nicotine were prospectively associated with smokeless tobacco (“*snus*”) use only.

**Conclusions:** A high level of knowledge of the risks associated with tobacco is not a predictor of future nonuse or of a shift to smokeless tobacco rather than cigarettes. Attitudes and expectations may determine knowledge rather than vice versa. © 2005 Society for Adolescent Medicine. All rights reserved.

### Keywords:

Adolescence; Cigarette smoking; Smokeless tobacco; Knowledge score; Questionnaires

Both lay people and health professionals seem to instinctively believe that gaining knowledge is a successful way to change one's behavior. Hence, knowledge of the consequences of tobacco use is regarded as a possible mediator of decisions on future cigarette smoking among adolescents [1]. Indeed, knowledge of the health effects of tobacco may be expected to modify attitudes and expectations towards the substance, as well as to be part of a more general complex of distal determinants of tobacco use [2]. In cross-sectional studies of adolescents, differences in knowledge have also been found between users and nonusers of smokeless tobacco [3]. However, the association appears to be weak for both tobacco products [4]. There is a possibility that in affluent soci-

eties with a widespread antismoking policy, well-informed segments of the population will tend to shift towards the use of smokeless tobacco products, perceiving them to be relatively safe, rather than quitting or abstaining from tobacco altogether. Sweden is one such country, with declining smoking trends and widespread use of *snus* (moist oral snuff, the Swedish variety of smokeless tobacco) in the male population. The present study, based on a prospective cohort of adolescents, had three aims. First, we wanted to clarify whether the association between acquired knowledge about tobacco and its subsequent use differed among cigarette smokers and *snus* users. Second, we aimed to understand whether a possible association between knowledge and behavior is stable over time. A lack of association would indeed be expected in studies with a long follow-up if the effect of knowledge were short-lived in comparison with other influences. Finally, we wanted to explore whether adolescents' knowledge and behavior were modified by their access to specific information sources.

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## Methods

### Subjects

The BROMS cohort encompassed at baseline 3050 children recruited from the fifth grade in 1997. Detailed information on the cohort has been presented previously [5] and will be summarized only here. This study is based on 2581 adolescents (1285 boys and 1296 girls) who participated both in the sixth grade (mean [SD] age 12.6 [0.33] years) and in the ninth grade follow-up assessment.

### Data collection

The assessment of tobacco use was carried out annually from grades 6 through 9. Ever regular use and current use of cigarettes and *snus* were investigated separately, for each type of tobacco, by means of a self-administered questionnaire. The following questions were asked to cover regular use: “Have you ever smoked/used *snus* at least once per week for three months or longer?” Current use was assessed by the question “Do you smoke/use *snus* at present?,” with five response alternatives: not at all; occasionally, less than monthly; each month, but not weekly; each week, but not daily; daily. Information on the adolescents’ knowledge of tobacco-related issues was collected in the sixth grade survey. The students were asked to rate each of eight statements (Table 2) about the consequences of or policy on tobacco use with the following response alternatives: right; wrong; and don’t know. Sources of information about tobacco were investigated in the fifth grade by three questions (Table 4).

### Data analysis and statistical methods

We analyzed three outcomes related to tobacco use: ever regular use, current use, and discontinued use. The first two of these (ever regular and current use) were analyzed in relation to any tobacco product (yes/no) and in four mutually exclusive groups: no tobacco use; *snus* use only; cigarette smoking only; combined use of cigarettes and *snus*. Ever regular users were adolescents reporting weekly use during at least 3 months. Current users were adolescents reporting at least monthly use at the time. Discontinued use was defined as no current use among subjects who reported ever regular use of tobacco. Responses to the tobacco knowledge items were categorized as correct or incorrect (all other instances, including “don’t know” and item missing). The proportions of correct answers were first analyzed separately for each item. Correct answers were, thereafter, added to form three scores, one including all items (ranging between zero and eight), one including items related to cigarettes (ranging between zero and five), and one including items related to *snus* (ranging between zero and two). For the score including all items, two different scoring procedures were employed: one simple and one weighted summation. In the weighted summation a higher weight was

Table 1

Tobacco use (%) in the 9th grade by gender, The BROMS cohort

	Regular use		Current use	
	Boys n = 1014	Girls n = 970	Boys n = 1078	Girls n = 1139
No	65.7	70.0	73.7	76.5
Cigarettes only	7.4	23.1	6.6	21.4
<i>Snus</i> only	9.9	3.0	11.4	0.3
Cigarettes and <i>snus</i>	17.0	3.9	8.3	1.8

given to correct responses to items with a higher overall proportion of “don’t know” or missing responses. The full item score was analyzed both as a continuous score and according to the following categories: 0–1 (low), 2–3 (intermediate), and 4–8 (high). Similarly, we computed one score for cigarette-related items and one for *snus*-related items, which were analyzed according to three categories (low, intermediate, or high). Odds ratios (ORs) were calculated as a measure of association between adolescents’ tobacco use and knowledge about tobacco, with the intermediate knowledge group as a reference category. Likewise, ORs were calculated as a measure of association between adolescents’ knowledge about tobacco and access to specific information sources. In this analysis, the knowledge score (dependent variable) was categorized as a binary response, 0–3 (low and intermediate) and 4–8 (high). The ORs for all outcomes, except for mutually exclusive categories of tobacco use, were estimated by ordinary binary logistic regression. In the analysis of mutually exclusive categories of tobacco use, multinomial logistic regression was employed. The latter is an extension of the ordinary logistic regression and is especially suitable for outcomes on an ordinal scale [6]. The 95% confidence intervals (CIs) were calculated around ORs in order to estimate precision. Since the frequency of cigarette and *snus* use differed greatly between boys and girls (Table 1) we used gender as adjustment factor in the analysis. We also adjusted for prior use of tobacco (yes/no), since this factor is a likely predictor of subsequent knowledge and of tobacco use.

## Results

Information on ever regular use and current use of tobacco in the ninth grade is presented in Table 1. Roughly one third of the adolescents had used tobacco regularly and 1 out of 4 reported current use. The use of *snus*, both exclusive and combined with cigarette smoking, was more frequent among boys, while exclusive cigarette smoking was more frequent among girls. Table 2 presents the ORs and 95% CIs of current tobacco use for each correct answer given in single items. Only results adjusted for gender are presented, since the adjustment for prior tobacco use did not impact on the results. Two items were differentially associated with current use of cigarettes and *snus*, both dealing

Table 2

Odds ratios\* (ORs) and 95% confidence intervals (CIs) of current tobacco use for a correct answer to knowledge items in the 6th grade

Knowledge items	Any use		<i>Snus</i> only		Cigarettes only		Cig and <i>snus</i>	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Nicotine in cigarettes causes lung cancer (no vs. yes)	1.0	0.7–1.4	1.1	0.6–2.0	0.8	0.5–1.2	1.7	1.0–2.9
Nicotine dependence develops only after smoking several cigarettes per day for many years (no vs. yes)	0.8	0.6–1.0	0.5	0.3–0.9	0.8	0.6–1.0	1.1	0.7–1.7
Nicotine dependence does not occur if one only uses <i>snus</i> (no vs. yes)	1.2	1.0–1.4	1.6	1.1–2.3	1.0	0.8–1.3	1.7	1.1–2.6
Quitting smoking causes weight gain (yes vs. no)	1.2	1.0–1.5	1.2	0.8–1.7	1.1	0.9–1.5	1.2	0.8–1.8
Smoking decreases the risk of acne (no vs. yes)	0.9	0.8–1.1	0.8	0.5–1.2	1.1	0.8–1.4	0.8	0.5–1.1
Heart pulse is slower in smokers (no vs. yes)	0.8	0.5–1.1	0.9	0.5–1.7	0.8	0.5–1.3	0.7	0.3–1.5
It is not established that <i>snus</i> can cause cancer (yes vs. no)	1.1	0.9–1.3	1.4	0.9–2.0	0.9	0.7–1.2	1.1	0.7–1.6
In Sweden tobacco ads are allowed in weekly magazines (no vs. yes)	1.0	0.8–1.2	1.1	0.8–1.6	0.9	0.7–1.2	1.3	0.9–1.9

\* = Adjusted for gender.

with knowledge of the addictive properties of nicotine. Correct answers to these two items did not predict future cigarette smoking, whereas responding correctly to the item on the number of cigarettes needed to develop nicotine dependence was associated with a lower risk (OR = .5, CI = .3–.9) of *snus* use. On the other hand, a correct answer to the item on the addictive properties of *snus* was associated with a higher risk of *snus* use, either exclusive (OR = 1.6, CI = 1.1–2.3) or combined with cigarette smoking (OR = 1.7, CI = 1.1–2.6). The association between knowledge score and subsequent use of tobacco is presented in Table 3 for all items and separately for items exploring specific knowledge of cigarette smoking and *snus* use. The analysis of the score as a continuous variable did not yield significant associations. Again, no differences were found between simple and weighted scores; hence, only the simple scores are reported. In the full-score analysis, no associations emerged between score and tobacco use. In the separate analysis of either smoking- or *snus*-related items, there was again no association with smoking, while the lowest score (0) on *snus*-related items appeared to be inversely associated with *snus* use (Table 3). The analysis of ever regular

tobacco use and discontinued use yielded the same results as for current use (data not shown). Very similar results were obtained when knowledge level was regressed on behavioral outcomes in grades 7 and 8 (data not shown). It should be noted, however, that the estimates for grade seven were very imprecise because of the low number of users. The prospective association between access to information sources (measured in the fifth grade) and knowledge about tobacco (measured in the sixth grade) is presented in Table 4. For each source, subjects who reported not being informed were consistently less likely to have a high knowledge score than those who reported being informed. A dose-response association was also seen, with decreasing proportions of high-score subjects with a decreasing number of sources.

## Discussion

In this study, knowledge about tobacco among adolescents showed essentially no relationship with future tobacco use. Taken together, our findings in this large prospective study are in line with previous observational and interven-

Table 3

Tobacco knowledge scores in the 6th grade as predictor of adolescents' current use of tobacco: Odds ratios\* (ORs) and 95% confidence intervals (CIs)

No of correctly answered items	Any use		<i>Snus</i> only		Cigarettes only		Cig and <i>snus</i>	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
All items (n = 8)								
0–1	1.0	0.8–1.3	0.8	0.5–1.3	1.2	0.9–1.7	0.8	0.5–1.3
2–3	Ref.		Ref.		Ref.		Ref.	
4–8	1.1	0.9–1.4	1.1	0.7–1.8	1.2	0.9–1.6	1.1	0.7–1.7
Cig items (n = 5)								
0	1.1	0.9–1.4	1.4	1.0–2.2	1.1	0.8–1.4	1.1	0.7–1.7
1–2	Ref.		Ref.		Ref.		Ref.	
3–5	0.9	0.7–1.2	0.9	0.5–1.8	0.8	0.5–1.2	1.4	0.8–2.5
<i>Snus</i> item (n = 2)								
0	0.9	0.7–1.1	0.5	0.3–0.9	1.1	0.8–1.4	0.7	0.4–1.0
1	Ref.		Ref.		Ref.		Ref.	
2	1.1	0.8–1.4	1.1	0.7–1.8	1.1	0.8–1.5	1.1	0.7–1.8

\* = Adjusted for gender.

Table 4

Sources of information/education in the 5th grade as predictors of adolescents' high knowledge score (4–8) in the 6th grade: Odds Ratios\* (ORs) and 95% confidence intervals (CIs)

Question	N	OR	95% CI
Has anyone (parent, teacher, school nurse, other person) ever explained to you why smoking is dangerous for health?			
Yes	2,406	Ref.	
No	123	0.4	0.2–0.7
Have you ever read any publication about the effects of tobacco use on health?			
Yes	1,416	Ref.	
No	1,100	0.7	0.6–0.8
Have you ever watched any television programs on the risks of tobacco for health?			
Yes	1,572	Ref.	
No	938	0.8	0.6–0.9
Number of sources of information/education on tobacco			
Three	1,011	Ref.	
Two	871	0.9	0.7–1.1
One	560	0.6	0.4–0.7
None	51	0.2	0.1–0.6

\* = Unadjusted.

tion studies [7]. There are several possible reasons for the lack of association between acquired knowledge and subsequent behavior. According to the stage-of-change model, knowledge is only effective in promoting behavioral changes when individuals are not aware of negative consequences of the behavior itself [8]. Concerning the health consequences of tobacco, exposure to this early stage may come at a very young age. In most western countries, nearly all individuals, even at a very young age, are aware that smoking is harmful. In this cohort, for instance, 95% of the children reported having been informed about the health hazards of smoking as early as at the age of 11. In other words, knowledge is likely to be a necessary, but not a sufficient, component of later behavioral change [9]. Furthermore, the appraisal of health risks from tobacco use might not be a necessary consequence of the knowledge about specific properties of tobacco products, which formed the core of most of the question items in this study. Perhaps most importantly, research on substance use also indicates that whether or not knowledge orients future behavior depends on whether the acquisition of knowledge happens in a general or personalized way [10]. Personalized knowledge focuses on personal risk, whereas general knowledge has its focus on average detrimental effects among people in general. It has been claimed that the behavior of young people may also be more sensitive to esthetic than to health considerations [11], in part because esthetic effects occur earlier than health effects [12]. In this study, however, only knowledge of the addictive properties of tobacco products was apparently associated with future tobacco use. Items related to possible esthetic consequences (acne, weight gain) did not predict tobacco use, even among girls [13]. The hypothesis that a high level of knowledge about tobacco would

predict less cigarette smoking but more *snus* use was not confirmed. In fact, we were surprised to observe that adolescents with the lowest level of initial knowledge were less likely to take up *snus*. Chance is a likely explanation for this finding. However, one plausible interpretation may be that curiosity and initial experiences precede knowledge rather than the reverse [12,14]. Therefore, adolescents who are susceptible to tobacco use and early triers may be or may become more interested in the product's properties and its health consequences than their non-using peers, thus being more receptive to information [15]. Furthermore, smokers and users of *snus* are exposed to health warning labels on cigarette and *snus* packages, while nonusers are not. We also found that the knowledge level measured did not predict discontinuation of use of tobacco among regular users between 12 and 15 years of age. We are not aware of previous studies exploring this outcome in such a young population. There was also no indication that the lack of association between knowledge and future behavior might depend on the time elapsing between the assessment of the predictor and outcome. In fact, knowledge score did not predict tobacco use at any wave of follow-up. However, it should be noted that the shortest follow-up interval in this study was 1 year, and this might still represent too long an interval for detecting short-lived influences. In contrast to the negative findings concerning the relationship between knowledge and behavior, there was a positive effect of media and school on the level of knowledge of adolescents. In fact, in this cohort there was a clear association between adolescents' acquired knowledge and earlier exposure to anti-tobacco information. The most obvious concern of the present study is whether we reliably measured the students' knowledge about tobacco through the proposed items, while other available questions might be more appropriate [16]. However, considering the young age of the cohort when this assessment was carried out and the high correlation between access to information sources and knowledge level, we believe that the latter was reasonably well described. Other advantages of this study are its large size, the longitudinal design, and the detailed assessment of tobacco use. Despite the weak, if any, relationship between cognitive and behavioral modification, we believe that it would be premature to conclude that youth information programs should be abandoned. First, even if knowledge modification is a minor determinant of adolescent behavior, the possibility that it may impact on decisions taken in adult life cannot be ruled out. Second, more evidence should be gathered on the effectiveness of programs conveying information relevant to young subjects, i.e., information likely to be useful in self-appraisal of risks for health.

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