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Smoking and snus use onset: Exploring the influence of snus debut age for the risk of smoking uptake **with cross-sectional survey data**

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ABSTRACT

Introduction: Snus use has become increasingly prevalent among young people in Norway, while smoking has declined. Little is known about the transitions between snus and other tobacco products, particularly for younger users. A major concern involves the association between snus initiation and future smoking uptake.

Methods: 409 lifetime snus users who had started with snus before cigarettes or were never-smokers were selected from a national sample of participants in annually repeated cross-sectional surveys (2005-11) of Norwegian men and women aged 15-74. 30% of them were lifetime smokers, 84% were men, and the mean age was 29.4 years. Logistic regression was applied to investigate the association between age of snus uptake and the risk of becoming a smoker later on.

Results: Respondents who started using snus before the age of 16 had an OR of 3.1 (1.98-4.76) over those who initiated snus later on of being lifetime smokers. The prevalence of current smoking among early snus initiators (22.9%) was comparable to that found among never-snus-users (29.6%). **Among late snus initiators, current smoking prevalence was 5.9%.**

Conclusion: In this study, snus debut age was an important factor for the association between snus use and smoking.

Keywords: snus, smokeless tobacco, debut age, smoking

INTRODUCTION

Since the early 1990s the use of Swedish moist snuff (snus) has become more prevalent among Norwegian men, while female snus use started to increase after 2005 (Lund & McNeill, 2013). Simultaneously the smoking prevalence has gone down, particularly since the turn of the century (Wiiium & Aarø, 2011). Likely contributing factors to this development are strict regulations on where and when smoking is permitted, increasingly negative public opinions on smoking, and a positive change in public opinions on snus (Moshuus, 2010; Wiiium, Aarø, & Hetland, 2009). Smokers have come to be seen in a gradually more disapproving and judgmental light (Sæbø, 2012), with connotations of poor health and low socio-economic status (Farrimond & Joffe, 2006). Meanwhile, snus use has remained much less associated with social and psychological problems (Lund, 2006).

Due to the use of snus as a smoking cessation aid, the majority of older snus users are former smokers (Lund, Scheffels, & McNeill, 2011). However, this is not the case for younger users, who often have no previous experience with tobacco (Lund et al., 2011). Still, it is among the young that snus has become most popular, and **in Norway** we are presently in a situation where snus use is more common than smoking among 16-24 year-old men (36 vs. 20%), and as common as smoking among 16-24 year-old women (22 vs. 19%) and 25-34 year-old men (31 vs. 30%) (Lindbak & Helleve, 2013).

The rapid increases in adolescent snus use have raised several concerns regarding the future tobacco career and health situation for young snus users. Important in the current context is that relatively little is known about the transitions between snus and other tobacco products, particularly for younger users. An essential issue yet to be fully resolved involves the risk for young snus users future uptake of smoking. Research have focused on the probabilities of snus being a gateway into smoking, or rather a protection against smoking uptake, with divided results. The current status seems to be that snus acts as a deterrent against smoking (Fagerström & Schildt, 2003; Foulds, Ramstrom, Burke, & Fagerström, 2003; Furberg et al., 2005; Ramström & Foulds, 2006; Rodu & Cole,

2010), although the gateway theory has also found some support (Severson, Forrester, & Biglan, 2007; Tomar, 2003).

Should the gateway-effect turn out to be more important than the protective effect, the observed increase in snus prevalence levels among adolescents is likely to result in a net public health loss, in spite the substantially lower risk related to the use of snus compared to cigarettes (Royal College of Physicians, 2007; SCENIHR, 2008). Furthermore, if the new snus users are individuals who would otherwise have remained tobacco free, public health will be negatively affected (Mejia, Ling, & Glantz, 2010; Tomar, 2003). In case of a deterrent effect however, a net public health benefit might ensue contingent, among other things, on a faster reduction in smoking prevalence levels than would otherwise have been achieved (Lund, 2009).

An important question not touched much upon by research is the possibility of an effect of snus debut age on the risk for subsequent smoking uptake. It has been suggested in the literature that early snus initiation might be a marker for a tendency for risk taking behaviour in general (Foulds et al., 2003). Within other risk behaviours, early initiation has repeatedly been shown to be associated with behaviour patterns later in life. Early smoking initiation has been related to subsequent daily smoking, heaviness of smoking (Everett et al., 1999), and nicotine dependence (Breslau, Fenn, & Peterson, 1993). Similar associations have been found for other substances, and even in other forms of risk behaviour (Wu, Witkiewitz, McMahon, & Dodge, 2010). Empirical research has for example consistently associated early onset of alcohol use with increased risk of alcohol problems (DeWit, Adlaf, Offord, & Ogborne, 2000; Pitkänen, Lyyra, & Pulkkinen, 2005), while early onset of drug use has been associated with an elevated risk of drug dependence later in life (King & Chassin, 2007). Furthermore, the association between initiation age and later use behavior is not necessarily substance specific. Early drinkers have been shown to be more likely to engage in other kinds of substance use (Kandel, 1982), and to be at risk for developing drug dependence by young adulthood (Robins & Przybeck, 1985), while adolescents who start to use drugs at an early age

have an elevated risk of both alcohol dependence and drug dependence later on (Lynskey et al., 2003; Robins & Przybeck, 1985).

Assuming that snus use behaviour follows similar trajectories, one might expect an association between the age of snus uptake and later tobacco use behaviour, and an interesting aspect of this concerns how early initiation might influence the probability of a gateway-effect between snus and cigarettes. The aim of the current study is thus to explore the association between the age of snus uptake and the risk of becoming a smoker later.

METHOD

From annual national representative cross-sectional survey data, collected in the period 2005-2011, and including a total of 8313 respondents evenly distributed over the years, all lifetime snus users who had started with snus before cigarettes or who were never-smokers, were selected. The total survey is thoroughly described elsewhere (Lund & Scheffels, 2013). The final sample consisted of 409 individuals, evenly distributed over the sampling years, 84 per cent of them were men, 30 per cent were lifetime smokers. **All lifetime smokers were defined as dual users, regardless of whether the snus use and smoking took place concurrently or not.** The respondents were between 15 and 74 years-of-age, although 61 per cent of them were 30 years or younger, and only 5 per cent were 50 years or older at the time of the surveys. The mean age was 29.4 years (median 27).

Snus use status was measured by two separate questions in the survey: 'Are you using snus' and 'have you used snus earlier'. Additionally, respondents were asked to specify their age of snus initiation, and dual users were asked to also specify their cigarette initiation age and to report whether snus or cigarettes was the first tobacco product they used. All dual users included in the sample responded that they started with snus before cigarettes. Furthermore, those who indicated

the opposite (smoking first) when asked specifically about initiation ages, were excluded from the analyses.

The mean age for snus initiation was 17.7 years, while the median was 16 years (Table 1). Initiation age was dichotomized such that those who had experimented with snus before the age of 16 were defined as early starters (1), while those who waited till they were 16 or older were defined as not early (0). The background for choosing the median as the cut-off-value was both technical and substantial: it ensured a reasonable number of individuals in each group, at the same time as it made it possible to single out a group who started at an earlier age than the average snus user. An important factor that was taken into consideration was also the age at which smoking uptake often occur. In Norway the mean age for uptake of daily smoking was 17.8 and 18.3 years for men and women respectively in 2010-12 (Lindbak & Helleve, 2013), while in the current sample, the mean age for the uptake of any smoking was 16.2 years (Table 1). Nobody in our sample took up smoking after the age of 22 (Table 1). Regardless of snus use, one can assume that the risk of smoking uptake starts to decline in the final years of adolescence and the early 20s, and as this study only included individuals who were never-smokers when they took up snus, it was necessary to use a cut-off below the mean age of smoking initiation to reduce the risk of skewed results.

The respondents' lifetime smoking status was calculated by adding together information about current and historic smoking habits (daily, non-daily, former or never smoker), and dichotomizing into lifetime smoker (1) vs. lifetime non-smoker (0).

In addition, gender and age at the time of the survey was included as control variables. The justification for including gender was based on the idea that early snus initiation might mark a tendency for risk taking behaviours. Traditionally, snus was much less used by females than males, and early snus initiation might therefore signal a more obvious break with normality, and thus a stronger tendency for risk taking behaviours, for girls. Age at survey time was included as a response to the increasing prevalence of snus and decreasing prevalence of smoking in recent years, as this

might imply a different association between early snus initiation and smoking in older age groups, who took up snus at a time when snus use was less common than smoking.

Statistical analysis

Logistic regression was applied to estimate adjusted and unadjusted odds ratios (ORs) for smoking uptake among early snus initiators. Gender and age was used as controls.

A non-trivial difference between snus initiation and smoking initiation was that while there was no-one in the sample who had taken up smoking after the age of 22, snus initiation could occur at much higher ages, the highest debut age in this sample was 50 (Table 1). To reduce the risk of biased results due to this characteristic of the data, regressions were performed on three different (sub) sets of the sample. In addition to all lifetime snus users, i.e. the entire sample, separate logistic regressions, using the same dependent and independent variables were performed on only those lifetime snus users who were 30 years or younger at the time of the surveys, and on only those who started to experiment with snus before the age of 20.

RESULTS

In the entire group of lifetime snus users, those who initiated snus before the age of 16 had an unadjusted OR of 3.1 ($p < 0.001$) over those who initiated snus later on of being lifetime smokers (Table 2). Some of this effect might be due to the existence of very late snus starters, as snus initiation occurred up to the age of 50. However, reducing this bias by including in the analysis only those who started to experiment with snus at the age of 20 or earlier, or only those who were 30 years or younger at the time of the survey, did not obliterate the association between early snus initiation and subsequent smoking uptake. In both these sub-sets of snus users, those who started with snus before the age of 16 had an OR of being lifetime smokers of 2.3 ($p < 0.001/p < 0.01$), over those who initiated snus use after the age of 16.

Controlling for gender and age only led to small changes in these results. Gender was not significantly associated with lifetime smoking, and the respondents' age at the time of the survey was only significantly associated with lifetime smoking in the regression on all snus users (AOR= 0.97, $p<0.05$), and not in the regressions on snus users 30 years or younger, or snus users who initiated snus at age 20 or younger. The adjusted odds ratios for being a lifetime smoker was 2.8 ($p<0.001$) for early initiators in the total sample, and 2.2 ($p<0.01$) for early initiators in samples limited to those who started using snus before or at the age of 20, or who were 30 or younger at the time of the survey.

Contrasting the proportions of current smokers among early and late snus initiators with other available information (Table 3) shows that the prevalence of smoking among early snus initiators is comparable to the prevalence found among never-snus-users in the same survey data from which the snus users were drawn (no significant difference), as well as the prevalence found in the official national statistic. While 5.9 per cent of the late snus initiators were current smokers, this applied to 22.9 per cent of the early initiators, a difference that was statistically significant (Chi square, $p< 0.001$).

DISCUSSION

Whether snus use functions as a deterrent from, or a gateway to, smoking has been a matter of much debate in the tobacco control community in later years and research supporting both possibilities have been published (Furberg et al., 2005; Ramström & Foulds, 2006; Rodu & Cole, 2010, Tomar, 2003; Severson, Forrester, & Biglan, 2007). The results from this study indicate that if there is a protective effect of snus, there might be a critical age at which it kicks in. Those who started to experiment with snus before the age of 16 were significantly more likely to become smokers than those who started with snus later on, and comparisons with additional material indicated that the smoking prevalence in the early initiator-group was at the same level as among non snus users. Among those who initiate snus at the age of 16 or later the smoking prevalence was low in

comparison to all other groups. These results did not change after limiting the sample to include only those who started with snus before the age of 20, or to respondents who were 30 years or younger at the time of the survey.

This study has some limitations. First, the analyses were based on a series of cross-sectional surveys, with debut ages asked about retrospectively and therefore subject to the risk of erroneous recall. While it is not possible to eliminate the increased uncertainty from such errors, the dichotomization of snus debut age would have worked to reduce the consequences on the results. Second, with Nagelkerke R squares ranging from 0.06 to 0.1 in the models with controls (Table 2), it is clear that other factors, not controlled for in the current analyses, also have influenced the choice between smoking and non-smoking for the participants in these surveys. A possibility discussed in the literature is that early snus initiation could be a marker for a tendency for risk taking behaviour in general (Foulds et al., 2003), and that this is the main factor behind both early snus use and later cigarette smoking in this group (Foulds et al., 2003; Galanti, Wickholm, & Gilljam, 2001). This interpretation was also suggested by Galanti, Rosendahl, & Wickholm (2008) who found that simultaneous uptake of both snus and cigarettes increased the risk for later smoking more than taking up any of the two products alone. Associations between early onset and other risk taking behaviour has also been observed in relation to alcohol, where the effects of early onset of alcohol on later alcohol outcomes such as dependence were greatly diminished when other risk factors were controlled for (Warner & White, 2003).

The question of whether it is the early onset of use of snus that leads to later smoking or whether early initiation could be a marker of underlying vulnerability in itself is highly relevant, and more research on how patterns of snus and cigarette use correspond with those found for other substances is needed in order to illuminate the question of how the availability of snus will impact public health in the years to come.

As shown by earlier research, development of identity is important when adolescents take up a tobacco habit, regardless of whether it is snus (Edvardsson, Troein, Ejlertsson, & Lendahls, 2012) or

cigarettes (Scheffels, 2009). Among adult smokers it has been shown that a strong smoking identity might prevent substituting snus for cigarettes (Bahreinifar, Sheon, & Ling, 2013), and one could speculate that individuals find it difficult to combine snus use with smoking, given the distinctly different social representations of snus and cigarette users that have been found in studies among young people in Norway (Wium, Aaro & Hetland, 2009). It is possible that the relatively low prevalence of smoking among adolescents who took up snus use at the age of 16 or later results partly from a protective effect from developing a snus user identity. This would however require that resilient snus user identities form more rapidly for this group than is the case for younger people, a question that is also yet to be researched.

Conclusions

In this study, snus debut age was an important factor for the association between snus use and smoking. For the group who started with snus before the age of 16, snus use did not protect against lifetime smoking. This finding highlights the importance of tobacco control interventions that include efforts to keep adolescents tobacco free for as long as possible.

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Declaration of interests

No competing interests declared.

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Table 1: Tobacco initiation in the sample of lifetime snus users

	Mean	Median	Minimum	Maximum	N
Age of snus initiation	17.7	16	10	50	409
Age of smoking initiation	16.2	16	12	22	65 ^a
Years from snus initiation to smoking initiation	1.4	1	0	6	65

^a High item non-response for this question.

Table 2: Unadjusted and adjusted ORs for being a lifetime smoker if snus initiation occurred early in three different sub sets of lifetime snus users who did not initiate smoking before snus¹.

	Initiated snus at age 20 or earlier (N=346)		Snus users 30 years or younger at survey time (N=250)		All snus users (N=409)	
	OR ²	95% C.I. for OR	OR	95% C.I. for OR	OR	95% C.I. for OR
Early snus initiation ⁴	2.29***	1.45-3.60	2.30**	1.35-3.94	3.06***	1.98-4.76
	AOR ³	95% C.I. for AOR	AOR	95% C.I. for AOR	AOR	95% C.I. for AOR
Early snus initiation ⁴	2.24**	1.42-3.53	2.18**	1.26-3.75	2.75***	1.76-4.31
Female	0.95	0.48-1.85	0.84	0.42-1.66	0.78	0.41-1.48
Age at survey	0.98	0.96-1.01	0.97	0.91-1.03	0.97*	0.95-0.99
Unadjusted versions:	-2 Log likelihood = 431,033 Nagelkerke R Square = 0.051		-2 Log likelihood = 309,699 Nagelkerke R Square = 0.052		-2 Log likelihood = 471,329 Nagelkerke R Square = 0.086	
Adjusted versions:	-2 Log likelihood = 428,777 Nagelkerke R Square = 0.060		-2 Log likelihood = 308,477 Nagelkerke R Square = 0.058		-2 Log likelihood = 464,430 Nagelkerke R Square = 0.11	

¹ Results from binary logistic regressions with lifetime smoking as dependent variable ² Odds ratios ³ Adjusted odds ratios ⁴ Initiated snus before the age of 16

***: p<0.001. **: p<0.01

Table 3: The proportion of current smokers (daily and non-daily) among early and late snus initiators, never-snus users from the 2005-11 original survey sample, and according to official statistics.

	Proportion of current smokers (%)	N
Early snus initiators ¹ , 2005-11	22.9	153
Late snus initiators ² , 2005-11	5.9	255
Never-snus-users in original surveys, 2005-11	26.6	7442
Norway 2008-12, 16-74 years ³	29.0	

¹ started before age 16 ² started at 16 or later ³Source: Lindbak & Helleve, 2013