

Evolving patterns of tobacco use in northern Sweden

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Abstract. Rodu B, Stegmayr B, Nasic S, Cole P, Asplund K (University of Alabama at Birmingham, Birmingham, AL, USA; Umeå Hospital, Umeå, Sweden). Evolving patterns of tobacco use in northern Sweden. *J Intern Med* 2003; **253**: 660–665.

Background and objectives. Cross-sectional data from northern Sweden suggest that the increased use of Swedish moist snuff (snus) may have contributed to a decline in the prevalence of smoking, especially amongst men. This study describes the evolving patterns of tobacco use in this population over the period 1986–1999.

Design. This is a prospective follow-up study of 1651 men and 1756 women, aged 25–64 years, who were enrolled in the northern Sweden MONICA project (entry in 1986, 1990, 1994) and who were followed-up in 1999. Information on tobacco use at entry and at follow-up was used to describe the stability of tobacco use over a period of 5–13 years ending in 1999.

Results. Snus was the most stable form of tobacco use amongst men (75%); only 2% of users switched to cigarettes and 20% quit tobacco altogether. Smoking was less stable (54%); 27% of smokers were tobacco-free and 12% used snus at follow-up. Combined use (smoking and snus) was the least stable (39%), as 43% switched to snus and 6% switched to cigarettes. Former users of both products were much less stable than former users of either cigarettes or snus. The stability of smoking amongst women was 69%, which was higher than that amongst men ($P < 0.05$).

Conclusions. The use of snus played a major role in the decline of smoking rates amongst men in northern Sweden. The evolution from smoking to snus use occurred in the absence of a specific public health policy encouraging such a transition and probably resulted from historical and societal influences.

Keywords: prevalence, smokeless tobacco, smoking, smoking cessation, snus.

Introduction

In 1999, Sweden attained a smoking prevalence under 20% and so became the first country to achieve the goal set by the World Health Organization [1]. This remarkable achievement has received little attention or investigation of its determinants, although a recent report attributed the decline in smoking amongst Swedish men to the large number who try to stop smoking every year [2].

The low smoking prevalence amongst Swedish men appears to be associated with the use of snus, a form of moist snuff placed in the oral cavity between the upper lip and gingiva. In a recent report based on cross-sectional data from the northern Sweden

component of the World Health Organization MONICA (Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases) study, we reported that, although overall tobacco use was stable amongst men from 1986 to 1999, the prevalence of smoking declined from 23 to 14% during that period, whilst snus use increased from 22 to 30% [3]. In all survey years, the prevalence of smoking in men was lower than that amongst women. In addition, quit-smoking rates were much higher in men than in women and were strongly associated with a history of snus use.

About 70% of subjects enrolled in the northern Sweden MONICA surveys of 1986, 1990 or 1994 were successfully followed-up in 1999, allowing us

to use repeated tobacco use data from individual subjects to describe the stability of tobacco use amongst this population over a 5–13-year period.

Methods

This study uses a data set of the northern Sweden component of the World Health Organization MONICA study. Sampling and selection details have been published elsewhere [3–5]. Briefly, information was collected during three separate population-based surveys in 1986, 1990 and 1994 (cohort 'entry' years). Potential subjects were randomly selected from population registers, stratified for age and gender, in the two most northern Swedish counties (Norrbotten and Västerbotten; target population 320 000 in 1999). Participants completed questionnaires focused on cardiovascular disease risk factors. Members of all entry cohorts were invited to participate in a follow-up survey in 1999. This study presents follow-up information for men and women, aged 25–64 years, at study entry.

Responses to tobacco-related questions were used to construct three mutually exclusive categories of snus users: past, current or never, and three comparable categories of smokers. We further classified subjects' tobacco use by cross-tabulating the three snus use categories with the three smoking categories. We classified as smokers those persons who smoked at least one cigarette daily. Ex-smokers were persons who reported quitting more than 1 month prior to completing their survey [7]. We categorized persons who used any amount of snus each day as users.

Subjects were grouped according to their tobacco use at entry in 1986, 1990 or 1994, and tobacco use status was reported again for the 1999 follow-up. As very few women used snus before 1999, results are presented only for ex-smokers, current and never smokers. For clarity, we consolidated the nine possible tobacco-use categories at follow-up into four: exclusive smokers, exclusive snus users, combined smokers/snus users and non-users of tobacco. Tobacco use patterns at follow-up are grouped by duration of follow-up, which was 13 years for subjects entering in 1986, 9 years for those entering in 1990, and 5 years for those in the 1994 cohort.

'Stability' was defined as the percentage of subjects in a particular tobacco use category at

entry who were in that category at follow-up. A special focus of the study is the stability of snus use and smoking, and transitions between these two forms of tobacco use. The chi-square statistic was used to evaluate the statistical significance of differences in stability between tobacco use groups.

This study was approved by Institutional Review Boards at Umeå University and at the University of Alabama at Birmingham.

Results

Of the 2296 eligible men, aged 25–64 years, in the entry cohorts, 1662 completed the follow-up survey in 1999. Amongst women, 1765 of 2328 in the entry cohorts completed the follow-up survey. The final study group consists of 1651 men (72%) and 1756 women (75%) for whom there was complete information on tobacco use.

We used multiple logistic regression to evaluate the effects of several demographic and behavioural variables on success or failure of follow-up. The percentage of subjects completing the follow-up survey was similar for persons who differed according to level of education, residence characteristics (population size or medical district), or cohort entry year. The completeness of follow-up varied somewhat according to age, civil status and tobacco use at entry. However, the combined effect of all three variables accounted for only 3–4% of unsuccessful follow-up. In general, follow-up was lower for men, for subjects in the youngest and oldest age groups (25–34 and 55–64 years) who were unmarried and smokers.

Follow-up tobacco use – men

Never users of tobacco at entry ($n = 603$) showed the highest overall stability at follow-up (98%), with little variation by cohort year. Table 1 shows the follow-up status for ex-users of tobacco products at entry. Ex-smokers had the highest stability (93%) followed by ex-users of snus (89%). Ex-users of both products had the lowest stability (79%), which was significantly lower than that of ex-smokers ($P < 0.01$), but not that of ex-users of snus ($P = 0.07$). Ex-users of both products who were using tobacco again at follow-up chose snus over cigarettes by a three to one margin. Ex-smokers had the highest mean age of all groups studied (51 years).

Entry year	Number	Mean age (years)	Follow-up tobacco use (%)			
			Smoking	Snus	Combined	No tobacco
Ex-smoker						
1986	90	51	2	0	0	98
1990	67	50	2	6	2	90
1994	75	53	8	3	0	89
All years	232	51	4	3	0	93
Ex-snus						
1986	13	39	8	0	0	92
1990	34	43	3	9	0	88
1994	26	44	4	8	0	88
All years	73	43	4	7	0	89
Ex-both						
1986	47	48	9	23	0	68
1990	44	47	2	14	0	84
1994	32	48	3	9	0	88
All years	123	47	5	16	0	79
All ex-users	428	49	4	7	0	89

Table 1 Tobacco use at follow-up for men who were ex-users of tobacco at entry

Entry year	Number	Mean age (years)	Follow-up tobacco use (%)			
			Smoking	Snus	Combined	No tobacco
Ex-smoker						
1986	51	41	6	64	2	28
1990	44	43	5	52	11	32
1994	64	48	2	86	3	9
All years	159	45	4	70	5	21
Never smoker						
1986	51	40	0	67	2	31
1990	58	41	0	81	2	17
1994	44	40	0	93	0	7
All years	153	40	0	80	1	19
All snus user	312	43	2	75	3	20

Table 2 Tobacco use at follow-up for men who were snus users (ex-smoker or never smoker) at entry

Table 2 shows tobacco use at follow-up for snus users (either ex- or never smokers) at entry. Snus users who had never smoked had higher stability than those who had a smoking history (80% vs. 70%, $P = 0.04$). In general, stability declined as length of follow-up increased. Amongst snus users who were never-smokers at entry there were no smokers at follow-up. Amongst snus users at entry who were also ex-smokers, only 4% had returned to smoking at follow-up. Snus users who were never smokers had the lowest mean age in this study (40 years). The average age of snus users who were ex-smokers was 41 years in 1986, but was 48 years in 1994.

Table 3 shows tobacco use at follow-up for smokers (ex-snus users and those never using snus)

at entry. Overall stability was 54%, which was significantly lower than that of snus users (75%, $P < 0.01$). Smokers who had never used snus had higher stability than those who had a snus history (57% vs. 37%, $P = 0.01$). Again, stability generally declined with increasing duration of follow-up. Amongst smokers at entry who had never used snus, the majority (86%) were either smoking or using no tobacco at follow-up, and the latter became more frequent as the duration of follow-up increased. Smokers who had never used snus were more likely to have become nonusers of tobacco at follow-up than smokers who were ex-snus users (29% vs. 20%), although not significantly so ($P = 0.21$), but they were significantly more likely to be smoking (57% vs. 37%, $P = 0.01$). The

Table 3 Tobacco use at follow-up for men who were smokers (ex or never use of snus) at entry

Entry year	Number	Mean age (years)	Follow-up tobacco use (%)			
			Smoking	Snus	Combined	No tobacco
Ex-snus						
1986	20	42	40	20	15	25
1990	18	39	28	44	11	17
1994	8	45	49	25	13	13
All years	46	41	37	30	13	20
Never snus						
1986	72	46	47	10	4	39
1990	64	46	58	8	9	25
1994	59	49	72	5	3	20
All years	195	47	57	8	6	29
All smokers	241	46	54	12	7	27

Table 4 Tobacco use at follow-up for men who were combined tobacco users at entry

Entry year	Number	Mean age (years)	Follow-up tobacco use (%)			
			Smoking	Snus	Combined	No tobacco
1986	23	44	9	60	22	9
1990	27	44	4	41	44	11
1994	17	46	6	24	52	18
All years	67	45	6	43	39	12

frequency of no tobacco use was higher amongst both groups with longer duration of follow-up. Amongst smokers who were ex-snus users, 30% returned to snus use, whilst 13% were combined users at follow-up. However, the numbers of subjects in these groups were small.

Table 4 shows follow-up tobacco use for combined users at entry. Overall stability was 39%, which was significantly lower than that of snus users or smokers (75 and 54%, respectively, $P < 0.05$). Furthermore, only 12% of combined users were using no tobacco at follow-up, which was lower than either snus users (20%, $P = 0.12$) or smokers (27%, $P = 0.01$), both groups with higher overall stability. Combined users moved much more often to snus (43%) than to smoking (6%), and the frequency of this transition was strongly related to duration of follow-up.

Follow-up tobacco use – women

As with men, overall stability amongst never users of tobacco was very high (99%), with essentially no variability by cohort year. Table 5 shows follow-up tobacco use for smokers and ex-smokers at entry. For smokers overall stability was significantly higher

amongst women than amongst men (69% vs. 54%, $P < 0.01$), but there was no difference between women and men in the percentage using no tobacco at follow-up (27% for each group). Only 3% of women smokers at entry were snus users at follow-up. Stability amongst ex-smokers was 91%, whilst 8% had started smoking again during the follow-up period.

Discussion

The major finding of this study is that men in northern Sweden, who had amongst the world's lowest smoking prevalence rates in a recent cross-sectional study [3], continued to quit smoking throughout the 1990s. At entry the smoking prevalence in these three cohorts combined was 15%; in 1999 the smoking prevalence was 10%. Over one-quarter of smokers quit all tobacco during the follow-up period, but 12% switched to snus. Smoking rates at follow-up amongst men with a snus history were 7–30% lower than amongst men without a snus history, although the former group were not as likely to be tobacco-free.

The impact of snus use on smoking is more fully appreciated when comparing the stability of

Entry year	Number	Mean age (years)	Follow-up tobacco use (%)			
			Smoking	Snus	Combined	No tobacco
Smokers						
1986	153	41	59	3	1	37
1990	125	43	69	2	1	28
1994	145	46	78	4	1	17
All years	423	43	69	3	1	27
Ex-smokers						
1986	95	46	6	0	0	94
1990	96	46	7	2	0	91
1994	140	46	9	1	0	90
All years	331	46	8	1	0	91

Table 5 Tobacco use at follow-up for women who were smokers or ex-smokers at entry

smoking amongst men (never users of snus) (Table 3) and women (Table 5). Stability of smoking was 6% points higher amongst women than amongst men in the 1994 cohort (78% vs. 72%), and 11–12% higher in the other two cohorts (69% vs. 58% in 1990 and 59% vs. 47% in 1986). For all cohorts combined, this difference was statistically significant. At follow-up, men were using snus more frequently, and they were combined users more commonly as well. A longitudinal study with 1 year of follow-up from Malmö in southern Sweden also showed that snus use played a role in the higher smoking cessation rate amongst men [6].

Combined users of snus and cigarettes were the least stable group in this study, and they also were the least likely to be tobacco-free at follow-up (12%). However, 43% of combined users were using snus at follow-up; only 6% were smoking. A recent study of American male combined users also showed that this group is more unstable than either smokers or smokeless tobacco users, but much less likely to quit using tobacco altogether [7]. Ex-users of both snus and cigarettes showed lower stability than either ex-smokers or ex-users of snus, especially after 13 years of follow-up. However, these regressed tobacco users were more likely to have taken up snus than cigarettes, by a margin of 3–1.

The use of snus was relatively stable, although as many as 30% of users became tobacco-free with longer duration of follow-up. Importantly, very few snus users, even those with a smoking history, became smokers. In our previous study we documented a high prevalence of snus use amongst ex-smokers. These snus users were reasonably stable, with transition to no tobacco occurring far more frequently than a return to smoking.

The strengths of this study are the consistency of data collection at entry and at follow-up within the MONICA study, and the prospective, population-based design. This allows accurate description of tobacco-use transition patterns across the population whilst avoiding the bias resulting from recall of past tobacco use, common to retrospective studies. A population-based study such as this also avoids the bias resulting from studies of smokers presenting for health care or seeking smoking cessation services [8]. In fact, the Framingham Heart Study [8, 9] from the US is one of the few population-based studies reporting longitudinal data relating to changing patterns of tobacco use. However, that study is limited to smoking, and it covers a completely different time period (roughly 1950–1984), so comparisons with this study are not possible.

The limitations of this study are related largely to the limited follow-up of all subjects, and especially lower follow-up of smokers. The main concern is that smokers who were not followed-up might be different with regard to their stability from those smokers who were followed up. It is possible that smokers ages 55–64 years might have suffered smoking-related illnesses or deaths that precluded follow-up. Thus, our study might have been over-represented with smokers who had quit, resulting in an underestimation of the stability of this group.

Amongst men the increasing trend of snus use began in the mid-1960s. At that time cigarette smoking had become the dominant form of tobacco use throughout Sweden, and snus use was declining. However, increased awareness of the adverse health risks of smoking was accompanied by a

revival of snus use. The transition occurred in the absence of a specific public health policy, although several societal factors may have played a role. First, snus traditionally has cost about half as much as cigarettes, primarily because of the difference in excise taxes between the products [10]. This was not the result of any specific governmental intervention, but probably reflects the longstanding consideration of snus as 'fattigmans lyx', or the poor man's luxury. As a result, snus increasingly became established as an effective nicotine substitute that cost far less than cigarettes, making it an attractive alternative for smokers trying to quit. Another social factor contributing to the resurgence of snus use is its relatively high prevalence amongst players of hockey and soccer, the two most popular sports in Sweden.

In summary, this study shows the major role of snus use in lowering smoking rates amongst men in northern Sweden during the past decade. The availability of snus as an alternative source of nicotine that is far safer than cigarettes [11, 12] has permitted many men to avoid the adverse risks of long-term smoking without abstaining from tobacco altogether.

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Conflict of interest statement

No conflict of interest was declared.

References

- 1 Anonymous. Swedes break record for giving up smoking. *Bull WHO Org* 1999; **77**: 202.
- 2 Wersäll JP, Eklund G. The decline of smoking among Swedish men. *Int J Epidemiol* 1998; **27**: 20–6.
- 3 Rodu B, Stegmayr B, Nasic S, Asplund K. Impact of smokeless tobacco use on smoking in northern Sweden. *J Int Med* 2002; **252**: 398–404.
- 4 Asplund K, Huhtasaari F, Lundberg V, Stegmayr B, Wester PO. Trends in cardiovascular risk factors in the northern Sweden MONICA study: who are the winners? *Cardiovasc Risk Factors* 1993; **3**: 215.
- 5 Persson M, Carlberg B, Mjörndal T, Asplund K, Bohlin J, Lindholm L. 1999 WHO/ISH guidelines applied to a 1999 MONICA sample from northern Sweden. *J Hypertens* 2002; **20**: 29–35.
- 6 Lindström M, Isacson S. Smoking cessation among daily smokers, aged 45–69 years: a longitudinal study in Malmö, Sweden. *Addiction* 2002; **97**: 205–15.
- 7 Wetter DW, McClure JB, de Moor C *et al.* Concomitant use of cigarettes and smokeless tobacco: prevalence, correlates, and predictors of tobacco cessation. *Prev Med* 2002; **34**: 638–48.
- 8 Freund KM, D'Agostino RB, Belanger AJ, Kannel WB, Stokes JS III. Predictors of smoking cessation: the Framingham study. *Am J Epidemiol* 1992; **135**: 957–64.
- 9 Sorlie PD, Kannel WB. A description of cigarette smoking cessation and resumption in the Framingham study. *Prev Med* 1990; **19**: 335–45.
- 10 Anonymous. Unpublished data, Swedish Match. Stockholm, Sweden, 2002.
- 11 Asplund K. Snuff – how dangerous is it? The controversy continues. *J Int Med* 2001; **250**: 457–61.
- 12 Rodu B, Cole P. Tobacco-related mortality. *Nature* 1994; **370**: 184.

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