

Impact of smokeless tobacco use on smoking in northern Sweden

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Background and objectives. For many years Swedish men have had the world's lowest rates of smoking and smoking-related mortality. Despite these facts, a thorough analysis of tobacco use patterns in Sweden has not been performed. The purpose of this study was to examine the prevalence and interaction of cigarette smoking and use of Swedish moist snuff (snus) in the population of northern Sweden.

Design. The study cohort of 2998 men and 3092 women aged 25–64 was derived from the northern Sweden MONICA study, consisting of population-based surveys in 1986, 1990, 1994 and 1999. Detailed information on tobacco use was used to develop prevalence data, and the prevalence ratio

was used to compare rates amongst various subgroups.

Results. Amongst men ever-tobacco use was stable in all survey years at about 65%, but the prevalence of smoking declined from 23% in 1986 to 14% in 1999, whilst snus use increased from 22% to 30%. In women the prevalence of smoking was more stable in the first three surveys (~27%) but was 22% in 1999, when snus use was 6%. In all years men showed higher prevalence of ex-smoking than women. A dominant factor was a history of snus (PR = 6.18, CI = 4.96–7.70), which was more prevalent at younger ages.

Conclusions. The recent transition from smoking to snus use amongst men, and incipiently amongst women, in northern Sweden is remarkable and relevant to the global discussion on strategies to reduce smoking.

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

Introduction

For the past 100 years cigarette smoking has been the dominant form of tobacco consumption in almost all developed countries. One notable exception is Sweden, where smoking rates amongst men have been considerably lower than those of comparable countries for decades. As a result, Swedish men had the lowest rates of smoking-related cancers of the lung, larynx, mouth and bladder in Europe over the 35-year period from 1955 to 1989 [1]. A 1992 study revealed that Swedish men have the lowest percentage of deaths related to smoking of all developed countries [2]. In contrast, smoking prevalence amongst women in Sweden is closer to that

of other European countries, and this is reflected in comparable data for smoking-related illnesses.

Whilst the prevalence of smoking amongst Swedish men has been historically low, the prevalence of oral smokeless tobacco use has been high. During the past century, Sweden had amongst the world's highest per-capita consumption of smokeless tobacco [3], predominantly in the form of snus, finely cut nonfermented moist snuff which is placed inside the upper lip.

Although there is general information about smoking and snus use in Sweden, a thorough investigation of tobacco use patterns within a specific population segment has not been performed previously. The purpose of this study was to document

tobacco use patterns in the two northern-most counties of Sweden, the population of which has a high prevalence of snus use [4].

Methods

This study used a dataset developed for the Northern Sweden component of the World Health Organization Multinational Monitoring of Trends and Determinants in Cardiovascular Diseases (MONICA) study. Details of sampling and selection have been published elsewhere [5, 6]. Briefly, the dataset contains information collected from four separate population-based surveys conducted in 1986, 1990, 1994, and 1999. Subjects were randomly selected from population registers, stratified for age (25–64 years in the first two surveys, 25–74 in the latter) and gender, in the two most northern Swedish counties (Norrbotten and Västerbotten; target population 320 000 in 1999). Survey participants completed questionnaires that were focused on cardiovascular disease risk factors.

In addition to questions regarding cigarette smoking on the standard MONICA questionnaire, the Northern Swedish version included detailed questions regarding current and historical snus use. We used the responses from tobacco-related questions to construct three mutually exclusive categories of snus use: past, current, or never use; and three comparable categories of smoking. We further classified subjects' tobacco use by cross-tabulating the three snus use categories with the three smoking categories (e.g. ex-smokers who were current snus users). We used survey data on tobacco consumption to calculate mean daily cigarette and snus consumption amongst subjects in different categories of current tobacco use.

We classified current smokers as those smoking at least one cigarette daily; subjects not smoking daily were nonsmokers. We categorized as current snus users those subjects who used any amount each day. We classified as ex-smokers only those subjects who reported quitting more than 1 month prior to completing their survey [7]. With regard to the association of snus use with smoking cessation, ex-smokers were classified as either those with a history of snus use (current or ex-snus users) or those reporting never-use of snus. Ever-use categories of smoking, snus and all tobacco included both current and ex-users of these products. Tobacco use

is reported as gender-specific prevalence, and comparisons of prevalence rates between two groups of subjects were measured by the prevalence ratio with 95% confidence interval.

Where appropriate, statistical analysis was performed to assess prevalence trends according to various characteristics. Mantel–Haenszel chi-square test and testing interaction through a logistic regression model were used for this purpose. Age, education, marital status, and location of residence were studied as possible demographic or lifestyle characteristics influencing tobacco use status. Subjects were classified with regard to the highest level of education achieved within the Swedish education system: primary (9 years), secondary (12–14 years) and university (15+ years). Subjects were classified as single (which included never-married, divorced, separated and widowed) or married/cohabitant (given equal status under Swedish law). Subjects' location of residence was classified with respect to population size: communities with a population of 1000 or less (rural), those with a population of 1001–15 000 (small village), and those with over 15 000 residents (large village or city).

This study was approved by institutional review boards at Umeå University and the University of Alabama at Birmingham.

Results

The MONICA database from which this study is derived consists of 3030 men and 3137 women aged 25–64 years. Of these, 32 men (1.1%) and 45 women (1.4%) were missing information related to tobacco use and were excluded from the analysis. The final study population consisted of 2998 men (mean age = 45.5 years) and 3092 women (mean age = 45.0 years). Of the 6090 subjects, 1583 participated in the 1986 survey, 1561 in 1990, 1531 in 1994, and 1415 in 1999. Men accounted for 51.0% of the cohort in 1986, 49.1% in 1990, 48.7% in 1994, and 47.8% in 1999.

Figure 1 provides information on the prevalence of mutually exclusive categories of current tobacco use amongst the entire population, by gender and survey year. Overall prevalence of current tobacco use amongst men was stable at about 40%, but there were substantial differences amongst tobacco subtypes. The prevalence of exclusive smoking (no

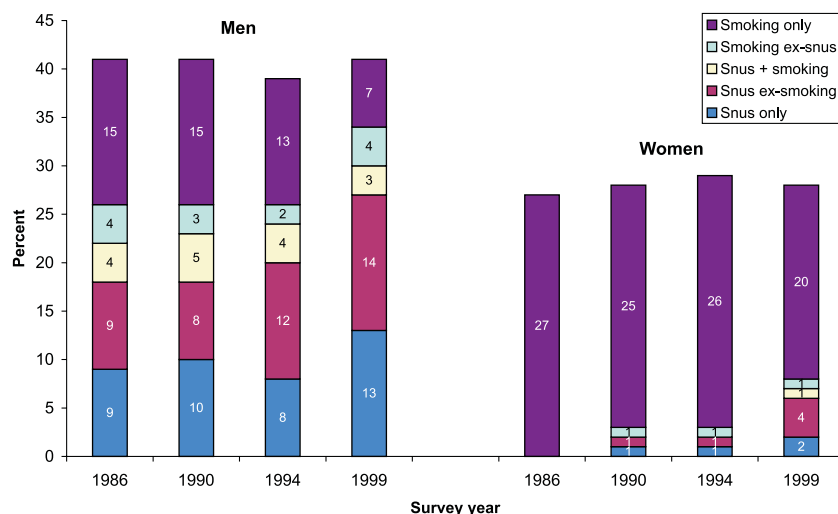


Fig. 1 Prevalence of current tobacco use (mutually exclusive categories) amongst the general population, men and women aged 25–64, by survey year.

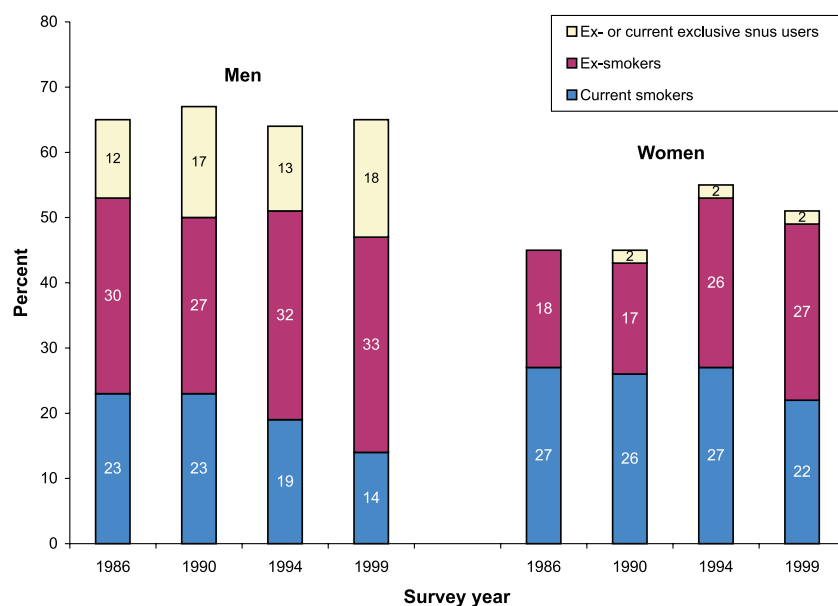


Fig. 2 Prevalence of ever tobacco use amongst the general population, men and women aged 25–64, by survey year.

prior or concurrent snus use) amongst men was 15% in 1986 but only 7% in 1999 whilst the prevalence of exclusive snus use (no prior or concurrent smoking) was 9% and 13%, respectively. The prevalence of current snus use/ex-smoking was higher than that of exclusive snus use in 1994 (12% vs. 8%) and in 1999 (14% vs. 13%). Combined use (snus + smoking) was stable (3–5%), as was ex-snus use/current smoking (2–4%). Amongst women the dominant form of current tobacco use was exclusive smoking (27% in 1986, 20% in 1999), although the prevalence of snus use was 6% in 1999. In that year 4% of

women were current snus users who were ex-smokers whilst 2% reported of exclusive snus use.

Figure 2 shows the prevalence of exclusive snus use (past or current), ex-smoking, and current-smoking amongst the entire population by gender for each of the survey years. Ever-tobacco use (the entire column for each year) was relatively stable in both men (~65%) and women (45–55%). In men exclusive use of snus accounted for about one-quarter of ever-tobacco use, whilst in women smoking was the dominant form of tobacco consumption. The prevalence of ever-smoking (ex-smoking + current

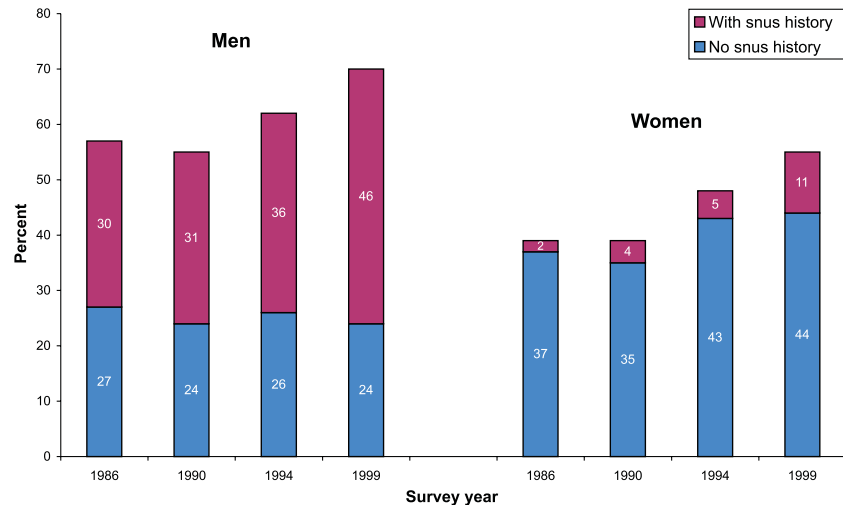


Fig. 3 Prevalence of ex-smoking amongst ever smokers, men and women aged 25–64, according to a history of snus use, by survey year.

smoking) amongst men was about 50%, but the prevalence of current smoking was 23% in 1986 and 1990, 19% in 1994 and only 14% in 1999.

Figure 3 shows the prevalence of ex-smoking (amongst ever smokers) subclassified according to a history of snus use, by gender. The overall prevalence of ex-smoking was much higher amongst men than amongst women. However, if a history of snus use is excluded, women had a higher prevalence of ex-smoking in all years. In men the prevalence of ex-smoking without a history of snus use was 27% in 1986 and lower in later survey years, whilst ex-smoking with a snus history was 30% in 1986 and was higher in each successive year. In women the prevalence of ex-smoking with a history of snus use was only 2% in 1986 but was 11% in 1999.

Amongst men there was a distinct trend of higher prevalence of ex-smoking with increasing age ($P < 0.001$). Men showed consistently higher prevalence of ex-smoking than women with respect to all ages, education levels, categories of marital status and survey years. In 1986 the male/female prevalence ratio of ex-smoking was 1.44 (95% CI 1.23–1.68) and in 1999 it was 1.27 (1.13–1.43). Although the PR was smaller in the more recent survey years, the trend was not significant. A history of snus use was a strong factor in the higher prevalence of ex-smoking in men compared with women (PR = 6.18, CI = 4.96–7.70).

Table 1 compares the demographic characteristics of male ex-smokers with and without a history of snus use. Ex-smokers with a history of snus use were

more likely to be younger ($P < 0.001$). They were slightly more likely to have completed primary or secondary school versus university ($P = 0.038$) and to be single, although the latter did not reach statistical significance. In addition, there was a strong trend of increased ex-smoking with a snus history in more recent survey years ($P = 0.006$). There was no difference in location of residence between ex-smokers with and without a history of snus ($P = 0.225$).

There were statistically significant differences in mean daily tobacco consumption between men who were combined users (snus + cigarettes) and those who were exclusive users (snus or cigarettes only). Regarding exclusive snus use, average daily consumption was 0.41 packages (SD ± 0.25) amongst ex-smokers and 0.44 packages (± 0.27) amongst never smokers. In comparison, combined users consumed 0.25 packages (± 0.20) of snus daily, about 40% less. With regard to smoking, ex-snus users averaged 15.1 cigarettes daily (± 7.52) and never users of snus smoked 16.0 cigarettes (± 7.98). In comparison, combined users smoked an average of 10.8 cigarettes daily (± 6.16), about 30% fewer.

Discussion

The major finding in this study is that the prevalence of smoking amongst men in northern Sweden was very low, falling from 23% in 1986 to 14% in 1999. These rates are several percentage points lower than those reported in national surveys

	No. with snus history (%)	No. without snus history (%)	All	Prevalence ratio (with/ without snus) (95% CI)
Age				
25–34	83 (75)	28 (25)	111	2.96 (2.11–4.16)
35–44	153 (71)	63 (29)	216	2.43 (1.94–3.04)
45–54	161 (58)	119 (43)	280	1.35 (1.14–1.60)
55–64	130 (43)	171 (57)	301	0.76 (0.64–0.89)
Trend ^a				$P < 0.001$
Education ^b				
Primary	203 (56)	158 (44)	361	1.28 (1.11–1.49)
Secondary	258 (63)	154 (37)	412	1.68 (1.45–1.94)
University	60 (50)	61 (50)	121	0.98 (0.76–1.27)
Primary + Secondary versus University				$P = 0.038$
Marital status ^c				
Single	83 (64)	46 (36)	129	1.80 (1.38–2.35)
Married	443 (57)	334 (43)	777	1.33 (1.20–1.47)
Year				
1986	128 (53)	114 (47)	242	1.12 (0.94–1.34)
1990	118 (56)	93 (44)	211	1.27 (1.05–1.54)
1994	136 (58)	98 (42)	234	1.39 (1.15–1.67)
1999	145 (66)	76 (34)	221	1.91 (1.55–2.34)
Trend ^d				$P = 0.006$
Location ^e				
<1000	131 (56)	104 (44)	235	1.26 (1.05–1.51)
1,001–15 000	142 (58)	104 (42)	246	1.37 (1.14–1.64)
>15 000	252 (59)	172 (41)	424	1.47 (1.27–1.68)
Trend				$P = 0.225$

^aTrend of decreasing prevalence of ex-smoking with history of snus use as age increases. ^bExcludes six men in the first column and eight in the second for whom there were incomplete data. ^cExcludes one man in each column for which there were incomplete data. ^dTrend of increasing prevalence of ex-smoking with snus use in more recent surveys. ^ePopulation of location of residence. Excludes two men in the first column and one in the second for whom there were incomplete data.

[8–10], which is even more remarkable as Swedish men enjoy the lowest smoking prevalence in Europe [11]. Unfortunately, low smoking rates are limited to men, as the women in our study had prevalence rates very similar to those of other European countries [11]. In fact, women in this cohort had higher smoking prevalence than men in all survey years, an inversion of the pattern in virtually every other society in the world.

Whilst smoking prevalence amongst men in this study was low, the prevalence of snus use was very high and was the dominant factor in the higher prevalence of ex-smoking amongst men compared with women (prevalence ratio 6.18, 95% CI 4.96–7.70). A comparison of demographic factors between male ex-smokers with and without a snus history revealed some interesting findings. First, there was a trend of ex-smoking with snus use at younger ages ($P < 0.001$), when smoking cessation affords greater

benefits to health. This was in distinct contrast to overall prevalence of ex-smoking amongst men, which was more common at older ages. Second, there were only small and insignificant differences in education, marital status or location of residence amongst ex-smokers with and without a snus history. In the United States, a country with a tradition of smokeless tobacco use and in which comparable usage data is available, prevalence is strongly correlated with lower educational status and residence in rural areas [12].

The unique trend in tobacco use in northern Sweden emerges more fully when additional comparisons are made with American statistics [13–15]. For example, in 1990 the quit ratio (prevalence of ex-smokers divided by prevalence of ever smokers $\times 100$ [16]) amongst men in our study was 55%, compared with 53% of American men. However, in 1999 the quit ratio amongst men in

Table 1 Prevalence (amongst ex-smokers) of men with ($n = 527$) and without a history of snus use ($n = 381$), by age, education, marital status, survey year and location of residence

northern Sweden was 70%, whilst the figure for American men was only 52%. The trend amongst women was similar. In 1990 the quit ratio amongst women in our study was 39%, compared with 47% of American women. In 1999 the Swedish figure was 55%, whilst the American ratio was 46%.

In addition to increasing cessation rates, it is possible that snus use influenced smoking prevalence amongst men by reducing smoking initiation. First, in 1990 rates of ever tobacco use amongst men in our study were similar to those of American men (67% and 65%, respectively). In our study 17% of men were ever (exclusive) users of snus, whilst the comparable figure for American men was 6%. But only 50% of men in this cohort were ever smokers, compared with 59% of men in the US. Thus, whilst prevalence of ever tobacco use was similar for both populations, prevalence of ever smoking amongst men in northern Sweden was substantially lower than that amongst American men. In contrast, in 1990 the prevalence of ever-smoking amongst women was 43% in northern Sweden and 42% amongst American women, with very little use of smokeless tobacco (2% and <1%, respectively).

With the high prevalence of snus use amongst men, there is the possibility that a transition from snus use to smoking could also occur. We could not examine usage patterns amongst persons younger than 25 years of age, but our results do not indicate that snus use played a prominent role in smoking initiation in this adult population. For example, in this study the 1999 male cohort had the highest prevalence of current snus use (30%) and the lowest prevalence of ever-smoking (47%). The prevalence of smoking/ex-snus use was low in all survey years (2–4%), and combined users were infrequent (3–5%). So, the evidence suggests that amongst adult men in northern Sweden the dominant transition is from smoking to snus, not vice versa.

The major strengths of this study are the relative homogeneity of the population and the standardized data collection in all MONICA surveys [17]. In addition, multiple questions on tobacco use permitted accurate definitions of current and former smokers. A general limitation of prevalence data is that tobacco use is self reported [7]. However, in the 1990 survey tobacco use status, validated by nicotine and cotinine levels, was found to be highly reliable in this cohort [18].

Recent epidemiologic studies have shown that Swedish snus is not associated with oral cancer [19, 20] or other smoking-related cancers. Furthermore, snus does not appear to be a strong risk factor for cardiovascular diseases [4, 21]. Thus, the balance of tobacco use in northern Sweden amongst men – and perhaps incipiently amongst women – may confer substantial health advantages compared with smoking-dominated societies.

Acknowledgements and conflict of interest

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