Scandinavian Journal of Public Health, 2009; 37: 487–493

ORIGINAL ARTICLE

Snuff use associated with abdominal obesity in former smokers

MATS SUNDBECK[1], MATHIAS GRAHN[2], VINCENT LÖNNGREN[3], NILS OVE MÅNSSON[3], LENNART RÅSTAM[3] & ULF LINDBLAD[3–5]

[1]*Public Health Unit, City Council of Malmö, Sweden,* [2]*Department of Social and Preventive Medicine, Malmö University Hospital, Malmö, Sweden,* [3]*Department of Clinical Sciences, Malmö, Lund University, Sweden,* [4]*Skaraborg Institute, Skövde, Sweden, and* [5]*Department of Public Health and Community Medicine/Primary Health Care, Sahlgrenska Academy at Göteborg University, Sweden*

Abstract

Aim: To describe the consumption of snuff in a rural male population and to explore associations between snuff use and obesity. *Participants and Methods:* Tobacco use was explored in 834 men aged 30–75 years old who participated in a cross-sectional population survey in the municipality of Vara (participation rate was 81%). Self-reported questionnaires assessed the habits of smoking and snuff use. Anthropometric measures were obtained during a health examination. *Results:* Of these men 21% ($n = 179$) were snuff users, 13% ($n = 109$) current smokers, and 65% ($n = 546$) were non-users. Of all snuff users 65% ($n = 116$) were former smokers, and 35% ($n = 63$) were exclusive snuff users (current users who never smoked). Among non-users 65% ($n = 357$) were never users and 35% ($n = 189$) had quit smoking without nicotine substitution. These men were characterized by abdominal obesity; OR 1.84 (1.08–3.12) ($p = 0.002$) (WHR >1.0) and OR 1.71 (1.08–2.72) ($p = 0.022$) (waist circumference >102 cm). One can/week use of snuff among ex-smokers was associated with a 1.21 cm wider (0.05–2.36) ($p = 0.041$) waist circumference and 0.01 (0.00–0.02) units higher ($p = 0.021$) WHR. There were statistically significant associations between former smoking without current nicotine substitute and both general and abdominal obesity. No similar association with abdominal obesity was seen among exclusive snuff users. ***Conclusions:*** **Abdominal obesity in current snuff users is limited to former smokers. The remaining effect of previous smoking has to be considered in future studies on obesity and related disorders in snuff users. Counselling among people who substitute snuff for smoking should include measures to prevent weight gain.**

Key Words: *Snuff, smokeless tobacco, smoking, obesity, overweight*

Introduction

Obesity is a risk factor for poor health in general, low quality of life, increased morbidity e.g. in cardiovascular diseases [1,2], and type 2 diabetes [3]. Abdominal obesity in particular is strongly associated with cardiovascular diseases [4], dyslipidaemia [5], and all-cause mortality [6]. Obesity results from a complex interaction between genetic and lifestyle factors [7]. The use of smokeless tobacco (ST), in the form of snuff has received attention as a possible cause for overweight [8–11], but also in relation to other components of the metabolic syndrome [9]. It is demonstrated that ST could be a risk factor for insulin resistance and hyperinsulinaemia [12], type 2 diabetes [13], hypertension [11] and cardio-vascular diseases [14], and it increases serum levels of triglycerides [9]. However, other studies have shown conflicting results [15,16]. The differences between smoking and ST, with regard to metabolic risk factors are not fully clear. The effects of smoking, however, seem stronger, and smoking has been shown to be a risk factor for dyslipidaemia [17], the insulin resistance syndrome [18], type 2 diabetes [13], and abdominal obesity [19].

Daily smoking has decreased by 20% among men and 10% among women since 1980. In 2004 14% of men and 19% of women, between 16 and 84 years of

Correspondence: Ulf Lindblad, Department of Public Health and Community Medicine/Primary Health Care, Box 454, SE-40530, Göteborg, Sweden. Tel: +46-31-7866831. Fax: +46-31-7781704. E-mail: ulf.lindblad@allmed.gu.se

(Accepted 19 March 2009)

DOI: 10.1177/1403494809105546

age, were daily smokers [20]. Among men especially, snuff use has acted as a substitute for smoking and has become a common habit in Sweden. In 2004 about 22% of all men and 4% of all women between 16 and 84 years of age used snuff [20], while this proportion in men aged 30–44 years was as high as about 30% [20]. Some decades ago snuff use was most common among working class men, but today the use has spread to the middle class [20]. Swedish Match, the biggest Swedish producer of snuff, sold 200 million cans in 2005. Use of snuff is limited to a few countries in the world e.g. Sweden, Norway, the US, India, Pakistan and some countries in northern Africa. Swedish Match is optimistic about expanding the market in North America and Russia. "The strategy is aimed at further strengthening these positions and developing snuff as a smokeless alternative in an increasing number of markets" [21].

The prevalence of obesity in Sweden has increased over the past decades and has been considered to be about 10%, based on self-reported information [22]. However, self-reported information underestimates the true prevalence of obesity and recent population-based studies of obesity based on body height and weight measured at a physical examination have shown that the prevalence of obesity is at least 20% in both sexes [23–25].

The purpose of this study was to describe the consumption of snuff in a rural male population and to explore the relationships between snuff consumption and obesity.

Materials

Participants

This study is based on a population survey in Vara, a small municipality in a rural area in south-western Sweden, within the Skaraborg Project. The study protocol has previously been described in detail [23,25]. The participants were invited by post three weeks in advance to be examined by the study team at the Vara primary healthcare centre (participation rate 81%). Two specially trained nurses and one lab technician collected the data from November 2001 until December 2003 enrolling 1,811 participants (age range 30–75 years).

Only eight women used snuff and consequently this study was restricted to men. Of the 904 participating men 34 were excluded because they did not answer all the questions about tobacco use in the questionnaire. People were also excluded ($n = 36$) if they used chewing tobacco, nicotine gum or declared use of more than one sort of tobacco. Thus, 834 men remained to be further explored in this study. The Research ethical committee in Gothenburg approved the study. The participants were given written and verbal information about the aims and purpose of the study, and their written consent was collected before they were included in the study.

Methods

A structured questionnaire, filled out by the participants at the clinic, was used to collect data on socioeconomic background with focus on educational and occupational experiences. The participants also completed a questionnaire about tobacco and alcohol use together with physical activity at leisure time. It included quantification of tobacco consumption both for snuff users and smokers. A case history about cardiovascular diseases was collected by a structured interview. The nurses at the clinic performed a physical examination of the participants including body weight (to the closest 0.1 kg), body height (to the closest cm) and waist and hip circumferences were measured (to the closest cm).

Body mass index (BMI) defines overweight and obesity. BMI was calculated as body weight in kg divided by squared body height in meters (m^2). Compared with normal BMI (BMI $< 25\,kg/m^2$) a person was categorized, according to the recommendations of the World Health Organization, as overweight if BMI was $\geq 25\,kg/m^2$, and as obese if BMI was $\geq 30\,kg/m^2$. Waist circumference (WC) or waist:-hip ratio (WHR) defines abdominal obesity. WHR is the ratio between the circumference of the waist (defined as the narrowest part of the body below the costal margin), and the hip (defined as the widest part of the body below the waist). A man was categorized as being abdominally obese when the WHR was ≥ 1.0. Waist circumference was measured in cm and when exceeding 102 cm men were categorized as abdominally obese in accordance with the NCEP ATP III recommendation [26].

A snuff user was defined as a man who only uses snuff and uses it at least every week. Swedish snuff is ground and moistened dark tobacco. It is placed under the upper lip in contact with the oral mucosa. Today it is common to use snuff in small bags instead of a moistened powder. The "bag can" contains 24 grams of snuff and the "powder can" contains 50 grams of snuff. The study does not differ between types of cans. Current snuff users are subdivided into two groups – exclusive snuff users who have never smoked, and former smokers who had changed to snuff. The snuff users were also divided into two

groups after consumption – ≤4 cans/week was defined as low consumption, and >4 cans/week accordingly as high consumption. A smoker smokes at least one cigarette/cigar/pipe a day. A non-user does not use snuff, nicotine gum, chewing tobacco or smoke but may have used it before. An exclusive non-user has never smoked.

The participants were categorized into four groups, on marital status – married or living together with a partner, not married, divorced, and widowed. Education was categorized into three levels, on its lengths in years: compulsory school (6–9 years), upper secondary school (12 years), and post secondary school (>12 years). The participants were divided into five work categories – housework (do not work outside the home), gainful employment, retirement (including early retirement and sickness pension), students, and unemployed. Work-related physical activity (WRPA) was ranked in three categories – low (e.g. driving, reading and standing with little muscle activity), moderate (walk around, carry less than 5 kg e.g. carpeting), and high (high and very high muscle activity; e.g. heavy gardening, unloading cargo, digging). The participants were ranked in four categories of physical activity in leisure time (LTPA); sedentary life (e.g. watching television, collecting stamps), low physical activity (easy walking, bicycling etc. for a minimum of four hours per week), moderate physical activity (running, swimming, tennis etc. for a minimum of two hours per week), and a high level of physical activity (hard training in football, skiing, running, etc regularly and several times per week).

Statistical methods

Statistical analysis was performed using SPSS 12.0.1 for Windows. Standard methods were used for descriptive statistics. All analyses were adjusted for difference in age. Associations between consumption of tobacco and measures of obesity consistently accounted for differences in age, LTPA, and in education if not otherwise specified. Proportions were age standardized by five-year age groups using the whole Vara population as standard.

Associations between categorical variables were analyzed by logistic regression and expressed as odds ratios (OR) with 95% confidence intervals (CI). Associations between continuous variables were analyzed with linear regression and expressed by the regression coefficient and its 95% confidence interval (CI). All tests were two-sided and statistical significance was assumed when $p < 0.05$.

Results

The study population was made up of 834 men with a mean age of 48.2 years (SD 11.8). Of these men 21% ($n = 179$) were snuff users, 13% ($n = 109$) were current smokers, and 65% ($n = 546$) were non-users. Of all snuff users 65% ($n = 116$) were former smokers, and 35% ($n = 63$) were exclusive snuff users. Among non-users 65% ($n = 357$) were never users and 35% ($n = 189$) had quit smoking without nicotine substitution. The average consumption of snuff was 3.5 cans of snuff/week in all users, 3.7 cans/week in exclusive snuff users, and 3.4 cans/week in snuff users who were former smokers. Snuff users were on average 44.1 (SD 12.1) years of age compared with exclusive smokers, who were 50.3 (SD 11.8) years of age, and non-users, who were 49.1 (SD 12.2) years of age. The high consumers of snuff (>4 cans/week) were on average 41.4 (SD 5.6) years of age, while the mean age in low consumers (≤4 cans/week) was 44.8 years of age (SD 10.7). There was a statistically significant inverse association between age and consumption in cans/week ($p = 0.010$).

Characteristics of the study population are shown in Table I. The participants in general had a low level of education and a high WRPA with few men engaged in housekeeping, few were students, and few were unemployed. The majority, 70–80% of the study population, were wage earners. Marital status and LTPA were similar in all groups. Nineteen per cent of all men in the study population were generally obese (BMI $\geq 30\,kg/m^2$), and about the same proportion were abdominally obese (Table I). Low education ($p = 0.027$), and low LPTA ($p = 0.008$), were significantly associated with snuff use and were accordingly included as covariates in all further analyses of the associations between snuff use and obesity. Former smokers who quit smoking without use of any nicotine preparation were the only group with a significant association with overall obesity (BMI $\geq 30.0\,kg\ m^{-2}$), OR 2.10 (1.32–3.35) ($p = 0.002$) and abdominal obesity; OR 1.84 (1.08–3.12) ($p = 0.024$) for WHR >1.0 and OR 1.71 (1.08–2.72) ($p = 0.022$) for a waist circumference >102 cm, respectively. There were no associations between any category of snuff use and overall obesity as compared to non-users. However, there was a more than doubled odds of being abdominally obese in former smokers who consumed >4 cans a week when only age was adjusted for (OR 2.88, 95% CI 1.12–7.40). This association was not seen in any other category, and as shown in Table II it was lost when differences in LTPA and education were also accounted for (2.29, 0.75–6.97) confirming the confounding effects of these factors.

Table I. Characteristics of the study population in subgroups of tobacco use.

		All $n=834$		Snuff users $n=179$		Non users $n=546$		Exclusive smokers $n=109$	
		n	(%)	*n*	(%)	*n*	(%)	*n*	(%)
Age (years)	30–49	535	64	148	83	323	59	64	59
	50–76	299	36	31	17	223	41	45	41
Marital	Married	671	81	146	82	445	82	80	75
Status[a]	Single	161	19	33	18	99	17	29	26
Education in years	<10	295	36	53	30	195	36	47	45
	10–12	337	41	90	51	202	37	45	43
	>12	187	23	34	19	140	26	13	12
WRPA[b]	Low	240	35	46	29	170	38	24	29
	Moderate	213	31	48	30	138	31	27	32
	High	239	34	64	41	143	32	32	38
Work	Housework	21	3	4	2	15	3	2	2
	Gainfully employed	639	79	147	85	418	78	74	73
	Retired	128	16	15	9	91	17	22	22
	Student	6	1	2	1	4	1	0	
	Unemployed	15	2	5	3	6	1	4	4
LTPA[c]	Sedentary	64	8	18	10	34	6	12	11
	Light	441	54	96	55	285	52	60	56
	Moderate	287	35	52	30	201	37	34	32
	Hard	33	4	8	5	24	4	1	1
BMI kg/m^2	≥30	160	19	36	20	105	19	19	17
WHR[d]	≥1.0	123	16	22	14	84	17	17	17
WC[e] (m)	>102	174	21	40	22	112	21	22	20

WC = waist circumference. [a]Single includes not married and living alone, divorced or widower. [b]WRPA = work-related physical activity. [c]LTPA = leisure time physical activity. [d]Abdominal obesity for men; waist : hip ratio >1.0. [e]Abdominal obesity for men; waist circumference >102 cm.

Table II. Associations between categories of tobacco use and obesity.

	Exclusive non-user	All snuff users		Current exclusive snuff users		Current snuff users who quit smoking		Quit smoking without any nicotine substitute			Current exclusive smokers	
	($n=357$)	($n=179$)		($n=63$)		($n=116$)		($n=189$)			($n=109$)	
	Ref.	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	OR	CI (95%)	*p*	OR	CI (95%)
Associations with BMI ≥ 30 kg/m^2												
≤4 cans/week	1.0	1.27	(0.73–2.20)	0.67	(0.24–1.82)	1.65	(0.90–3.01)					
>4 cans/week	1.0	1.18	(0.50–2.79)	1.36	(0.36–5.10)	1.13	(0.39–3.25)					
All	1.0	1.24	(0.75–2.06)	0.83	(0.36–1.90)	1.51	(0.87–2.63)	2.10	(1.32–3.35)	0.002	1.11	(0.65–2.04)
Associations with WHR ≥1.0												
≤4 cans/week	1.0	0.96	(0.48–1.94)	0.77	(0.25–2.37)	1.06	(0.48–2.37)					
>4 cans/week	1.0	1.32	(0.46–3.80)	1)	1)	2.29	(0.75–6.97)					
All	1.0	1.04	(0.55–1.95)	0.60	(0.20–1.82)	1.31	(0.66–2.61)	1.84	(1.08–3.12)	0.024	1.16	(0.59–2.27)
Associations with waist circumference >102 cm												
≤4 cans/week	1.0	1.14	(0.69–2.04)	0.92	(0.33–2.22)	1.36	(0.74–2.50)					
>4 cans/week	1.0	1.52	(0.67–3.39)	1.31	(0.35–4.89)	1.76	(0.68–4.57)					
All	1.0	1.27	(0.78–2.06)	1.01	(0.47–2.17)	1.45	(0.84–2.50)	1.71	(1.08–2.72)	0.022	1.18	(0.67–2.10)

1) Too few subjects for conclusive results. Associations were analyzed with logistic regression adjusting for age, leisure time physical activity and education.

Continuous measures of obesity and snuff consumption by cans/week were used to further explore associations between snuff use and obesity (Table III). Among all snuff users there were statistically significant associations between snuff dose/week and abdominal obesity, such as that 1 can/week was associated with a 0.01 (0.00–0.01) higher WHR ($p=0.024$), and a 0.87 (0.03–1.71) cm wider waist circumference ($p=0.043$). When snuff users were stratified into exclusive snuff users, and

Table III. Association between snuff consumption, in cans/week, and obesity.

	B	CI	*p*
All snuff users ($n = 179$)			
BMI	0.21	(−0.09–0.52)	0.170
WHR	0.01	(0.00–0.01)	0.024
Waist circumference	0.87	(0.03–1.71)	0.043
Exclusive snuff users ($n = 63$)			
BMI	0.15	(−0.33–0.64)	0.535
WHR	0.00	(−0.04–0.04)	0.892
Waist circumference	0.49	(−0.80–1.78)	0.449
Current snuff users who were former smokers ($n = 116$)			
BMI	0.24	(−0.18–0.66)	0.253
WHR	0.01	(0.00–0.02)	0.021
Waist circumference	1.21	(0.05–2.36)	0.041

Associations were analyzed with linear regression adjusting for differences in age, education, leisure time physical activity.
B: Regression coefficient.

into former smokers, respectively, the associations were reinforced in former smokers, but lost in exclusive snuff users (Table III). There were no statistically significant associations between the weekly dose of snuff and overall obesity.

Discussion

This study showed an association between snuff consumption and abdominal obesity. The association was strengthened by a statistically significant dose response as abdominal obesity was more pronounced the more cans of snuff consumed per week. The association was limited to former smokers and was not seen among exclusive snuff users. Thus, the weight increase commonly seen among former smokers should be considered as the possible causal factor. However, causality, which includes the effects of snuff itself, remains to be explored in prospective controlled designs.

One of the strengths of this study was that both overall and abdominal obesity were explored. Another advantage with this study was that exclusive snuff users – people who have never have smoked – were specifically examined, thus excluding remaining effects of smoking. A weakness is that the use of tobacco is self-reported, which can confer a recall bias. The measure of consumption is a general methodological issue in this and most other studies about snuff. Usually cans/week is used as a measure of consumption, but since the 1970s, snuff has been produced in two kinds; a 24-gram can with snuff in bags, and a 50-gram can with snuff in bulk. Almost half of the production by Swedish Match is in the form of 50-gram cans. We found no previous papers considering this important source of potential misclassification. Consequently, some extent of misclassification is inevitable when high and low consumption is defined by cans/week, however, this should rather tend to underestimate the true associations. The main findings in the present study were still robust and independent of differences in age, LPTA, and education. However, alcohol consumption and energy-intake could not be accounted for. Other more rare consequences of snuff use, such as cancer, could not be considered due to low sample size.

There are some studies in non-European countries that explored the use of other types of snuff than the type most common in Scandinavian countries [27–31]. Besides different ethnicities, they showed various and conflicting associations with obesity. There are, to our knowledge, eight Swedish studies that have considered obesity among snuff users [8–11,15,16,32,33]. Overall obesity by BMI is used in all studies, whereas abdominal obesity by waist circumference or WHR was explored in only half of the studies. Four studies showed significant associations between exclusive snuff use and overweight by BMI [8–11]. In a large sample of Swedish construction workers Bolinder et al. found that snuff users significantly more often had a BMI >26 kg/m^2 [11]. The association with overall obesity is further supported by findings in cross-sectional analyses by Hergens et al. and Rodu et al., which also include a follow-up part [10,8]. In a longitudinal study Norberg et al. found that exclusive snuff users who consumed >4 cans/week had a significant risk of developing obesity (BMI ≥30 kg/m^2): OR 1.7 (1.36–2.18) [9]. However, no such associations were seen in those who consumed ≤4 cans/week. None of the other studies could find any associations with overall or abdominal obesity and exclusive snuff use [15,16,32,33]. One of these studies did, however, demonstrate a weak significant association between snuff years (grams/daily x snuff use in years) and WHR [33]. We did not have information on duration of smoking or duration of snuff use and we could accordingly not consider total exposure of these risk factors, which is a limitation of our study.

Three of the four studies that showed an association with overall obesity had larger samples of exclusive snuff users than the present study [8,9,11]. All four studies adjusted for differences in age, and one for differences in smoking [10]. The opposing results of positive associations with BMI in these four studies compared with our study may be explained by the fact that the association between overall obesity and exclusive snuff use is weak and calls for greater sample size and/or longitudinal

follow-up. The possible remaining effect of previous smoking was, however, not specifically explored in any of these studies. In the present study a dose-dependent association was found which supports the conclusion by Norberg et al. that the level of snuff consumption has a decisive influence on the development of overall obesity [9]. Abdominal obesity was not explored in any of the studies referred to [8–11]. In the present study snuff users who were former smokers were more often abdominally obese. A similar finding was reported in one other study about snuff and overall obesity where the association remained up to 10 years after snuff users stopped smoking [8]. That former smokers develop abdominal obesity after quitting smoking, compared to non-smokers, is a consistent finding in this and in other studies [16,19,33].

Available studies on snuff use and overall obesity show inconsistent results and the topic needs to be studied in more detail. However, one previous well-conducted Swedish study showed a significant association between snuff use and waist circumference in ex-smokers [15], but did not consider abdominal obesity. Our findings in the Vara population are thus the first to show a corresponding association with increased abdominal obesity defined in accordance with the NCEP ATP III recommendations [26] in ex-smokers who switched to snuff, while exclusive snuff users did not differ in abdominal obesity compared with exclusive non-users of tobacco [15].

A substantial proportion of men who give up smoking switch to snuff and this has been considered as a less unhealthy habit compared with smoking and may thus give these men a feeling of safety [34]. Of course quitting smoking confers a major reduction in cardiovascular risk [35], but according to our findings this protection may still be dubious if abdominal obesity is not prevented in quitting smokers, considering the strong association between abdominal obesity and cardiovascular disease. The implications for public health are significant because the number of snuff users has increased, and prevention strategies should also consider that snuff use is more frequent in younger men and in men with low education, as well as in men who are sedentary in their leisure time, as shown in this study. This concept of defining quitting smokers as a risk category in need of special intervention has not been emphasized before.

In summary, this study showed that abdominal obesity was greater the higher the snuff consumption. This association was based on the more frequent abdominal obesity seen among snuff users who used to smoke, so former smoking may bear some of the explanation. The interaction between snuff use and the remaining effects of previous smoking have to be considered in future prospective studies on obesity in snuff users. Future studies should also consider can size when defining snuff consumption.

Funding

The study was supported by grants from the Skaraborg Institute, Swedish Medical Research Council and Skaraborg Primary Care, Sweden, the Health & Medical Care Committee of the Regional Executive Board of the Region Västra Götaland, Malmoe University Hospital, Region Skane and the Faculty of Medicine, Lund University, Sweden.

Conflicting interests

None of the authors have any conflicts of interest to declare.

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