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PAPER

Intentional weight loss and smoking in young adults

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OBJECTIVE: To investigate whether current smoking and lifetime snuff use are associated with a lifetime history of major ($\geq$5 kg) intentional weight loss in young adults, and to examine the dependence of this association on familial factors.
DESIGN: Cross-sectional population-based questionnaire survey of young adult Finnish twins participating in the fourth wave of the longitudinal FinnTwin-16-study in 2000–2002.
SUBJECTS: A total of 4521 young adult Finnish twins aged 23–27 y.
MEASUREMENTS: Questionnaire data on the number of intentional weight-loss episodes and on body mass index (BMI), cigarette smoking and snuff use, educational level, and number of subjects' own children.
RESULTS: Current daily smoking was strongly associated with a history of two or more intentional major weight-loss episodes (lost $\geq$5 kg twice or more lifetime) both in women odds ratio (OR 1.87; 95%; confidence interval (CI) 1.39–2.50) and in men (OR 2.00; 95% CI 1.37–2.90). Frequent lifetime snuff use was statistically significantly associated with recurrent intentional weight loss episodes in men (OR 1.51; 95% CI 1.08–2.13). Among the twin pairs discordant for daily smoking, the smoking twin was more likely than the nonsmoking co-twin to have recurrent intentional weight-loss episodes (OR 1.57; 95% CI 1.03–2.41). These episodes were also strongly associated with high BMI. Education was inversely related to recurrent intentional weight-loss episodes in men.
CONCLUSION: Tobacco use is strongly associated with a lifetime history of recurrent intentional major weight-loss episodes in early adulthood. This represents a major challenge to existing attitudes on smoking prevention and the promotion of healthful weight control.
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Introduction

With alarmingly increasing trends in overweight and obesity, dieting has in recent years become more prevalent among women and men also with normal weight. In the last few decades dieting in young adult Finns has increased more than three-fold,[1] and health-compromising dieting methods such as intense training, skipping of meals, using laxatives, diuretics or diet pills, or tobacco have become more widespread.[2–4] Adolescents and young adults are particularly inclined to use such unhealthy methods to lose weight.[5] The long-term health consequences of weight loss still remain controversial.[6–8]

Adolescents often believe that smoking can help to control weight.[3] Some longitudinal studies have examined the role of weight control intentions in smoking initiation. Austin *et al*[9] found, based on weight-loss intentions, a doubled odds ratio (OR) for smoking initiation in frequent dieters compared to that in nondieters among 15-y-old US schoolgirls during a 2-y follow-up. In a 1 y follow-up of 12 to 15-y- old adolescents in Minnesota, French *et al*[10] found that girls who reported two or more eating disorder symptoms were about twice as likely to become smokers as other girls. In a later analysis of the same sample in a 3-y follow-up using different dieting categories, French *et al*[11] found no significant difference in increases in smoking rates by dieting status. Ryan *et al*[12] reported that 13% of 15-y-old female smokers gave weight control as a reason for smoking initiation or continuation. In the past years the prevalence of adolescent smokers who cite weight control as a reason for starting to smoke has increased considerably. In 1993 among 12th grade smokers in the USA, 39% of girls and 12% of boys began their smoking for reasons of weight control.[2] In 1998, the corresponding figures were 49% in girls and 28% in boys.[13]

The results of the few studies concerning the association between tobacco use and intentional weight loss in adults

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are somewhat contradictory probably due to methodological differences.[14–17] In a small sample of US women, Gerend *et al*[15] found that 45% of cigarette smokers ($n=20$) and 17% of users of smokeless tobacco ($n=18$) attributed their habit to reasons of weight control. French *et al*[14] found that dieting and weight concerns were unrelated to smoking cessation or relapse in a population-based sample of working adults. In a population-based survey in the USA, Serdula *et al*[16] found that current smokers were 30–40% less likely than never smokers to try to maintain their current weight compared to doing nothing to weight. On the other hand, heightened levels of weight concerns[18] and body dissatisfaction[19] have been observed more frequently among female smokers than nonsmokers.[20,21] Weight concerns are considered an important factor in smoking initiation and inhibiting smoking cessation not only among adolescents but also among young adults, particularly women.[10,22–24] This may have important implications for the planning of public health actions on tobacco.

Both genetic and common environmental factors have been shown to be important in tobacco use[25] and in weight-loss attempts.[26] The association between tobacco use and weight losses might be due to effects of smoking on weight loss or alternatively because weight loss precedes smoking. There is also a third possible explanation: the association could be explained by familial factors associated with both smoking and weight losses. Thus, it seemed reasonable to examine the association between weight loss and tobacco use in a twin sample to investigate the role of familial effects. This question can be analyzed by studying twin pairs discordant for smoking.

The aim of this study was to examine the association between intentional major weight-loss (≥ 5 kg) episodes and tobacco use in a cross-sectional population-based sample of young adult Finnish twins.

Subjects and methods

Study population

This study is based on national population-based survey data from virtually all Finnish twins born during the years 1975–1979.[27] A questionnaire was distributed between autumn 2000 and autumn 2002 to those twin pairs who had replied to a baseline questionnaire they received at the age of 16 y.[28] The respondents were 22.8–27.2-y-old at the time of response. The total number of questionnaires returned was 4868 (response rate, 88%).

Compared to singletons, twin boys in this data have been shown to have somewhat lower BMI at the age of 17 y whereas in girls the difference was not statistically significant. As the differences in body size between singletons and twins do get smaller with age, we can assume that the small difference disappears also in males from late teenage to adulthood.[29]

Smoking rates among Finnish twins have been shown to be very similar compared to singletons, especially at age 20–30 y.[30] Thus, our sample can be considered as representative of Finnish young adults.

We excluded from the analyses those subjects who were pregnant ($n=112$) or had a condition that could clearly affect weight (cerebral palsy, mental disability, motor handicap, infectious bowel disease or chronic diarrhea, celiac disease, hypo- or hyperthyroidism, congenital heart failure, diabetes, or antipsychotic or antidepressant drug treatment affecting weight) ($n=174$) as well as those with missing data on weight or height ($n=37$), dieting status ($n=45$), smoking status ($n=30$), or snuff use ($n=31$). Our final data included 2123 male and 2398 female twin individuals. Zygosity was defined by a validated questionnaire method also used in other large twin studies.[31] The data set thus included 1367 monozygotic (MZ), 1419 same-sex dizygotic (DZ) and 1476 opposite-sex DZ twin individuals and 259 subjects of unknown zygosity. Pairwise analyses were conducted among those pairs in which both twins in a pair had responded and had no missing data.

Measures

Subjects were asked how many times they had intentionally lost at least 5 kg (never, once, 2–4 or, 5 or more). Those who reported having intentionally lost 5 kg or more at least twice in their lifetime were classified as having recurrent intentional weight-loss episodes and were labeled 'weight loss' hereafter. Further, subjects were asked to compare their own behavior with their co-twins behavior during the last 12 months: which twin is or has been dieting more often (me, my co-twin, there is no difference between us, do not know). Body mass index (BMI, kg/m^2) was calculated from self-reported weight and height.

Subjects were asked to choose the best characterization of their current smoking habit from seven choices (never, former, less than weekly, weekly but less than daily, 9 or fewer cigarettes smoked daily, 10–19, and 20 or more). Smoking status was classified in four categories (never, former, less than daily, and daily smokers). Snuff use was classified in three categories according to the number of times ever used (0–1, 2–50, or >50).

Educational level was classified in three categories based on questions concerning degrees achieved and current studies. The categories included elementary school, college or polytechnic, and university education of 9 y or less, 10–12 y, or more than 12 y, respectively.

The number of children was based on the reported number of the subjects' own children and used as a dichotomous variable (no children or 1 child or more).

Validity assessment

The validity of self-reported BMI was ascertained from a subsample of 206 twins participating in an ongoing laboratory study on the consequences of adolescent alcohol use. The measurements were taken between September 2001

and March 2003, with a median of 356 days (from 89 days to 2.4 y) after the self-report. Owing to the timing of the laboratory study, the twins were not invited immediately after they had replied to the questionnaire. Height was measured without shoes on a stadiometer and weight in light clothes on a calibrated beam balance. The mean self-reported BMI was 22.9 (s.d. 3.3) and measured 23.5 (s.d. 3.6). The measured and self-reported values agreed rather closely ($r = 0.92$ for BMI and $r = 0.98$ for height).

Statistical methods

The association between weight loss and tobacco use was analyzed by logistic regression analysis where weight loss served as the outcome variable. Since BMI was an important predictor of weight loss, it was adjusted for in all models in addition to age. Smoking and snuff use were analyzed in separate models for both sexes. Educational level was a strong explanatory factor for tobacco use, both educational level and number of own children were considered as potential covariates of intentional weight losses. Thus, the analyses were carried out before and after adjusting for these variables.

Since the study population was formed by identifying and including twin pairs, the subjects (twin individuals) do not represent fully independent observations but may correlate for study traits within pairs. All analyses but those concerning discordant twin-pairs were carried out treating the subjects as singletons. The effect of the twin-sampling design on the standard errors was taken into account in the individual level analysis by using the cluster-option in Stata®. This is pertinent for same-sexed pairs, where both twins in a pair are considered as individual observations. Since analyses were conducted separately for men and women, the twins from opposite-sex pairs are independent observations within the analysis sets (i.e. men and women). The analyses were continued by studying the association between weight loss and smoking within twin pairs discordant for daily smoking by using conditional regression analysis. If the association is found also within discordant twin pairs, it suggests that there is a direct association between smoking and intentional weight loss or they are both due to environmental factors or experiences unshared by the twins. Comparison of MZ and DZ twin pairs gives further information about the role of genetic factors behind this association. If genetic factors are the main explanation for the association between intentional weight losses and smoking, this association should be seen only within DZ but not within MZ twin pairs. Twin pairs share the same family background and MZ twin pairs also same genes, whereas DZ twins share on average 50% of their segregating genes. Thus, if the association between intentional weight loss is found only in individual level analyses but not within discordant twin pairs, that is, smoking twins do not have a higher risk for intentional weight loss than the nonsmoking co-twins, this result indicates that the association is due to shared familial and genetic factors affecting both intentional weight loss and smoking.

All statistical analyses were carried out by the Stata® statistical software.[32]

Results

The background characteristics of the subjects appear in Table 1. Approximately 18% of female subjects and 11% of males had intentionally lost at least 5 kg twice or more during their lifetime and were therefore classified as having weight loss. No difference in the prevalence of weight loss existed between zygosity groups. One-fourth of the women (25%) and nearly a third of the men (32%) smoked daily, yet no statistically significant differences in mean BMI appeared between smoking categories (Table 2). Table 3 gives the prevalence of weight loss according to smoking categories. In both sexes, the prevalence of weight loss increased with the number of cigarettes smoked.

Table 1 Descriptive statistics of the participants of the FinnTwin16-study

	Women n = *2398*	*Men* n = *2123*
Age (y)	*Mean 24.4 (s.d. 3.4 y) (%)*	*Mean 24.4 (s.d. 3.1 y) (%)*
Intentional weight loss (≥5 kg)		
Never	58	76
Once	24	14
2–4 times	16	9
≥5 times	2	2
Cigarette smoking		
Never	46	40
Former	14	13
Occasional	15	16
Daily	25	32
1–9 cigarettes	10	8
10–19 cigarettes	12	17
≥20 cigarettes	2	6
Snuff use /times		
0–1	96	63
2–50	4	24
>50	0	13
BMI (kg/m²)	*Mean 22.2 (s.d. 3.4 kg/m²)*	*Mean 23.9 (s.d. 3.1 kg/m²)*
<18.5	7	1
18.5–25	78	70
25.1–30	11	25
>30	4	4
Educational level (y)		
<9	4	5
10–12	70	72
>12	26	22
Number of own children ≥1	15	11

s.d.: standard deviation.

Table 4 on cigarette smoking and Table 5 on snuff use show the results of the logistic regression analyses in individuals. Daily smokers in both sexes were more likely to report weight loss than did never-smokers (multivariate adjusted OR 1.87; 95% confidence interval (CI) 1.39–2.50 for women, OR 2.00; 95% CI 1.37–2.90 for men). Increased likelihood for weight loss was seen among occasional smokers as well, but was significant only in women. No statistical difference for weight loss existed between former smokers and never-smokers.

Snuff use was associated with increased likelihood to report intentional weight loss (Table 5). The result was statistically significant only in men having used snuff 2–50 times (multivariate adjusted OR 1.51; 95% CI 1.08–2.13), but the point estimate for those using snuff more than 50 times was at the same level (OR 1.41; 95% CI 0.91–2.19) and in women as well. It should be noted that snuff use among women was quite uncommon. Combining smoking and snuff use in the same multivariate model somewhat diminished the ORs but did not change overall trends.

BMI was a strong explanatory factor for weight loss in both sexes. In female subjects, the risk for weight loss increased with age, even within the limited age range of this study. The more highly educated males ran a 43% lower risk for weight

Table 2 Mean BMI (kg/m^2) according to number of weight-loss episodes and smoking in young adult Finnish twins

	Women n = *2398*	*Men* n = *2123*
Frequency of major weight loss		
Never	21.1 (21.0–21.3)	23.2 (23.1–23.3)
Once	22.8 (22.6–23.1)	25.5 (25.1–25.9)
Twice or more often	24.6 (24.4–25.0)	26.8 (26.3–27.3)
Frequency of smoking		
Never	22.0 (21.8–22.2)	23.8 (23.6–24.1)
Former	22.7 (22.1–22.8)	24.2 (23.8–24.6)
Occasional	22.0 (21.6–22.3)	24.0 (23.7–24.4)
Daily	22.4 (22.1–22.7)	23.7 (23.4–23.9)

(95% CI).

Table 3 Weight-loss history (%) by smoking status among young adult Finnish twins

	Weight losses							
	Women (n = *2398*)				*Men* (n = *2123*)			
	Total number	*Never*	*Once*	*At least twice*	*Total number*	*Never*	*Once*	*At least twice*
Smoking status	*n*	%	%	%	*n*	%	%	*n*
Never	**1112**	64	23	14	**825**	80	12	8
Former	**362**	51	30	19	**298**	76	14	10
Occasional	**353**	61	22	18	**322**	71	17	11
Daily	**571**	49	26	24	**678**	73	14	13
Of daily smokers, number of cigarettes								
<10	**235**	44	31	25	**178**	71	16	13
10–19	**292**	55	23	23	**366**	75	15	10
>19	**44**	41	18	41	**134**	68	10	22

Smoking status *vs* weight losses $P<0.001$ for women, $P<0.01$ for men. Among daily smokers: number of cigarettes *vs* weight loss $P<0.01$ for women, $P=0.01$ for men.

Table 4 Odds ratios of the logistic regression models for intentional weight loss according to cigarette smoking by women ($n=2398$) and men ($n=2123$)

	Model 1 (BMI and age-adjusted)		*Model 2 (BMI, age, educational level, number of children adjusted)*	
	Women	*Men*	*Women*	*Men*
Smoking status				
Never	1.00	1.00	1.00	1.00
Former	1.31 (0.94-1.83)	1.11 (0.66-1.88)	1.27 (0.90-1.78)	1.17 (0.69-1.96)
Occasional	1.45 (1.03-2.04)*	1.44 (0.92-2.27)	1.44 (1.02-2.02)*	1.42 (0.90-2.24)
Daily	1.93 (1.45-2.56)*	1.96 (1.37-2.80)*	1.87 (1.39-2.50)*	2.00 (1.37-2.90)*
BMI (kg/m^2)	1.25 (1.20-1.30)*	1.33 (1.27-1.39)*	1.25 (1.20-1.30)*	1.33 (1.27-1.40)*
Age (y)	1.24 (1.08-1.43)*	1.05 (0.88-1.25)	1.24 (1.08-1.44)*	1.05 (0.88-1.25)
Educational level (y)	—	—		
<9 years			1.00	1.00
10-12 years			1.18 (0.65-2.16)	0.46 (0.26-0.84)*
>12 years			1.01 (0.52-1.94)	0.57 (0.29-1.13)
Children	—	—		
0			1.00	1.00
≥1			0.87 (0.64-1.20)	1.02 (0.62-1.68)

*$P<0.05$, (95% CI).

Table 5 Odds ratios of the logistic regression models for intentional weight loss according to snuff use by women ($n=2398$) and men ($n=2123$)

	Model 1 (BMI and age-adjusted)		*Model 2 (BMI, age, educational level, number of children adjusted)*	
	Women	*Men*	*Women*	*Men*
Snuff use (times)				
0–1	1.00	1.00	1.00	1.00
2–50	1.59 (0.96-2.65)	1.53 (1.09-2.14)*	1.63 (0.98-2.70)	1.51 (1.08-2.13)*
>50	—	1.44 (0.94-2.22)	—	1.41 (0.91-2.19)
BMI (kg/m²)	1.25 (1.20-1.30)*	1.33 (1.27-1.39)*	1.25 (1.20-1.30)*	1.33 (1.26-1.39)*
Age (years)	1.27 (1.10-1.46)*	1.04 (0.88-1.24)	1.26 (1.09-1.46)*	1.05 (0.88-1.25)
Educational level				
<9 y	—	—	1.00	1.00
10–12 y			0.95 (0.53-1.71)	0.43 (0.24-0.78)*
>12 y			0.73 (0.39-1.37)	0.46 (0.23-0.89)*
Children	—	—		
0			1.00	1.00
≥1			0.85 (0.62-1.16)	1.02 (0.62-1.68)

*$P<0.05$ (95% CI).

loss. The number of the subjects' own children was not associated with weight loss. The unexpected findings regarding parity and weight loss may be due to the timing of the questions; given this young adult sample, having children is probably a relatively recent event whereas weight loss may have occurred earlier.

We also studied the association between weight loss and daily smoking by pairwise conditional logistic regression analysis in the 478 twin pairs discordant for smoking. Since the association between weight loss and smoking was strongest in daily smokers, we defined twin pairs as discordant if one twin was a daily smoker and the other was not. A significant association between weight loss and smoking was observed for all discordant pairs (OR 1.57; 95% CI 1.03–2.41). We repeated these within-pair analyses in smoking-discordant MZ (OR 2.73; 95% CI 0.58–12.81 for women, OR 1.34; 95% CI 0.35–5.09 for men) and DZ (OR 1.55; 95% CI 0.95–2.51) twin pairs separately to obtain information about possible genetic factors affecting this association. The number of twins in the zygosity groups was small, and we found no statistically significant differences, even though the point estimates were greater than unity in all subgroups.

Further, we analyzed twin pairs consistent in their answers about which one is or has been dieting more often during the last 12 months. We found 375 pairs who were unanimously discordant for current dieting, that is both co-twins were referring to the same twin individual in their answer to the question 'which one of you is dieting more often — you or your co-twin?'. Of those, 108 pairs were also discordant for daily smoking and included in the statistical analysis. Conditional logistic regression analysis revealed a statistically significant association between daily smoking and dieting (OR 1.82; 95% CI 1.23–2.71). In same-sex and opposite-sex DZ pairs, the association of smoking and dieting was clear (OR 3.0; 95% CI 1.12–9.23 for SSDZ-pairs, $n=24$ and OR 1.86; 95% CI 1.08–3.28 for OSDZ-pairs $n=63$). The number of MZ pairs was small ($n=16$), and there was no difference between the more and less dieting co-twins in smoking (OR 1.00; 95% CI 0.33–3.06).

Discussion

In this study of the association between lifetime intentional weight loss (≥ 5 kg) and current tobacco use, we found a strong association between recurrent intentional weight loss and daily smoking in both sexes. This association persisted even after adjusting for BMI, educational level and number of subjects' own children. Contrary to our expectations, having one's own children showed no significant effect on weight loss. This may be due to the subjects' young age or cultural factors as parity has been shown to increase the risk for weight gain.[33]

The association between BMI and smoking is complex. Many epidemiological studies have shown that smokers have lower body weight than nonsmokers.[34–37] This is widely considered to be due to an effect of smoking on metabolic rate or differences in dietary habits[38,39]. Recent Finnish studies, however, have shown smokers to be heavier than nonsmokers.[40,41] In a large Australian population-based sample ($n=8726$) of young women, smokers were more prone to weight gain than were never-smokers.[33] In addition, short-term weight gain following smoking cessation is well documented,[42] but in longer follow-ups the effect is more controversial.[43–45] Molarius *et al*[46] and Laaksonen *et al*[47] have found that the association between smoking and BMI depends on level of education so that heavy smokers from more highly educated groups tended to be heavier than never-smokers whereas the opposite was observed in less-educated groups. No significant differences in BMI existed between smokers and nonsmokers in our data, which may be due to the subjects' relatively young age. Weight differences may develop with age due to the clustering of unhealthy habits. In less-educated groups, both smoking and overweight, and consequently recurrent intentional weight loss, were more common. In our study,

educational level was strongly associated with smoking, but the association between smoking and recurrent intentional weight loss persisted even after adjusting for educational level. These higher risk levels remained when we analyzed risk of intentional weight loss according to different educational categories. This indicates that the association between intentional weight losses and tobacco use is independent of educational level and smoking prevention and healthy weight control promotion campaigns must target all levels of society.

Despite scanty evidence, adolescents appear to have a belief in tobacco's ability to prevent weight gain.[22] One possible explanation is the misconception that because smoking cessation usually leads to weight gain, smoking initiation should consequently lead to weight loss. One factor frequently blamed for the misperception of tobacco's beneficial effect on body weight is tobacco advertising.[48] Interestingly, we found this association between tobacco use and weight loss in the young Finnish population even though tobacco advertising has been banned in Finland since the National Tobacco Act in 1977. This may be due to indirect advertising in international and national movies and magazines as well as direct advertising in international arenas.

A twin-study design provides a possibility to control for the family environment or other common background factors and thus yielding more information on this association than data on singletons only. The cross-sectional design of this study fails to permit the drawing of strong conclusions about causal relations. Unfortunately, we had no information on motivation for smoking initiation or for tobacco use in general. The special strengths of the present study are the large population-based sample, equal representation of men and women, and a high participation rate. Though all measures were self-reported, we found self-reported BMI to be highly reliable in these data. Vartiainen *et al*[49] have also shown the self-reported smoking status to be reliable in general Finnish population-based samples. The demographic factors of population-based twin-samples can be reliably compared to those of population at large, and smoking rates among adult twins and singletons have been shown to be very similar.[30]

Previous studies have shown the importance of both genetic and common background factors for smoking.[50] Moreover, Korkeila *et al*[26] have reported that weight-loss attempts have a common familial background, which may, however, be mediated partly through the genetic component in BMI. We found that the association between smoking and recurrent intentional weight loss also existed within twin pairs discordant for daily smoking. This finding indicates that the association between intentional weight loss and smoking is not the result of common family environment or other factors common to siblings alone. The power of further statistical analyses separately in MZ and DZ pairs was inadequate to permit definite conclusions about the role of genetic factors. Our results suggest that the association between recurrent intentional weight loss and tobacco use is real and is not accounted for familial factors. Parallel with these findings were the results of the examination of the association between recent dieting and daily smoking that showed an association in all pairs, particularly in DZ pairs. Although no association was observed in the 16 discordant MZ pairs, the numbers are small and conclusions about the role of genes on the association between smoking and weight-control behavior cannot be made.

Unhealthy life habits such as tobacco use represent a major challenge to health promotion. That the association between tobacco use and weight loss is independent of educational level clearly demonstrates that not only the lack of information but also the emotional needs and attitudes of different population groups must be targeted in the planning of publicity campaigns to prevent smoking and promote healthy weight control methods. Effective planning of such campaigns requires information that can be obtained by comparing the association of dieting and smoking behaviors in different age groups and undertaking longitudinal studies of the motivation for smoking initiation and weight-control methods.

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