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Effect of Acupuncture on Smoking Cessation or Reduction: An 8-Month and 5-Year Follow-up Study

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Background. **This study was undertaken to examine whether acupuncture treatment may have a long-term effect on smoking cessation or reduction.**

Methods. **Altogether 46 healthy men and women who reported smoking 20 ± 6 cigarettes per day (mean ± SD) volunteered in the study. They were randomly assigned to a test group (TG) or to a control group (CG) in which presumed anti-smoking acupoints were stimulated (TG) or acupuncture was applied to acupoints considered to have no effect on smoking cessation (CG). Before each treatment, after the last one, and 8 months and 5 years after the last one, each subject answered questionnaires about his or her smoking habits and attitudes. Blood samples for measuring variables related to smoking, i.e., serum cotinine and serum thiocyanate, were taken.**

Results. **During the treatment period the reported cigarette consumption fell on average by 14 (TG) and 7 (CG) cigarettes per day ($P < 0.001$). For both groups the reported cigarette consumption rose on average by 5–7 cigarettes during the following 8 months, and there was no systematic change thereafter. Consequently, TG showed a maintained reduction in smoking; no lasting effect was seen for CG. The TG reported that cigarettes tasted worse than before the treatments, and also the desire to smoke fell. For TG the serum concentration of cotinine fell, and the values correlated with the reported smoking.**

Conclusions. **This study confirms that adequate acupuncture treatment may help motivated smokers to reduce their smoking, or even quit smoking completely, and the effect may last for at least 5 years. Acupuncture may affect the subjects' smoking by reducing their taste of tobacco and their desire to smoke. Different acupoints have different effects on smoking cessation.**

Key Words: **smoking; tobacco; acupuncture; ear acupressure; cotinine; thiocyanate; fibrinogen; peroxides; TBARS; taste of tobacco; desire to smoke; follow-up studies.**

INTRODUCTION

Smoking is an important cause of premature disability and mortality worldwide. The WHO estimates that smoking causes about 4 million deaths annually in the world [*1*]. By recognizing the harm it does to the health, three of four of Norwegian smokers have tried to quit smoking [*2*]. A number of approaches have been carried out as an aid to quit smoking, and acupuncture is one of them.

A number of studies have pointed out that acupuncture may reduce the withdrawal symptoms seen when people quit smoking [*3–9*], but the long-term effect is much more ambiguous [*3,7,10,11*]. One problem is that the acupuncture treatment given differs between studies in terms of both treatment frequency and which acupoints have been used [*12*]. It may be that a positive effect requires that a relatively broad treatment is given, that is a treatment that combines different techniques and that uses several acupoints. Another problem is that few studies have actually looked at whether subjects who reduce their smoking or even quit during a treatment period abstain from smoking in the following months or years [*13*]. Moreover, most studies record the subjects' smoking only as reported on questionnaires, that is, without using independent biologic markers as controls of their subjects' reported smoking. A few studies report that subjects who quit smoking also report that they have less desire to smoke or that tobacco no longer tastes as good as before [*3,5,6,14*]. Despite

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this, no studies have to our knowledge measured quantitatively their subjects' taste of tobacco or their desire to smoke.

We have previously reported that adequate acupuncture treatment may help smokers to reduce their smoking or even to quit smoking if they are motivated [*15*]. Acupuncture at points that are assumed not to be related to smoking had a smaller but statistically significant effect as judged at the end of the treatment period. Our subjects have now been followed up at 8 months and 5 years after the last treatment; we here report their smoking status.

SUBJECTS AND METHOD

Subjects

In this follow-up study from our previous study [*15*] 46 smokers who were 39 ± 9 years of age (mean ± SD), had smoked 23 ± 8 years, and all wanted to quit smoking were recruited from a large company in Oslo, Norway (Table 1). The requirements for entry into the study were that the subjects should have at least 5 years of regular smoking and an average tobacco consumption of 10–30 cigarettes per day during the past year. Persons with diabetes or a history of coronary heart disease as well as pregnant and breast-feeding women were excluded. None of the subjects used other means of smoking cessation during the treatment period. The subjects were divided by complete randomization, that is, by drawing with replacement, into two groups, referred to as the test group (TG) and the control group (CG). The design of the study was approved by the Ethics Committee for Health Region 1 in Norway.

Dropouts

Two subjects in the control group dropped out after the second or third acupuncture treatment. A total of six other subjects (four in the TG and two in the CG) were lost before the follow-up 8 months after the treatments. Four of the dropouts at 8 months returned to the study at the 5-year follow-up (three in the TG and one in the CG). In the 5-year follow-up study another nine subjects were lost (three in the TG and six in the CG). Apart from the two subjects who dropped out during the treatment period, perhaps because of lack of motivation, all others dropped out for reasons not related to this study. More specifically, one subject died before the 5-year follow-up, and the others who dropped out had either retired, changed their job without leaving a new address, or gone on a long-term leave abroad. Thus, we regard these reasons for dropping out as random effects. Moreover, the dropouts did not differ from the other subjects in their smoking characteristics or in other parameters like age. More specifically, they were 37 ± 10 years of age, had smoked for 21 ± 9 years, and reported that they smoked 22 ± 5 cigarettes per day at the beginning of the study.

TABLE 1

Number of Subjects in the Test Group (TG) and the Control Group (CG) before the First Treatment, Right after, 8 Months after, and 5 Years after the Last Treatment

	Before		Right after		8 months after		5 years after	
	TG	CG	TG	CG	TG	CG	TG	CG
Number of subjects	26	20	26	18	22	16	22	11
Men	8	10	8	8	7	7	6	5
Women	18	10	18	10	15	9	16	6

Acupuncture Treatment

The acupuncture treatment, given by a well-trained and experienced acupuncturist, was a combination of body electroacupuncture, ear acupuncture, and ear acupressure. Each subject received a total of six acupuncture treatments given as two treatments per week over a period of 3 weeks. They were in addition instructed to carry out ear acupressure four times per day. The acupoints used for the test group were selected to affect smoking-related organs like the lungs, the airways, and the mouth. The acupoints used for the control group are related to the skeletal and muscle systems and are supposed to have no specific effect on organs directly exposed to smoking. Except for the site of acupoints applied there was no difference in the treatment procedure between the two groups. See He et al. [*15*] for further details.

Blood Sampling and Analyses

Blood samples were taken from an antecubital vein before the first treatment, after the last treatment, and again 8 months after the last treatment. The concentrations of serum cotinine, serum thiocyanate, plasma fibrinogen, and thiobarbituric acid-reacting substances (TBARS; a measure of lipid peroxidation) were measured as explained earlier [*15*].

Questionnaires

Three questionnaires, A, B, and C, were used to evaluate the effects of the acupuncture treatments and to get other relevant information from the subjects. Questionnaire A, completed before the first treatment, focused on the personal background and smoking characteristics of the subjects. Questionnaire B was used to assess the subjects' amount of smoking during the last 3 days, also addressing their motivation for smoking cessation, their evaluation of the taste of tobacco and smoking, and their desire to smoke compared with before the first treatment. The participants were asked to

complete questionnaire B before each of the subsequent treatments. Questionnaire C was used for the follow-up examinations 8 months and 5 years after the last acupuncture treatment, and it addressed the same questions as questionnaire B but quantified the subjects' smoking during the past months and years. Questionnaire C also included questions on whether the subjects had tried other means of smoking cessation after the last treatment. The motivation for smoking cessation was measured on an 11-point Likert scale. Possible changes in the desire to smoke and the taste of tobacco were measured on a Visual Analog Scale, and these data are given in arbitrary units.

Statistics

The results are presented as means ± SEM or as individual results. Univariate tests of statistical significance were carried out by Student's matched-paired (within each group) and two-sample *t* tests (between the groups). Since some of the subjects dropped out during the study, and therefore the number of subjects in each group varied between the different time points, we did not use repeated-measurements analysis of variance. Correlations are given as Pearson's product-moment correlation coefficient except for the correlation between the subjects' smoking and serum cotinine concentration. The cotinine analyses showed one very large value that in statistical terms has a large potential and thus would dominate the analysis. Therefore the correlations for these data are given as Spearman's rank correlation coefficient (r_S). This correlation is almost identical to Pearson's coefficient when used on normal data [*16*], but it is much less influenced by outliers.

RESULTS

Characteristics of the subjects and the dropouts are given Subjects and Method.

Reported Consumption of Tobacco

Before the first acupuncture treatment the reported tobacco consumption for the test group and the control group was 19.4 ± 1.2 and 19.8 ± 1.2 cigarettes per day, respectively ($P = 0.83$, Fig. 1A).

Within-group changes. The reported cigarette consumption fell during the treatment period by 75 ± 4% for the test group ($P < 0.001$) and by 39 ± 5% for the control group ($P < 0.001$; Fig. 1A). Eight months later the reported cigarette consumption was 59% of the value before the treatments for the test group ($P < 0.0001$) and 90% of the pretreatment value for the control group ($P < 0.008$). Thus, for both groups the reported smoking rose on average by 5–7 cigarettes per day ($P < 0.001$) compared with the situation just after the last acupuncture treatment. Five years after the last treatment the subjects in the test group smoked 37% less than before the first treatment ($P < 0.003$), while for the subjects in the control group no significant difference from before the treatments was found ($P =$

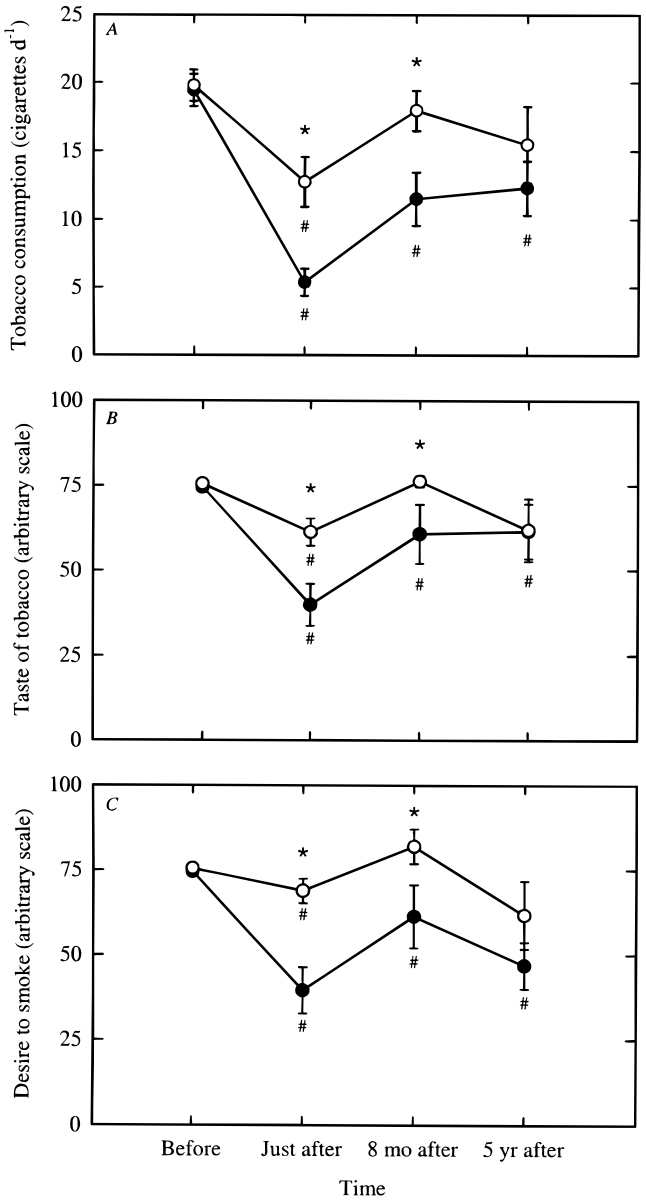

FIG. 1. Daily consumption of tobacco (A), taste of tobacco (B), and the desire to smoke (C) before the first treatment, just after the last treatment, and 8 months and 5 years after the last treatment for the test group (●) and the control group (○). The taste and the desire to smoke were recorded on visual analog scales that use arbitrary units. The data are mean ± SEM; SEMs not shown are so small that they are hidden by the symbols. * denotes a statistically significant difference between the two groups, while # denotes a statistically significant difference from the pretreatment value for the group in question.

0.17). During the period from 8 months to 5 years after the last treatment there was no systematic change in the reported smoking within either group ($P > 0.2$). Nevertheless, there were considerable individual variations. A scatter plot of each subject's reported smoking showed values distributed around the line of identity but with a random variation (error of regression) of 6 cigarettes per day (data not shown). In line with this, some subjects who quit smoking during the treatment later started smoking again, but at a lower level than before the treatments. Some subjects who reduced their smoking during the treatment period later quit completely.

Between-group differences. Right after the last treatment the subjects in the test group smoked only 43% of what the subjects in the control group did (Fig. 1A). The difference between the two groups was maintained 8 months after the last treatment ($P < 0.01$). Five years after the last treatment the test group consumed 12.3 ± 2.0 cigarettes per day compared with 15.5 ± 2.8 cigarettes per day for the control group ($P = 0.37$). For the control group two subjects had quit smoking 3–4 years after the last treatment, one using nicotine-containing plaster as a substitute. The rest of subjects in the control group smoked 19 ± 2 cigarettes per day at that time, almost the same as before the treatments and more than the test group smoked ($P = 0.01$).

All but two subjects who quit smoking some time during the study were in the test group. The subjects were randomly assigned to their treatment, and consequently, the probability of this outcome by pure chance is 0.008.

Distribution of the reported tobacco consumption. Before the treatments 41% of the subjects of both groups consumed 10–19 cigarettes per day while 59% smoked 20–30 cigarettes per day (Fig. 2). During the treatment period there was a redistribution toward nonsmokers (only in TG) and "light smokers," with fewer heavy smokers. Both groups increased their smoking during the follow-ups. The subjects in the test groups still reported that they smoked less than before the treatments. For the control group the changes from before the treatments were smaller.

Smoking cessation. Just after the last treatment eight subjects (32%) in the test group had quit smoking. At the 8-month and 5-year follow-ups, five (23%) and four subjects (18%), respectively, in the test group had still quit smoking. In the control group none of the subjects quit smoking at the end of the treatment or at the 8-month follow-up. At the 5-year follow-up two subjects reported that they had quit smoking (18%), one using nicotine-containing gum as a substitute.

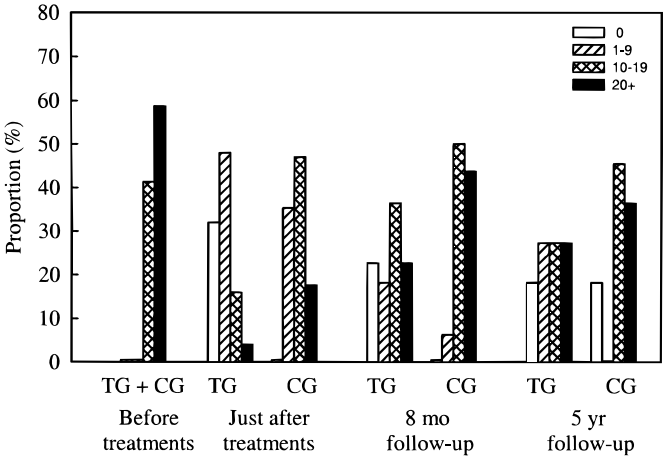

FIG. 2. Distribution of the subjects' reported smoking before the first treatment, just after the last treatment, and 8 months and 5 years after the treatments for the test group (TG) and the control group (CG). Empty bars are indicated by a thin line.

Taste of Tobacco

Both groups reported that smoking did not taste as good after the treatments as it did before the first treatment ($P < 0.001$; Fig. 1B). The effect was larger for the test group than for the control group ($P = 0.003$). In the follow-up study 8 months and 5 years after the last treatment the subjects in the test group still reported that tobacco did not taste as good as before the first treatment ($P = 0.02$). In contrast to this, the subjects in the control group reported in the follow-ups that the taste of tobacco was not systematically different from that before the first treatment. The effect differed between the two groups at the 8-month follow-up ($P < 0.05$) but not at 5 years.

Desire to Smoke

The reported desire to smoke fell for both groups during the treatments ($P < 0.001$, Fig. 1C). For the subjects in the test group the effect persisted at the 8-month and 5-year follow-up ($P < 0.001$). The subjects in the control group reported a desire to smoke not different from that before the first treatment during the follow-up period. The effect differed between the two groups both during the treatment period and at the 8-month follow-up ($P \leq 0.03$), but not at the 5-year follow-up ($P = 0.12$; Fig. 1C).

Correlations between the Reported Cigarette Consumption, the Taste of Tobacco, and the Desire to Smoke

The subjects' reported taste of tobacco after the last treatments and in the follow-up period correlated with their desire to smoke ($r > 0.80$, $P < 0.001$). Their desire

to smoke correlated with their reported smoking ($r \geq 0.56$, $P \leq 0.001$), and consequently their reported taste of tobacco correlated with their smoking ($r \geq 0.64$, $P < 0.001$). Subjects who had quit smoking reported poor taste of tobacco and little desire to smoke. Since their values may have a large influence on these analyses (in statistical terms, their values have a large potential), their values were excluded, and the analysis was repeated. The outcome on the reduced data set was largely the same. Since we examined here in particular the possible effect of a specific treatment procedure given to the test group only, the same analyses were carried out for this group separately. These subjects too reported correlations between the taste of tobacco, the desire to smoke, and the actual smoking ($r > 0.54$; $P \leq 0.02$). However, when the subjects who had quit smoking were excluded from the analysis, the correlations between the reported smoking versus the taste of tobacco and the desire to smoke were significant only after the last treatment ($r > 0.50$; $P \leq 0.04$).

Smoking-Related Blood Variables

Before the first acupuncture treatment there were no differences between the two groups in the serum concentrations of cotinine, thiocyanate, or TBARS or in the plasma fibrinogen concentration (Table 2).

Serum cotinine. For the test group the mean concentration of serum cotinine was lower right after ($P < 0.001$) and 8 months after ($P < 0.006$) the acupuncture treatments than before the first treatment. There was no difference for the control group in either period. Both just after and 8 months after the last treatment the concentration of cotinine was on average lower for the test group than for the control group ($P < 0.05$).

After the last treatment 8 of the 24 subjects in the test group (33%) had cotinine concentration less than 71 μg L^{-1}, a value normally found only among nonsmokers [*17*]. Seven of these subjects reported that they did not smoke anymore. Another subject who claimed that she did not smoke showed a cotinine concentration typical for a light smoker. None of the subjects in the control group showed cotinine concentrations below 100 μg L^{-1}. The corresponding results found 8 months later were that 7 of 22 subjects in the test group (32%) had cotinine concentration less than 71 μg L^{-1}. The lowest value in the control group was 160 μg L^{-1}.

Serum thiocyanate. For the test group the mean concentration of serum thiocyanate fell by 28% during the treatment period ($P < 0.001$, Table 2). Eight months later the value was back to the level of before the treatments. The thiocyanate concentration of the control group did not change, neither during the treatment nor during the 8-month follow-up period. There were no systematic differences between the two groups.

Plasma fibrinogen and serum TBARS. The concentrations of plasma fibrinogen and serum TBARS did not change during the treatment period for either group. Eight months after the last treatment the concentration of TBARS was on average 15% lower than before the treatments for both groups, and the effect did not differ between the two groups. The plasma fibrinogen concentration did not change during the treatment period or in the 8-month follow-up period for either group.

Tobacco Consumption versus Concentrations of Serum Cotinine and Serum Thiocyanate

Both the concentration of serum cotinine and that of serum thiocyanate correlated positively with the subjects' reported cigarette consumption before the first treatment, just after the last treatment, and 8 months later ($r_S = 0.60$ and $r = 0.54$ for all measurements pooled for cotinine and thiocyanate, respectively; Fig. 3). In particular, with one exception all subjects who claimed that they no longer smoked had serum cotinine concentrations less than 71 μg L^{-1}.

TABLE 2

Smoking-Related Blood Variables in the Test Group (TG) and the Control Group (CG) before the First Treatment, Just After the Last Treatment, and 8 Months after the Last Treatment

	TG			CG		
	Before	After	8 months after	Before	After	8 months after
Cotinine (μg L^{-1})	318 ± 25	201 ± 38[a,b]	228 ± 36[a,b]	335 ± 29[c]	287 ± 35[b]	308 ± 27[b]
Thiocyanate (μmol L^{-1})	115 ± 9	83 ± 10[a]	111 ± 13	117 ± 9	104 ± 10	118 ± 8
Fibrinogen (g L^{-1})	2.7 ± 0.1	2.7 ± 0.1	2.8 ± 0.1	2.8 ± 0.1	2.8 ± 0.1	3.0 ± 0.2
TBARS (μmol L^{-1})	2.3 ± 0.1	2.4 ± 0.2	1.9 ± 0.1[a,d]	2.3 ± 0.1	2.5 ± 0.2	2.0 ± 0.2[d]

Note. The data are means ± SEM of the number of subjects given in Table 1.
[a] After vs before treatment for one group ($P < 0.05$).
[b] Between-group comparison ($P < 0.05$).
[c] One extreme value has been excluded.
[d] After vs before treatment for both groups pooled ($P < 0.01$).

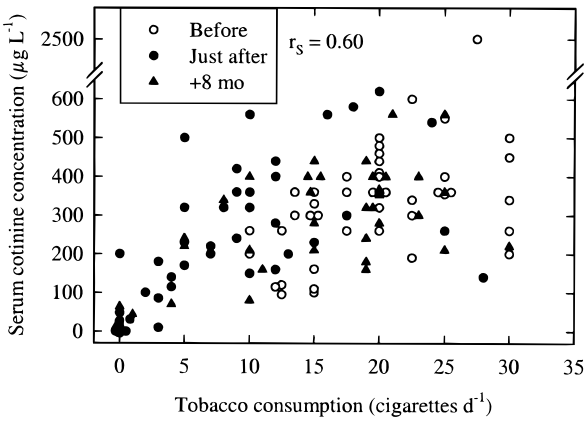

FIG. 3. The measured serum cotinine concentration versus the self-reported tobacco consumption before the first treatment, just after the last treatment, and 8 months after the last treatment. The data for the test group and the control group are pooled. r_S denotes Spearman's rank correlation coefficient.

Motivation for Quitting Smoking

Both groups of subjects were more motivated for quitting smoking during the follow-up period than just after the last treatment ($P < 0.001$). There was no difference in the motivation between the two groups neither during the treatments nor in the follow-up periods.

DISCUSSION

The acupuncture treatment examined here had a long-term effect in reducing the reported tobacco consumption in smokers motivated for quitting. There was no lasting effect for the control group who received acupuncture at points assumed to have no effect for smoking cessation. The subjects' reported smoking was closely related to the serum concentration of cotinine. While the subjects in the test group reported a reduced desire to smoke and that cigarettes did not taste as good as before the treatments, there were no such lasting effects for the control group. The subjects' reported taste for tobacco, their desire to smoke, and their reported smoking correlated.

Long-Term Effects on Smoking

The subjects in the test group reduced their daily smoking, an effect that lasted for at least 5 years. The effect differed from that of the subjects in the control group, who showed a smaller and only temporary reduction in their smoking. As pointed out above, the reported smoking and smoking reduction were independently confirmed by the serum cotinine concentration. This suggests that the different acupoints used have different effects for smoking cessation. In particular, while acupoints specifically associated with the lungs, airways, and the mouth seem to be effective for reducing smoking, there may be no long-lasting effect of a general or nonspecific acupuncture treatment on smoking reduction.

Several others have earlier examined whether adequate acupuncture treatment may help people quit smoking [*3,4,6–8,11,18*], but these studies report only cessation rates or so-called success rates, and they have apparently ignored that adequate acupuncture may reduce the subjects' daily smoking, an effect that is also important for their health [*19,20*]. Our data show that in addition to helping some subjects to quit smoking completely, other subjects were able to reduce their smoking considerably.

Taste of Tobacco and Desire to Smoke

We measured possible changes in the taste of tobacco and the desire to smoke by visual analog scale tests. To our knowledge, these tests, which appeared adequate for our purpose, have not been used in former studies on the effect of acupuncture for smoking cessation. Admittedly, Steiner [*14*], Fuller [*3*], Zalesskiy [*5*], and Hackett [*6*] have reported that some subjects feel that cigarettes do not taste as good as before or that they do not have the same desire to smoke as before. These are measures on a qualitative and not on a quantitative scale. Steiner and his colleges [*14*] reported that 80% of subjects in the real treatment group and 50% in the control group noted a decrease both in their appetite for cigarettes and in their desire to smoke. We found that adequate acupuncture reduced the taste of tobacco and the desire to smoke. In fact, many subjects reported a distaste of cigarettes after some treatments. These findings are in line with those of Zalesskiy et al. [*5*], who reported that some subjects felt "perversion of the tobacco smell." Moreover, Fuller [*3*] found that the smokers felt calm and relaxed, and they lost their desire to smoke after some acupuncture treatments.

Possible Model for the Effect of Acupuncture on Smoking Reduction

We found positive correlations between the subjects' reported taste of tobacco, their desire to smoke, and how much tobacco they used. Acupuncture given at points affecting the lungs, the airways, and the mouth (which was given to our test group) may reduce the taste of tobacco by some unknown mechanism. Since tobacco does not taste as good, the subjects have less desire to smoke, and the lower desire to smoke reduces their smoking. We therefore propose the following model for the effect of acupuncture on smoking cessation: Acupuncture → reduced taste of tobacco → reduced desire to smoke → reduced smoking. Acupuncture may perhaps also affect the desire to smoke directly.

Our subjects reported a lower desire to smoke and a poorer taste of tobacco even 5 years after the last

treatment. Mechanisms behind the effect of acupuncture are still poorly understood, and we can therefore neither conclude nor exclude that acupuncture per se will have an effect lasting that long. It may on the other hand be that acupuncture reduces these drives temporarily, thus helping the subjects to reduce their smoking. As a consequence of reduced smoking, cigarettes do not taste as good, and the subjects may have a lesser desire to smoke.

Since Allport [*21*] presented the knowledge–attitude–behavior model in 1935, it has been widely discussed and used in health promotion researching [*20,22,23*]. That model postulates that people acquire information about a behavior, and this leads to a changed attitude, which in turn, leads to a new behavior that is in agreement with the attitude. That model may not apply to our subjects since all know that smoking is not good for their health. Rather we here propose that humans' feelings and sensations, like for example the taste, can play an important role in changing the behavior. Even though the mechanisms behind the effect are still unknown, our results suggest that the effect of our treatment may be by changing the perceived taste of tobacco. We accordingly propose a "sensation–desire–behavior" model to explain acupuncture effects on smoking cessation.

Comparisons with Former Studies

A number of studies have addressed possible long-term effects of acupuncture on smoking cessation in the past 20 years [*3,4,6–11,18,24–26*]. The results vary considerably. The success rates as judged over 1-year follow-ups vary between 7 and 35% cessation rates [*3,4,6,7,9,11,25*]. In these studies the subjects reported their tobacco consumption on questionnaires. Although some studies mention that blood samples were taken, no one has to our knowledge given data on biologic markers as independent controls of their subjects' smoking. Thus, although we found fair agreements between the subjects' reported smoking and their smoking as judged from the biologic markers, it is not known whether this agreement can be extrapolated to other studies.

The possible long-term effect on smoking reduction is essential for the subjects' health. We followed our subjects for 5 years after the last treatment. Clavel-Chapelon et al. [*11*] followed their subjects for 4 years. Otherwise, no other study has to our knowledge followed their subjects for more than 2 years, and most studies in fact follow their subjects for only 1 year or less. Thus, these studies do not allow drawing conclusions about possible effects beyond a year or so. We found no difference between the follow-up results 8 months and 5 years after the last treatment for each group. If these results apply to the other studies too, it may be that for those who report a significant effect after 1 year, the effect may last for several years. However, it should be noted that while the average smoking did not change between 8 months and 5 years after the last treatment for our two groups, there were large individual variations.

Disregarding the limitations in the experimental design of former studies addressed above, the different outcomes of the different studies should be discussed. Several studies found that acupuncture may have some lasting effect in smoking cessation [*3,4,6,8,9*]; on the other hand, several others saw no lasting effect on the subjects' smoking [*7,11,18,24–26*]. A direct comparison between these different studies is difficult because they used different approaches. Some used ear acupuncture [*3,4,8,9,18,26*], while others used electroacupuncture to the body [*7,11,25*]. In addition, the treatment regimens differ also in the treatment frequency, the duration of each treatment, and the number of acupoints used. However, it is interesting to note that in all studies reporting no lasting effect of acupuncture treatment, the treatment was given at most once per week. This may suggest that the lack of effect found in these studies was a consequence of too long of a time between each treatment.

The discussion above suggests that there is a great need for standardizing the approach used in the study of whether acupuncture may help people to quit smoking. It is highly important to have a design that includes an effective type of treatment, or combination of different acupuncture techniques, that enough acupoints are used, that enough time for stimulation is applied during each treatment, and that the treatments are given at a sufficiently high frequency. The discussion above for example suggests that treatments should be given at least twice per week.

Methodological Questions

The design of this study was single-blind and not double-blind since the acupuncturist knew what treatment each subject received. All subjects were treated as equally as possible apart from the different acupoints used for the two groups, and none of the subjects knew what kind of treatment she or he got. Although unintended differences in the treatment attitude cannot formally be excluded, we suggest that the results found here are mainly an effect of the acupuncture treatment given and not a placebo effect.

Our subjects reported their smoking on questionnaires. As a control blood samples were taken before the first treatment, just after the last treatment, and 8 months later and analyzed for parameters affected by smoking, for example, cotinine. There were fair correlations between the reported smoking and the serum concentration of cotinine and thiocyanate. In particular,

with one exception, those subjects who reported that they had quit smoking also showed cotinine concentrations normally found only among nonsmokers, that is, values less than 71 μg L^{-1} [*17*]. On the other hand one subject who claimed that she still smoked showed cotinine concentrations normally found only among nonsmokers. Thus, we suggest that our subjects reported their smoking honestly and that the data obtained from the questionnaires are reliable.

Two subjects in the control group (9%) reported that they had quit smoking 5 years after the last treatment. This is in line with the conclusions of a review by Viswesvaran [*27*], who examined the outcome of 3,295 subjects in 41 control groups altogether and found that on average 6.4% of all subjects in the control group had quit smoking without any further intervention or treatment. The fact that 5 years after the last treatment in the control group two subjects had quit smoking led to a large variation in the daily smoking within this group. That may have caused the nonsignificant difference in the daily smoking between the two groups at that stage.

Altogether 11 subjects, 4 in the treatment group and 7 in the control group, did not answer the 5-year follow-up questionnaire. As pointed out under Subjects and Method, all of these but 2 in the control group dropped out for reasons that should not be related to the acupuncture treatment. The dropouts did not differ from the other subjects in smoking characteristics or in age. Thus, it is reasonable to regard the dropouts in this study largely as a random effect and not as subjects who dropped out because they had experienced no effect of the treatment and thus were unwilling to participate anymore.

CONCLUSIONS

This study suggests that acupuncture can help motivated smokers to reduce their smoking or even quit smoking completely, and the effect may be lasting. A nonspecific treatment may have no lasting effect. The effect of acupuncture on smoking cessation may be related to how acupuncture affects the taste of tobacco and the desire to smoke.

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