A smoking cessation programme in HIV-infected individuals: a pilot study

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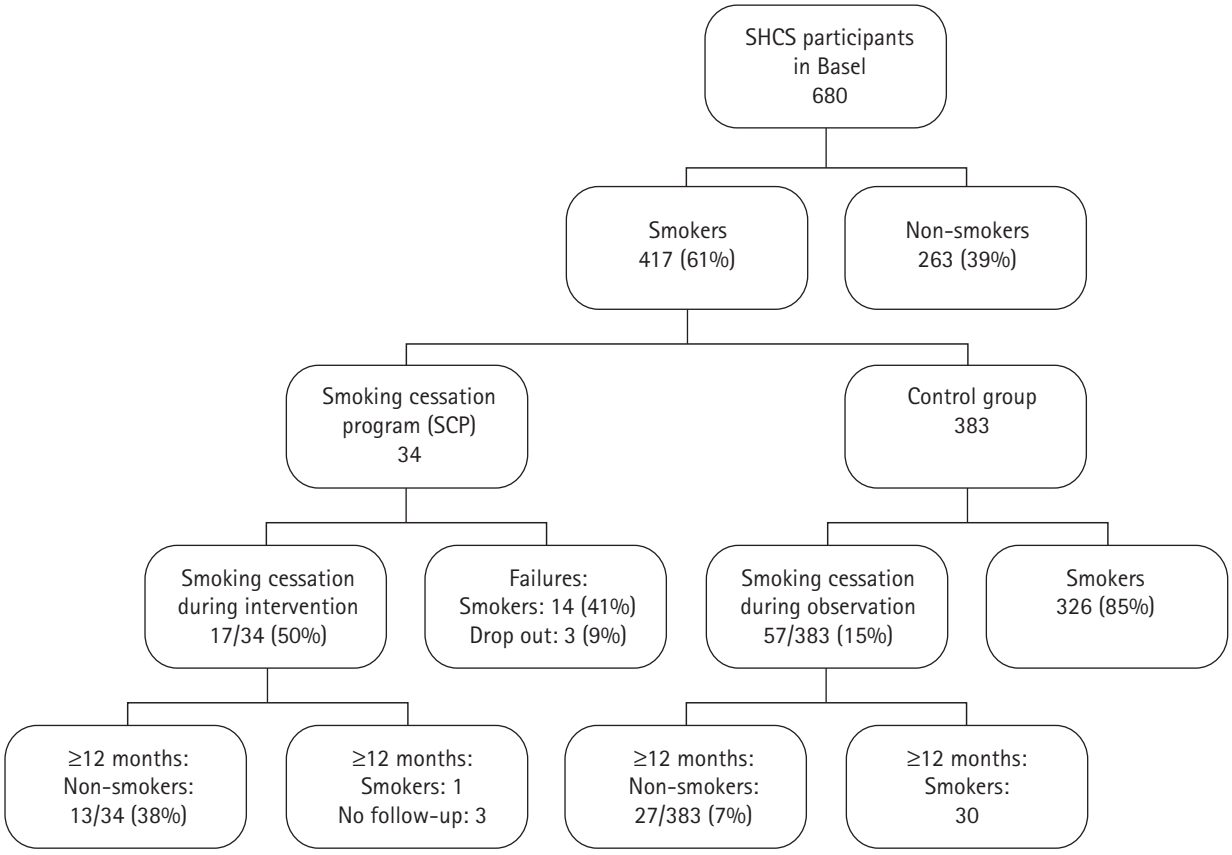
Background: Antiretroviral therapy (ART) is a risk factor for cardiovascular disease (CVD) and smoking the most important modifiable cardiovascular risk factor.
Methods: We prospectively evaluated a smoking cessation programme (SCP) in HIV-infected individuals (intervention: counselling and nicotine replacement therapy). Primary endpoint was the smoking cessation rate at 12 months; secondary endpoints were CVD morbidity and mortality. Controls were a not randomized control group of smokers not participating in the SCP.
Results: Four-hundred and seventeen of 680 (61%) patients were smokers, and 34 of these participated in the SCP. Of these 34 individuals, 82% were male, the median age was 43 years, prior AIDS was recorded in 29%, and depressive disorder was recorded in 18%. Twenty-five (74%) patients were receiving ART. Additional risk factors were dyslipidaemia (68%), a prior cardiovascular event (24%), hypertension (15%), and a family history of CVD in 2/34 (6%) individuals. According to the Framingham equation, the 10-year risk of CVD was higher in SCP participants than in controls (11.2% versus 8.5%, *P*=0.06). At termination of the SCP, 17/34 (50%) individuals had stopped smoking compared with 57/383 (15%) controls. Self-reported smoking abstinence for ≥12 months was 13/34 (38%) in the intervention group and 27/383 (7%) in the control group (odds ration 6.2, 95% confidence interval 2.8–14.3). During the follow-up, two SCP participants and 4 controls experienced a myocardial infarction. One patient in the control group died of CVD.
Conclusions: SCP in HIV-infected individuals is feasible and should be encouraged. The long-term impact of smoking cessation on CVD morbidity and mortality should be evaluated in comparative trials.

Introduction

Highly active antiretroviral therapy (ART) has led to a marked decrease in HIV-related morbidity and mortality [1–3]. However, cardiovascular diseases (CVD) are emerging causes of death among HIV-infected individuals responding well to ART [4–8]. Recently, data from the large international collaborative cohort study (D:A:D - Data Collection on Adverse Events of Anti-HIV Drugs) indicated that the prevalence of cardiovascular risk factors among HIV-infected individuals is increasing, in particular smoking was reported by over 50% of individuals and conferred a greater than twofold risk of myocardial infarction [4,5]. In addition, there is convincing epidemiological evidence linking some of the well-described metabolic complications of ART, including dyslipidaemia, insulin resistance and type 2 diabetes mellitus, with an increased risk for CVD [4]. Cigarette smoking is the most important modifiable cardiovascular risk factor. Hence, cessation of smoking is more likely to reduce cardiovascular risk than either the choice of ART or the use of any lipid-lowering therapy. Also, smoking has been associated with an increased risk for lung cancer in HIV-infected individuals, for example, in the Swiss HIV Cohort Study (SHCS), as indicated by a relative risk of 2.8, reaching 12.6 for intravenous drug users, possibly due to the higher smoking prevalence in this population [9]. In addition, chronic obstructive pulmonary disease (COPD) and respiratory infections, in particular pneumococcal and *Pneumocystis carinii* pneumonia [10–12], are more frequent among HIV-infected smokers than non-smokers. These observations emphasize the importance of implementing smoking

Figure 1. Study flow chart



Comparison of the smoking cessation programme population (*n*=34) with the control population (*n*=383), that is, smokers attending the Basel Swiss HIV Cohort Study (SHCS) centre. Non-smoking = having stopped smoking for ≥12 months.

cessation programmes (SCPs) in this population. Nevertheless, to date no controlled clinical trials have been conducted that specifically target smoking cessation among HIV-infected patients.

The primary aim of this study was to evaluate the feasibility and effectiveness of a pilot SCP among HIV-infected individuals participating in the SHCS study centre in Basel, Switzerland. Results were compared with individuals who did not participate in the SCP but were regularly followed within the SHCS. The primary endpoint was the smoking cessation rate for ≥12 months. Secondary endpoints were the prevalence of CVD morbidity and mortality, and lung cancer.

Methods

Study population

Study participants were followed within the SHCS (http://www.shcs.ch), a large prospective cohort study with continuing enrollment of HIV-infected individuals aged 16 years or older. Enrollment in the SHCS is independent from the stage of disease, the degree of immunosuppression or whether the individual is receiving ART. Over 14,000 HIV-infected individuals have been included in the SHCS so far, corresponding to about 70% of all HIV-infected individuals in Switzerland. Informed consent is obtained from all participants. Information about HIV-associated diseases, laboratory parameters and medication are assessed every 6 months. A questionnaire regarding CVD was introduced on April 1st, 2000, collecting additional data on the smoking status, weight, hip and waist measurement, body fat changes, blood pressure, family history and occurrence of CVD events or related procedures. No systematic counselling about smoking cessation is performed within the SHCS.

Study design

Between April 2000 and March 2002, we assessed the current smoking status in 680 HIV-infected individuals who had at least two cohort visits at our clinic in Basel (Figure 1). Of these, 417 (61%) were identified as smokers and 263 (39%) as non-

smokers. We defined the smoking status as at least one cigarette daily for longer than 12 months in order to identify true smokers in the database of the Swiss HIV Cohort Study (SHCS). However, all smokers in our study had been smoking since several years. Between April 2002 and March 2005, we conducted a pilot study to evaluate the feasibility and effectiveness of a SCP in HIV-infected individuals. Due to the pilot character of our study, participation in the programme was offered to those individuals who expressed interest to quit smoking, and not systematically proposed to all SHCS smokers. The primary endpoint was the smoking cessation rate at 12 months determined by self-report. Individuals who reported to have ceased smoking for at least 12 months were considered to have stopped smoking. Secondary endpoints were the CVD-related morbidity and mortality, and lung cancer.

Intervention

The SCP was delivered by two nurses trained for smoking cessation counselling [13]. Detailed smoking history and habits, level of nicotine addiction according to the Fagerstrom score [14] (high nicotine dependence is indicated by a Fagerstrom score ≥7), and readiness to quit according to the transtheoretical model of behaviour change by Prochaska and Di Clemente; that is, precontemplation, contemplation, preparation, action and maintenance [15] were assessed. Individual counselling (30 minutes sessions once weekly during the first month and once monthly thereafter for 12 months) was based on a cognitive behavioural approach, including stress coping strategies and management of nicotine withdrawal symptoms. After quitting, relapse was prevented by anticipating tempting situations and rehearsing coping strategies. Nicotine substitution, available as transdermal patches, tablets, inhalers, chewing-gums and sprays, was offered to all participants based on individual needs. Bupropion was not used as a component of the smoking cessation strategy, due to its potential interactions with ART. Study participants were contacted by phone 3 months after the end of the SCP. Twelve months after termination of the intervention patients were seen at our clinic and smoking cessation was assessed. Hence, the total study duration was 24 months. Results were compared with individuals not participating in the SCP but followed regularly within the SHCS at our clinic.

Risk factors for cardiovascular disease

Cutoffs for individual risk factors were based on those by the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III), the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNCP) [16] and the American Diabetes Association (ADA) [17]. These were defined as follows: dyslipidaemia: total cholesterol levels >6.2 mmol/l, and/or high density lipoprotein cholesterol <1.03 mmol/l and/or triglycerides >2 mmol/l; hypertension: systolic blood pressure >140 mmHg and/or diastolic blood pressure >90 mmHg (systolic >135 mmHg and/or diastolic >85 mmHg in diabetic individuals) or use of antihypertensive drugs; diabetes mellitus: fasting plasma glucose >7 mmol/l or casual plasma glucose >11.1 mmol/l or antidiabetic therapy; family history was defined as a first-degree relative with a cardiovascular event before the age of 50. The Framingham score, estimating the 10-year risk of cardiovascular events [18], was calculated for all individuals.

Collection of data

Information concerning the smoking status and history, HIV-infection, cardiovascular events, procedures, causes of death, and laboratory parameters was extracted from the SHCS database and additionally completed by review of the medical records. Information about active intravenous drug use, psychiatric comorbidity and alcohol dependence during the observation period was collected from the charts. A total of 2,525 cohort visits were performed for the entire study population.

Statistical analysis

Baseline summary statistics between the SCP and the control group were performed with individual characteristics and cardiovascular risk factors. We used the χ^2 tests or the Fischer's exact test where appropriate and *t*-tests. Factors associated with successful smoking cessation versus failure were compared in individuals who entered the SCP. The sociodemographic characteristics and cardiovascular risk factors were then compared between SCP and control group based on whether abstinence of smoking was maintained for at least 12 months. Odd ratios were calculated using the Mantel–Haenszel test. All analyses were carried out using the Statistical Analysis Systems (SAS) package (SAS Institute, Cary, NC, USA, Version 8.2).

Results

Study population

Thirty-four individuals participated in the intervention programme, and 383 individuals served as controls (Figure 1). SCP participants were mostly male (28/34, 82%), median age was 43 years (range 23–63), and body

Table 1. Sociodemographic characteristics and cardiovascular profile of SCP and the control group

Characteristic	SCP (*n*=34)	Controls (*n*=383)	*P-value*
Sociodemographic characteristics			
Male, *n* (%)	28 (82)	258 (67)	0.07
Age, years (range)	43 (23–63)	40 (18–76)	0.3
Caucasian, *n* (%)	33 (97)	328 (86)	0.234
Depressive disorder, *n* (%)	6 (18)	149 (39)	<0.05
Antidepressant treatment, *n* (%)	2 (6)	77 (20)	<0.05
Active intravenous drug use, *n* (%)	3 (9)	97 (25)	<0.05
Alcohol dependence, *n* (%)	7 (21)	114 (30)	0.26
COPD, *n* (%)	6 (18)	21 (5)	<0.05
Lung cancer, *n* (%)	1 (3)	3 (1)	0.29
Education: Higher schooling or completed professional education, *n* (%)	22 (65)	216 (56)	0.31
Workers, *n* (%)	20 (59)	137 (36)	<0.01
Prior AIDS-defining disease, *n* (%)	10 (29)	92 (24)	0.06
Median $CD4^+$ T-cell count, 10^6 cells/μl (range)	577 (100–1,714)	470 (5–1,521)	0.06
Individuals receiving ART, *n* (%)	25 (74)	222 (58)	0.08
Cigarettes smoked daily, *n* (range)	28 (5–69)	21 (1–80)	<0.01
Pack years, *n* (range)	35 (5–93)	26 (1–120)	<0.01
Cardiovascular profile			
History of CVD:			
Coronary heart disease, *n* (%)	5 (15)	3 (0.8)	<0.01
Stroke, *n* (%)	0 (0)	2 (0.5)	0.67
Peripheral vascular disease, *n* (%)	3 (9)	3 (0.8)	<0.01
Hypertension, *n* (%)	5 (15)	10 (3)	<0.01
Diabetes mellitus, *n* (%)	0 (0)	6 (16)	0.46
Dyslipidaemia, *n* (%)	23 (68)	326 (85)	<0.01
Family history of CVD, *n* (%)	2 (6)	66 (17)	0.08
Framingham score (10-year cardiovascular risk), % (±SD)	11.2 (7.9)	8.5 (8.1)	0.06

COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; SCP, smoking cessation programme.

mass index 22 kg/m^2 (range 17–27; Table 1). A prior AIDS-defining disease was found in 10 (29%) patients. Of note, six individuals (18%) had a depressive disorder, but only two were treated with antidepressant drugs and none received psychiatric treatment. Three individuals (9%) were active intravenous drug users, and 7 (21%) reported alcohol dependence. The level of nicotine addiction was considered to be high (Fagerstrom score ≥7) in most individuals (74%). Twenty-five (74%) individuals were receiving ART. Median $CD4^+$ T-cell count was 577×10^6 cells/μl (range 100–1,714) and HIV-1-RNA 2.8 $\log_{10}$ copies/ml (range 1.3–5.2). Additional cardiovascular risk factors were a prior cardiovascular event in 8 (24%) patients (coronary heart disease in 5, peripheral vascular disease in 3), hypertension in 5 (15%), family history of CVD in 2 (6%) and dyslipidaemia in 23 (68%) individuals (Table 1). Five patients had ≥3 risk factors for CVD, none had diabetes mellitus. Chronic obstructive pulmonary disease (COPD) was present in 6 (18%) individuals, and lung cancer in one. Most individuals (26/34, 76%) were considered to be in transtheoretical model phase 3 (preparation) to quit smoking, while 8/34 (24%) were in phase 2 (contemplation).

Control group

The control group consisted of 383 smokers not participating in the SCP but followed regularly within the SHCS. The socio-demographic characteristics were similar in both groups (Table 1), except for the lower proportion of active intravenous drug users (9% versus 25%, $P<0.05$) and depressive disorder (18% versus 39%, $P<0.05$) in the SCP. The education and employment levels were higher in the intervention group than in the control group (65% versus 56% SCP individuals had completed apprenticeship or higher professional schooling and significantly more SCP participants were workers). Individuals in the SCP group reported a higher number of cigarettes smoked daily and pack years in comparison with the control group. We could not assess the willingness to quit smoking according to the transtheoretical model of behaviour change by Prochaska and

Table 2. Baseline characteristics of the SCP population (*n*=34) according to successful smoking cessation at 12 months versus failure

Characteristic	Successful smoking cessation (*n*=13)	Failure of smoking cessation (*n*=21)	*P-value*
Male, *n* (%)	12 (92)	16 (76)	0.63
Age, years (range)	45 (35–63)	42 (23–58)	0.34
Depressive disorder, *n* (%)	1 (8)	5 (24)	0.37
Antidepressant treatment, *n* (%)	1 (8)	1 (5)	1.00
Active intravenous drug use, *n* (%)	0	3 (14)	0.27
Alcohol dependence, *n* (%)	2 (15)	5 (24)	0.68
COPD, *n* (%)	2 (15)	4 (20)	1.00
Lung cancer, *n* (%)	0	1 (5)	1.00
Framingham score (10-year cardiovascular risk), %, (± SD)	14.54 (9.25)	9.52 (6.57)	0.07
Prior AIDS-defining disease, *n* (%)	4 (31)	6 (29)	1.00
$CD4^+$ T-count, 10^6 cells/μl (range)	596 (100–1,714)	562 (145-1268)	0.79
Individuals receiving ART, *n* (%)	10 (77)	15 (71)	1.00
Individuals treated with ART showing HIV-RNA <400 copies/ml, *n* (%)	7 (70%)	10 (71)	0.72
Cigarettes smoked per day, *n* (range)	28 (5–60)	28 (15–69)	0.99
Pack years, *n* (range)	39 (7–90)	32 (6–93)	0.40
Fagerstrom score ≥7, *n* (%)	10 (77)	15 (71)	0.72
Age at smoking beginning, years (range)	17 (15–18)	19 (14–37)	0.13
Previous attempts to stop* [n, range]	5 (1–19)	8 (1–19)	0.25
Individuals in phase 2 of TTM†, *n* (%)	2 (15)	6 (29)	0.44
Individuals in phase 3 of TTM†, *n* (%)	11 (85)	15 (71)	0.44
Individuals living with smokers, *n* (%)	4 (31)	7 (34)	1.00

*Median number of past attempts to stop smoking. †TTM, transtheoretical model of change in behaviour by Prochaska and Di Clemente, indicating phase 2 (contemplation) or phase 3 (preparation) to stop smoking. COPD, chronic obstructive pulmonary disease.

Di Clemente in the control group, since detailed information for most control patients was lacking. We did investigate the interest to quit smoking in a representative subset of 190 smokers. Of these, 78 (41%) had tried to stop smoking. Hence, we may assume that at least one-third of all the study population was in transtheoretical model phase 2 (contemplation) or in phase 3 (preparation). COPD was more frequent among SCP participants (18% versus 5%, $P<0.05$), whereas lung cancer was equally observed in both groups. Importantly, major differences concerning the cardiovascular profile were noted between SCP and controls (Table 1). The 10-year risk of cardiovascular events according to the Framingham equation was higher among SCP participants than in the control group (11.2% versus 8.5%, $P=0.06$). The stage of HIV-infection, the $CD4^+$ T-cell count and the use of ART were similar in both groups, although slightly more SCP participants were receiving ART at enrollment into the study (75% versus 58%, $P=0.08$).

Smoking cessation

At the end of the SCP, 17/34 (50%) individuals had stopped smoking, compared with 57/383 (15%) in the control group. The self-reported smoking abstinence for ≥12 months was 13/34 (38%) in the intervention group and 27/383 (7%) among controls (OR 6.2, 95% CI 2.8–14.3). Only one SCP participant relapsed (after 6 months), whilst 1-year follow-up data are lacking for 3 SCP patients. Among those individuals who did not quit smoking during the intervention, 5 were able to reduce the number of cigarettes smoked by more than 50%; however, this was considered to be failure at evaluation. Four participants never attempted to stop smoking and three individuals dropped out due to lost of follow-up (Figure 1). Most SCP participants (25/34, 75%) required nicotine substitution. The preferred type of nicotine replacement were transdermal patches (65%), followed by chewing gums (56%), tablets (50%), inhalers (29%) and sprays (9%). The average body weight gain during the observation period was 1.7 kg among quitters and 2.5 kg among non-quitters. During the observation two individuals in the control group experienced recurrent bacterial pneumonia, while no *Pneumocystis carinii* pneumonia was recorded. We investigated factors associated with a successful smoking cessation among SCP participants (Table 2). A depressive disorder, active intravenous

Table 3. Predictors for successful smoking cessation at 12 months

Characteristic	SCP (*n=34*)	Control (*n=383*)	All smokers (*n=417*)	*P-value**
	Odds ratio (corresponding 95% confidence interval)			
Gender, male	2.82 (0.27, 28.52)	1.42 (0.58, 3.44)	1.56 (0.68, 3.57)	0.58
Ethnicity, Caucasian	–	1.61 (0.37, 7.06)	1.84 (0.43, 7.95)	0.54
Active intravenous drug use	–	0.35 (0.10, 1.18)	0.32 (0.10, 1.00)	0.40
Alcohol dependence	0.55 (0.09, 3.56)	0.51 (0.19, 1.39)	0.53 (0.22, 1.27)	0.91
Depressive disorder	0.27 (0.03, 2.59)	0.53 (0.22, 1.28)	0.48 (0.21, 1.09)	0.58
Education: higher schooling or completed professional education	0.27 (0.05, 1.57)	0.74 (0.32, 1.73)	0.61 (0.29, 1.29)	0.30
	Mean difference (corresponding 95% confidence interval)†			
Age, years	2.79 (-3.06, 8.65)	2.52 (-1.01, 6.04)	3.28 (0.36, 6.20)*	
Cigarettes smoked daily	0.01 (-10.55, 10.55)	0.02 (-6.34, 6.38)	2.88 (-1.98, 7.75)	
Pack years	6.83 (-9.52, 23.18)	1.12 (-5.56, 7.81)	3.45 (-2.36, 9.26)	
Framingham score	5.02 (-0.51, 10.54)	3.08 (-0.08, 6.25)	4.04 (1.42, 6.67)†	

*P-value for heterogeneity of odd ratios between the smoking cessation programme (SCP) and the control group using the Breslow–Day heterogeneity test when calculating the odds ratio regardless of patient grouping (based on the Mantel–Haenszel test). †Mean difference in characteristic value between those who stopped smoking and those who did not stop smoking for each grouping. †Statistically significantly associated at the 5% significance level.

drug use or alcohol dependence were more frequently observed in non-quitting patients during the intervention program, but these differences did not reach statistical significance. When SCP participants were compared with the control group (Table 3), the only predictors for successful sustained smoking cessation at 12 months were a more advanced age and a higher Framingham score ($P<0.05$).

Cardiovascular morbidity and mortality

During follow-up, two out of 34 SCP participants and four out of 383 controls experienced an acute myocardial infarction. Furthermore, two individuals in the SCP and three in the control group underwent percutaneous transluminal coronary angioplasty; none required coronary artery bypass graft surgery. In the SCP group one patient died of lung cancer after 13 months. Among the control group, 32/383 (8%) individuals died during the observation, 11 deaths were HIV-related, of which one was related to lung cancer, and one to CVD. In the control group, three patients developed lung cancer during the follow-up.

Discussion

The results of our study provide first evidence that a SCP among HIV-infected individuals is feasible, as demonstrated by the significantly higher rate of smoking abstinence at 12 months in comparison with control individuals followed within the SHCS (38% versus 7%, OR 6.2, 95% CI 2.8–14.3).

Approximately 60% of HIV-infected individuals at our clinic were smokers compared with ~30–40% in the Swiss general population of the same age [19]. These findings reflect the high prevalence of cardiovascular risk factors observed among this population [4–8] and emphasize the importance of planning smoking cessation programmes for HIV-infected individuals with regard to the prolonged survival related to ART. In this particular context, interventions should implement access to smoking cessation programmes of demonstrated efficacy and increase motivation to quit [20]. However, as indicated by the high smoking prevalence in the SHCS, nicotine abstinence may be very difficult to achieve. On the other hand, the HIV-specific long-term care setting provides an excellent opportunity to deliver smoking cessation interventions.

The high sustained abstinence from smoking among SCP participants in our study may be explained by several factors. First, most individuals entering our intervention programme were highly motivated to quit smoking, as indicated by the voluntary enrollment in the study, the estimated readiness to quit according the transtheoretical model phase of preparation and the low drop-out rate during the observation period. Furthermore, SCP participants demonstrated a trend towards higher cardiovascular risk as compared to the control group (Framingham score 11.2% versus 8.5%, $P=0.06$), which may additionally have increased their motivation to quit smoking. In particular, 24% of patients in the intervention group had a history of CVD, compared with only 2% in the control group. Also, we could identify the Framingham score as predictor for smoking cessation (Table 3). We used the Framingham equation in our study, since it has been demonstrated to be useful for assessing the cardiovascular risk in HIV-infected individuals as shown in the D:A:D study [21]. The cardiovascular risk score based

on the PROCAM study [22] may overestimate CHD risk in HIV-infected individuals, since they are younger than the general population at cardiovascular risk, and metabolic complications related to ART are of acute onset and not a result of a more stable damage over years. Overall, smoking cessation is likely to be related to the motivation of the smokers to attempt to quit. Individuals who are aware of an imminent health problem or have a history of CVD are more likely to quit smoking [23–27], whereas smoking cessation rates tend to be lower in studies recruiting hospitalized patients unselected for their readiness to quit [28,29]. In particular, after a coronary event or coronary artery bypass surgery 30–45% of patients were reported to stop smoking spontaneously [23,27]. Nevertheless, high relapse rates up to 50% within the first 6 months were noted even if SCPs were used [24–27], suggesting that long-term support after quitting may be necessary to prevent relapse even in highly motivated patients. Second, the SCP consisted of intervention strategies, that is, counselling and nicotine replacement therapy, which have been associated with long-term smoking cessation rates in 15-30% of smokers regardless of the clinical setting [30–38]. It is estimated, that about one-third of smokers try to stop smoking each year, but only 20% of them seek help [39] and less than 10% achieve long-term success when trying to quit on their own [30]. While even brief medical advice during routine care can increase the smoking abstinence rate significantly (OR 1.74, 95% CI 1.45–2.05) [37], practical guidelines generally recommend a brief intervention in which asking about tobacco use is followed by advice to quit and an assessment of the smoker's willingness to make a quit attempt [30–34]. Hence, patients wishing to stop should be offered specific assistance and follow-up [32,34]. In addition, nicotine replacement therapy, which aims to reduce the withdrawal symptoms associated with smoking cessation, was demonstrated to increase the chances of long-term quitting approximately by 1.5 to 2-fold regardless of the intensity of the additional support provided to the smoker (OR 1.77, 95% CI 1.66–1.88) [37]. Finally, the proportion of active intravenous drug users and depressive disorders were lower among SCP participants than in the control group ($P<0.05$). This suggests a selection of individuals more motivated to quit in the intervention group, since drug users often consider smoking a minor problem compared with their illegal drug consumption and/or HIV-infection, an attitude which is possibly shared by physicians. Furthermore, the presence of depression/anxiety and other dependency such as alcohol, cannabis or other illicit drugs have been variably associated with a lower chance to quit smoking [40,41]. However, among SCP participants (Table 2), the presence of active intravenous drug use, depressive disorder or alcohol dependence were not correlated with a failure of smoking cessation at 12 months, although due to partly small numbers interpretation is difficult. Further analysis of sociodemographic characteristics revealed a higher education level among SCP participants in comparison with the control group (65% versus 56% had completed apprenticeship or higher professional school), and a higher employment degree (59% versus 36% were workers, $P<0.05$). This is in agreement with a study which reported sociodemographic factors with successful smoking cessation [42]. Importantly, stage of HIV-infection, median CD4 T-cell count, and use of ART were similar in both groups, suggesting that motivation to quit smoking is not related to specific characteristics associated with HIV-infection. In the control group we noted a smoking cessation rate of 7% for ≥12 months, which is similar to quit rates observed among the general population if no intervention to promote smoking is performed [30]. The latter aspects suggest that HIV-infection does not represent a barrier to quit smoking, and that interventions to promote smoking cessation among this population should be encouraged and included in the standard care.

A total of six smokers, two SCP participants and four controls, experienced an acute myocardial infarction during follow-up (incidence, 4.4 events per 1,000 person-years), compared with 11 of 680 HIV-infected individuals (incidence, 3.9 events per 1,000 person-years), that is, the entire population at our clinic including non-smokers. These results indicate that the incidence of coronary events was high in our study population. The D:A:D study reported an incidence of 3.5 events per 1,000 person-years [4]. Only one patient in the control group died of CVD. However, the number of individuals is too small to have any meaningful outcome. Moreover, since smoking cessation after myocardial infarction was associated with a 50% reduction in mortality rate after 3–4 years [43], the impact of smoking cessation on CVD morbidity and mortality should be evaluated in comparative trials.

Limitations of this prospective study are the small number of participants and the non-randomized enrollment in the intervention programme, since our findings indicate that SCP participants represent a selection of patients with a high cardiovascular risk, and therefore high motivation to quit smoking. We could not assess the exact willingness to quit smoking in the entire control group. Nevertheless, we may assume that at least one-third of HIV-infected individuals in the control group were in the contemplation or preparation phase of the transtheoretical model. This percentage is considerably lower than in SCP participants. Hence, the

efficacy of implementing such a programme for an unselected HIV population is most likely overestimated. However, our results indicate that when participants are motivated smoking cessation programs have a chance to be successful. A further limitation is the self-reported smoking abstinence without assessment of biomarkers as indicators of nicotine abstinence. However, we believe that the self-report to have quit smoking is reliable in a setting where most individuals have been attending our clinic for many years.

Our study has also several strengths. To our knowledge, this is the first prospectively conducted study on smoking cessation in a controlled HIV-specific health care setting with a prolonged follow-up. In addition, we could compare the study population with the entire HIV population of our centre and identify predictors of smoking cessation that may help clinicians to implement more effective smoking cessation interventions for HIV-infected individuals.

Conclusions

In conclusion, our study demonstrates that a SCP delivered by trained nurses is a valuable instrument to support HIV-infected individuals to quit smoking. Comparative trials will be needed to evaluate the long-term impact of smoking cessation interventions on the incidence of cardiovascular events, but also the risk reduction for lung cancer and its associated mortality.

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References

1. Egger M, Hirschel B, Francioli P, *et al.* Impact of new antiretroviral combination therapies in HIV infected patients in Switzerland: prospective multicenter study. Swiss HIV Cohort Study. *BMJ* 1997; **315:**1194–1199.
2. Palella FJ, Delaney KM, Moorman AC, *et al.* Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. HIV Outpatient Study Investigators. *N Engl J Med* 1998; **338:**853–860.
3. Egger M, May M, Chene G, *et al.* Prognosis of HIV-1-infected patients starting highly active antiretroviral therapy: a collaborative analysis of prospective studies. *Lancet* 2002; **360:**119–129.
4. Friis-Moller N, Sabin CA, Weber R, *et al.* Combination antiretroviral therapy and the risk of myocardial infarction. *N Engl J Med* 2003; **349:**1993–2003.
5. Saves M, Chene G, Ducimetière P, *et al.* Risks factors for coronary heart disease in patients treated for human immunodeficiency virus infection compared with the general population. *Clin Infect Dis* 2003; **37**:292–298.
6. Friis-Moller N, Weber R, Reiss P, *et al.* Cardiovascular disease risk factors in HIV patients - association with antiretroviral therapy. Results from the D:A:D study. *AIDS* 2003; **17:**1179–1193.
7. D'Arminio A, Sabin CA, Phillips AN, Reiss *et al.* Cardio- and cerebrovascular events in HIV-infected persons. *AIDS* 2004; **18:**1811–1817.
8. Sabin C, Morfeldt L, Friis-Moller N, *et al.* Changes over time in the use of antiretroviral therapy and risk factors for cardiovascular disease in the D:A:D study. *12th Conference on Retroviruses and Opportunistic Infections*. 22–25 February 2005, Boston, USA. Abstract 866.
9. Clifford GM, Polesel J, Rickenbach M, *et al.* Cancer risk in the Swiss HIV Cohort Study: associations with immunodeficiency, smoking, and highly active antiretroviral therapy. *J Natl Cancer Inst* 2005; **97**:425–432.
10. Miguez-Burbano MJ, Rodriguez AD, Pitchenik DR, Quintero, Flores M, Shor-Posner G. Increased risk of Pneumocystis carinii and community-acquired pneumonia with tobacco use in HIV disease. *Int J Infect Dis* 2005; **9**:208–217.
11. Arcavi L, Benowitz NL. Cigarette smoking and infection. *Arch Intern Med* 2004; **164**:2206–2216.
12. Crothers K, Griffith TA, McGinnis KA, *et al.* The impact of cigarette smoking on mortality, quality of life, and comorbid illness among HIV-positive veterans. *J Gen Intern Med* 2005; **20**:1142–1145.
13. Voggensperger J, Nicca D, Battegay M, Zellweger JP, Spirig R. Smoking cessation for HIV infected patients. *Pflege* 2003; **16:**283–288.
14. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom test for nicotine dependence: a revision of the Fagerstrom tolerance questionnaire. *Br J Addiction* 1991; **86**:1119–1121.
15. Di Clemente CC, Prochaska JO, Fairhurst SK, Velicer WF, Velasquez MM, Rossi JS. The process of smoking cessation: an analysis of precontemplation, contemplation, and preparation stages of change. *J Consult Clin Psychol* 1991; **59:**295–304.
16. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation* 2002; **106:**3143–3421.
17. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2005; **28 Suppl 1:**S37–42.
18. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998; **97**:1837–1847
19. Galobardes B, Costanza MC, Bernstein MS, Delhumeau CH, Morabia A. Trends in risk factors for the

major "lifestyle-related diseases" in Geneva, Switzerland, 1993–2000. *Annal Epidemiol* 2003; **13:**537–540.

20. Niaura R, Shadel WG, Morrow K, Tashima K, Flanigan T, Abrams DB. HIV infection, AIDS, and smoking cessation: the time is now. *Clin Infect Dis* 2000; **31**:808–812.
21. Law MG, Friis-Moller N, El-Sadr WM, *et al*. The use of the Framingham equation to predict myocardial infarctions in HIV-infected patients: comparison with observed events in the D:A:D study. *HIV Med* 2006; **7**:218–221.
22. Cullen P, Schulte H, Assman G. The Münster Heart Study (PROCAM): total mortality is increased at low total and LDL-cholesterol concentrations in smokers but not in nonsmokers. *Circulation* 1997; **96**:2128–2136.
23. Rigotti NA, McKool KM, Shiffman S. Predictors of smoking cessation after coronary artery bypass graft surgery. Results of a randomized trial with 5-year follow-up. *Ann Intern Med* 1994; **120**:287–293.
24. Quist-Paulsen P, Gallefoss F. Randomised controlled trial of smoking cessation intervention after admission for coronary heart disease. *BMJ* 2003; **327:**1254–1258.
25. Dornelas EA, Sampson RA, Gray JF, Waters D, Thompson PD. A randomized controlled trial of smoking cessation counseling after myocardial infarction. *Prev Med* 2000; **30:**261–268
26. Hilleman DE, Mohiuddin SM, Packard KA. Comparison of consevative and aggressive smoking cessation treatment strategies following coronary artery bypass surgery. *Chest* 2004; **125:**435–438.
27. Vliestra R, Kornmal R, Oberman A, *et al*. Efffect of cigarette smoking on survival of patients with angiographically documented coronary artery disease: report from the CASS registry. *JAMA* 1986; **255**:1023–1027.
28. Ockene IS, Haymann LL, Pasternak RC, Schron E, Dumbar-Jacob J. Adherence issues and behavior changes: achieving a long-term solution. 33rd Bethesda Conference. *J Am Coll Cardiol* 2002; **40**:630–640.
29. Rigotti NA, Amsten JH, McKool KM, Wood-Reid KM, Pastemak RC, Singeer DE. Efficacy of a smoking cessation program for hospital patients. *Arch Intern Med* 1997; **157**:2653–2660.
30. A clinical practice guideline for treating tobacco use and dependence: A US Public Health Service report. The Tobacco Use and Dependence Clinical Practice Guideline Panel, Staff, and Consortium Representatives. *JAMA* 2000; **283:**3244–3254.
31. Rigotti NA. Clinical practice. Treatment of tobacco use and dependence. *N Engl J Med* 2002; **346:**506–512.
32. West R, McNeill A, Raw M. Smoking cessation guidelines for health professionals: an update. Health Education Authority. *Thorax* 2000; **55:**987–999.
33. Anderson JE, Douglas EJ, Scott WJ, Fiore MC. Treating tobacco use and dependence: an evidence-based clinical practice guideline for tobacco cessation. *Chest* 2002; **121**:932–941.
34. Fiore MC, Hatsukami DK, Baker TB. Effective tobacco dependence treatment. *JAMA* 2002; **288**:1768–1771.
35. Lancaster T, Stead L, Silagy C, Sowden A. Effectiveness of interventions to help people stop smoking: findings from the Cochrane Library. *BMJ* 2000; **321:**355–358.
36. Siglay C, Lancaster T, Stead L, Mant D, Fowler G. Nicotine replacement therapy for smoking cessation. *The Cochrane Database Syst Rev* 2004; **3:**CD000146.
37. Lancaster T, Stead LF. Individual behavioural counseling for smoking cessation. *Cochrane Database Syst Rev* 2005; **2:**CD001292.
38. Zhu S, Melcer T, Sun J, Rosbrook B, Pierce JP. Smoking cessation with and without assistance: a population-based analysis. *Am J Prev Med* 2000; **18:**305–311.
39. Lancaster T, Stead LF. Physician advice for smoking cessation. *Cochrane Database Syst Rev* 2004; **4:**CD000165.
40. Covey LS, Glassman AH, Stetner F, Becker J. Effect of history of alcoholism or major depression on smoking cessation. *Am J Psychiatry* 1993; **150:**1546–1547.
41. Humfleet G, Munoz R, Sees K, Reus V, Hall S. History of alcohol or drug problems, current use of alcohol or marijuana and success in quitting smoking. *Addict Behav* 1999; **24**:149–154.
42. Whelan AM, Cooke CA, Sketris IS. The impact of socioeconomic and demographic factors on the utilization of smoking cessation medications in patients hospitalized with cardiovascular disease in Nova Scotia, Canada. *J Clin Pharm Th* 2005; **30**:165–171.
43. Critchley JA, Capewell MD. Mortality risk reduction associated with smoking cessation in patients with coronary heart disease. *JAMA* 2003; **290**:85–97.

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