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ORIGINAL RESEARCH

Outcome of smoking cessation counselling of HIV-positive persons by HIV care physicians

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Objectives

Smoking is the most prevalent modifiable risk factor for cardiovascular diseases among HIV-positive persons. We assessed the effect on smoking cessation of training HIV care physicians in counselling.

Methods

The Swiss HIV Cohort Study (SHCS) is a multicentre prospective observational database. Our single-centre intervention at the Zurich centre included a half day of standardized training for physicians in counselling and in the pharmacotherapy of smokers, and a physicians' checklist for semi-annual documentation of their counselling. Smoking status was then compared between participants at the Zurich centre and other institutions. We used marginal logistic regression models with exchangeable correlation structure and robust standard errors to estimate the odds of smoking cessation and relapse.

Results

Between April 2000 and December 2010, 11 056 SHCS participants had 121 238 semi-annual visits and 64 118 person-years of follow-up. The prevalence of smoking decreased from 60 to 43%. During the intervention at the Zurich centre from November 2007 to December 2009, 1689 participants in this centre had 6068 cohort visits. These participants were more likely to stop smoking [odds ratio (OR) 1.23; 95% confidence interval (CI) 1.07–1.42; $P = 0.004$] and had fewer relapses (OR 0.75; 95% CI 0.61–0.92; $P = 0.007$) than participants at other SHCS institutions. The effect of the intervention was stronger than the calendar time effect (OR 1.19 *vs.* 1.04 per year, respectively). Middle-aged participants, injecting drug users, and participants with psychiatric problems or with higher alcohol consumption were less likely to stop smoking, whereas persons with a prior cardiovascular event were more likely to stop smoking.

Conclusions

An institution-wide training programme for HIV care physicians in smoking cessation counselling led to increased smoking cessation and fewer relapses.

Keywords: cardiovascular risk factors, HIV infection, Prochaska/Di Clemente model on behaviour change, smoking, smoking cessation counselling

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*Details are given in the Appendix.

Introduction

Tobacco smoking is the most prevalent risk factor for cardiovascular diseases (CVDs) and some malignancies [1,2]. Smoking is more prevalent in HIV-positive persons than in the general population, and smoking cessation reduces the risk of myocardial infarction in both groups [3]. Because antiretroviral treatment (ART) has greatly improved the course of HIV infection, clinical manifestations have changed: increasingly, non-AIDS morbidity and mortality are the focus of care – including cancers, CVD, diabetes mellitus, and liver diseases [4,5]. Many of these comorbidities are associated with modifiable risk factors [1], or are age-related [6].

Up to 70% of smokers in the general population intend to stop smoking, but without support less than 10% of those who intend succeed (i.e. approximately 2–3% per year) [7–8]. Only around 20% of smokers seek professional support, although smoking cessation counselling and pharmacotherapy increase the rate of smoking cessation, and the combination of both interventions has the highest chance of success [8–14]. In contrast, studies suggest that, without special education, physicians are often not convinced that counselling is of any benefit, and counselling is offered in only one-third of consultations [15–17]. However, physicians who have attended smoking cessation training are more likely to provide counselling, which has a positive effect on the smoking cessation of their patients [18,19]. Little information is available on how smoking cessation is addressed in HIV care. A pilot study at the Basle centre of the Swiss HIV Cohort Study (SHCS) found that smoking cessation was particularly successful among participants with a higher CVD risk profile [20]. Physicians appear often to neglect to identify smokers, and consequently do not offer advice on how to stop smoking [15,21]. Smoking cessation intervention studies in HIV-positive persons have mainly been conducted in selected or highly motivated smokers [20,22,23].

We hypothesized that training of HIV care physicians would increase the rate of smoking cessation among their patients. Therefore, from November 2007, all physicians at the Zurich SHCS centre underwent a half day of structured training in counselling and in the pharmacotherapy of smokers, and a prospective evaluation of this programme was initiated. The aims of this study were (i) to examine the feasibility of integrating structured counselling training for smoking cessation in HIV out-patient care; (ii) to describe the smoking cessation counselling activity of physicians after training; and (iii) to assess the effect of physicians' training by comparing the rates of smoking over time between participants attending the Zurich centre and those at other SHCS institutions without similar programmes.

Methods

Study population

The SHCS is a prospective observational cohort study, established in 1988, that continuously enrols and follows HIV-positive individuals aged $\geq$16 years at five university out-patient clinics, two cantonal hospitals, 14 affiliated regional hospitals, and 39 private practices collaborating with the university centres [24]. Laboratory, clinical and behavioural characteristics are collected at registration and at follow-up visits every 6 months. To study the smoking status, we selected cohort participants with at least one follow-up visit with available information on smoking after 1 April 2000, when information on smoking behaviour was included in the cohort questionnaires. The SHCS was approved by local ethical review boards, and written informed consent was obtained from all participants.

Intervention

The single centre intervention included training for HIV care physicians on smoking cessation counselling and in the pharmacotherapy of nicotine dependence, and a physicians' checklist for semi-annual documentation of counselling.

Between November 2007 and December 2009, all physicians at the HIV out-patient clinic at the University Hospital Zurich took part in half a day of training on smoking cessation. This training – conducted in a standardized way by trainers of the Swiss Lung Association – included information on identification of smokers, nicotine dependence, nicotine withdrawal-related problems, motivation stages of intended behavioural change of substance-dependent persons according to the Prochaska/Di Clemente transtheoretical model [19,25], methods of counselling, and pharmacological support of smoking cessation.

At every cohort visit during the intervention period, physicians had to complete a short checklist to document the participants' smoking status, their current motivation level to stop smoking, and physician's support offered at this visit. Support for smoking cessation included short or detailed counselling about problems associated with smoking cessation, information on medication (nicotine, bupropion and varenicline), arranging a follow-up appointment for further discussion about smoking cessation, and, if appropriate, planning a date for smoking cessation.

Definitions

According to the broadly accepted criterion of 6 months of nicotine abstinence for smoking cessation [26], we defined

a smoking cessation event as at least one follow-up visit with smoking followed by at least two consecutive semi-annual follow-up visits without smoking. Conversely, we chose two consecutive semi-annual follow-up visits without smoking followed by at least one visit with smoking as a relapse.

Motivation to stop smoking was assessed as an intention to stop immediately (i.e. 'action' according to the Prochaska/Di Clemente model of health behaviour change) [19,25], an intention to stop within the next 6 months ('preparation'), an intention to stop later ('contemplation'), no intention to stop, or no assessment made.

Alcohol use was classified according to the World Health Organization (WHO) definition as severe use (> 40 g/day for women and > 60 g/day for men), moderate use (20–40 g/day for women and 40–60 g/day for men) or light use (< 20 g/day for women and < 40 g/day for men).

Framingham 10-year risks for CVD, coronary heart disease (CHD) and myocardial infarction (MI) were calculated for every semi-annual follow-up visit [27]. Cardiovascular events were collected according to the D:A:D study protocol [1] and included MI, cerebral haemorrhage, cerebral infarction, coronary angioplasty/stenting, carotic endarterectomy, coronary artery by-pass grafting, procedures on other arteries, deep vein thrombosis and pulmonary embolism.

Statistical analyses

Transition between motivation levels and association with smoking cessation

Smoking status and counselling checklists at the Zurich centre were scanned using the TELEFORM® V10.2 software (Cardiff Software, Inc., Vista, CA, USA), and cross-linked with hospital records to identify visits without a checklist.

The probability of moving between different motivation levels was estimated using a first-order Markov model that allowed for missed visits or incomplete checklists. The association between motivation level at the previous visit and smoking status at the current visit was further analysed with marginal logistic regression using generalized estimating equations (GEEs) with exchangeable correlation structure and robust standard errors taking into account repeated measures per individual.

Smoking prevalence

The percentage of cohort visits with smoking was calculated on a yearly basis from April 2000 until December 2010. Prevalence plots over time were stratified by setting (Zurich centre, other SHCS centres and private practices), by presumed HIV transmission categories, and by sex.

Smoking cessation and relapses

To assess smoking cessation, two consecutive semi-annual follow-up visits after a visit with smoking were analysed in nonoverlapping triplets, first identifying cessation events, and then assigning noncessation events to the remaining triplets of consecutive observations. As participants could contribute at multiple time-points, we applied marginal logistic regression models with exchangeable correlation structure and robust standard errors to determine the odds of smoking cessation. Because of different levels of smoking prevalence between private practices and hospital-based institutions, and because of our interest in separate estimates for the intervention site of the Zurich centre, we chose a covariable for the setting with three levels: Zurich centre, other centres, and private practices. Calendar year was a covariable used to assess changes over time.

The basic multivariable model 1 incorporated calendar year and setting, with interaction terms assigning individual intercepts and time-changes for each setting. We included a covariable for the duration of the smoking cessation intervention at the Zurich centre. This variable was set to 0 for all settings and years except for the Zurich centre, where it was assigned values of 1, 2 and 3 for the intervention years 2008, 2009 and 2010, respectively. The completion of checklists was stopped in December 2009 but the regular training was maintained. We therefore hypothesized that the positive effects would continue for some time.

Because differences in patient characteristics between the different settings could potentially contribute to the effect observed, we fitted a second multivariable model with additional covariables: sex, age (grouped as <30, 30–49 and ≥50 years), HIV transmission category [with injecting drug users (IDUs) separated into former and current IDUs], occurrence of a cardiovascular event in the previous 2 years, and current psychiatric treatment or depression. Because Framingham risk scores are only defined for individuals aged 30–74 years, and collection of information on alcohol use was not started before 2005 in the SHCS, the sensitivity analysis (model 3) could only be performed on a subset of participants aged 30–74 years with information on alcohol use. We used the upper quartiles of the 10-year risks for CVD, CHD and MI as covariables. As Framingham scores incorporate information on current smoking, we lagged these scores by 6 months to avoid reverse causality with our outcome of interest.

Analyses were performed using R (version 2.10.1, 14.12.2009; The R Foundation for Statistical Computing, Vienna, Austria) [28] and STATA software (version 11.2; StataCorp, College Station, TX).

Results

Selection of participants

A total of 11 056 SHCS participants with available smoking information had 121 238 follow-up visits and 64 118 person-years of follow-up between April 2000 and December 2010, and contributed to the smoking prevalence analyses (Fig. 1). During the intervention at the Zurich centre from November 2007 to December 2009, 1689 participants were seen at this centre. The effect of the intervention was assessed in a smoking cessation analysis among 5805 smokers with at least three follow-up visits, and in a relapse analysis among 1953 participants who had stopped smoking over at least two consecutive semi-annual visits.

Participants at the Zurich centre were around 6 years older than those in other settings (Table 1), and were less likely to be alcohol abstinent (36% *vs.* 55% in other centres, and 50% in private care). Private physicians tended to care for more men who have sex with men (50% *vs.* 42% at the Zurich centre, and 26% in other centres), and for those with less advanced HIV disease [20% in Centers for Disease Control and Prevention (CDC) stage C *vs.* 24% at the Zurich centre, and 28% in other centres].

Smoking cessation counselling activities at different SHCS institutions

Activities of different SHCS institutions concerning smoking cessation counselling were annually assessed using a brief structured questionnaire. No institution except the Zurich centre offered structured programmes during the study period. Nearly all institutions reported providing – in addition to 'standard care' – 'frequent short counselling', half of the institutions reported offering 'detailed counselling' if indicated, and around half reported handing out information booklets. Also, institutions reported using nicotine substitution, or prescribing bupropion or varenicline in some patients. All institutions reported referring patients to specialized addiction treatment institutions if the patient so wished.

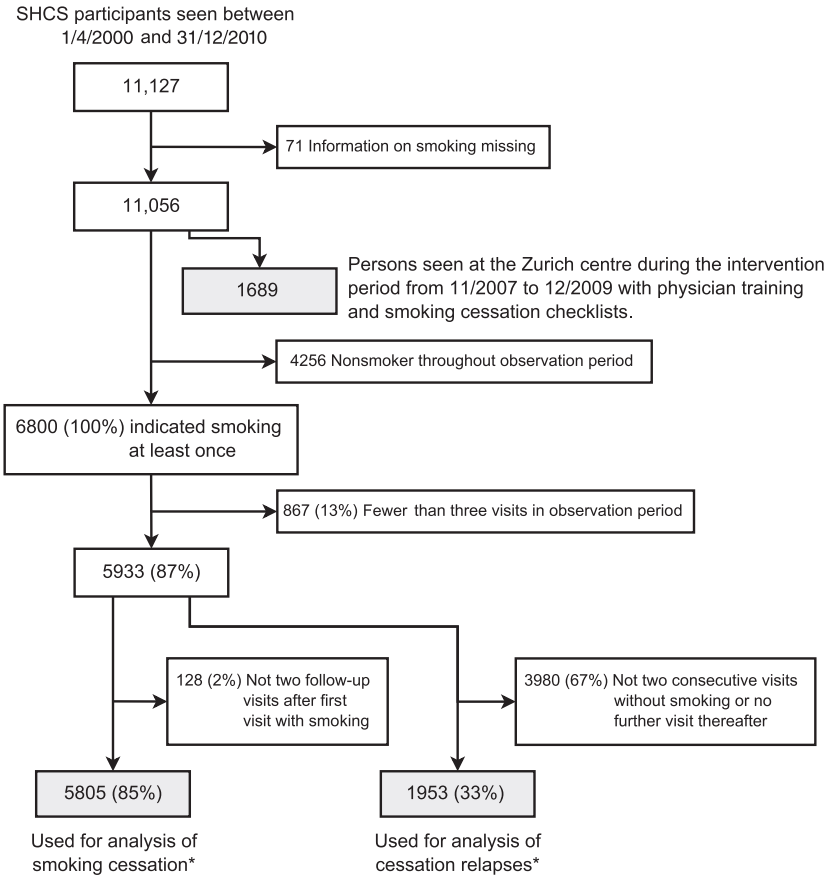

Fig. 1 Selection of the Swiss HIV Cohort Study (SHCS) participants. *Note: 1853 persons contributed to both analyses.

Table 1 Characteristics at the last visit for participants at the Zurich centre in the intervention period (November 2007 to December 2009), and for all Swiss HIV Cohort Study (SHCS) participants from April 2000 to December 2010 according to care setting

Last visit in period	November 2007 to December 2009	April 2000 to December 2010			
Characteristic	Zurich centre	Zurich centre	Other centres	Private practices	Total
Number	1689 (100)	2511 (100)	5026 (100)	3519 (100)	11056 (100)
Female	425 (25)	618 (25)	1719 (34)	979 (28)	3316 (30)
Age [median (IQR)]	44 (38–50)	44 (37–50)	38 (32–45)	38 (33–44)	38 (33–44)
Transmission category					
MSM	765 (45)	1066 (42)	1329 (26)	1774 (50)	4169 (38)
Heterosexual	611 (36)	838 (33)	2231 (44)	1044 (30)	4113 (37)
Former IDU	249 (15)	451 (18)	909 (18)	501 (14)	1861 (17)
Current IDU	23 (1.4)	88 (3.5)	282 (5.6)	80 (2.2)	450 (4.1)
Other	41 (3)	68 (2.7)	275 (5.5)	120 (3.4)	466 (4.2)
Antiretroviral therapy					
Naïve	152 (9)	284 (11)	544 (11)	356 (10)	1184 (11)
Off treatment	89 (5)	190 (8)	416 (8)	260 (7)	866 (8)
On treatment	1448 (86)	2037 (81)	4066 (81)	2903 (83)	9006 (81)
CDC stage C	389 (23)	604 (24)	1392 (28)	692 (20)	2688 (24)
CD4 count (cells/μL) [median (IQR)]	488 (351–648)	457 (304–622)	503 (331–709)	516 (360–693)	495 (334–682)
HIV-1 RNA < 50 copies/mL on ART	1336 (92)	1791 (87)	3502 (85)	2638 (89)	7931 (87)
Smoking status					
Never	520 (31)	751 (30)	1603 (32)	1228 (35)	3582 (32)
Former	382 (23)	524 (21)	917 (18)	731 (21)	2172 (20)
At last visit in period	787 (46)	1236 (49)	2506 (50)	1560 (44)	5302 (48)
Pack-years [median (IQR)]	18 (10–25)	20 (10–25)	20 (10–30)	20 (12–30)	20 (10–30)
Psychiatric treatment or depression	211 (12)	340 (14)	877 (17)	662 (19)	1879 (17)
Alcohol use*					
None	572 (34)	745 (36)	2294 (55)	1523 (50)	4562 (49)
Light	1051 (63)	1212 (59)	1533 (37)	1273 (41)	4018 (43)
Moderate	37 (2.2)	70 (3.4)	207 (5)	189 (6.2)	466 (5)
Severe	15 (0.9)	23 (1.2)	144 (3.5)	87 (2.8)	255 (2.7)
Cardiovascular event during last 2 years	25 (1.5)	31 (1.2)	106 (2.1)	57 (1.6)	194 (1.8)
Framingham 10-year risk in % [median (IQR)] for†					
Cardiovascular disease	8.3 (4.0–15)	8.0 (3.9–15)	8.0 (3.8–15)	8.4 (4.3–15)	8.2 (3.9–15)
Coronary heart disease	6.1 (2.8–11)	5.8 (2.8–11)	5.7 (2.5–11)	6.2 (3.0–11)	5.9 (2.8–11)
Myocardial infarction	2.7 (1.0–6.7)	2.7 (0.9–6.4)	2.6 (0.8–6.0)	2.8 (1.0–6.2)	2.7 (0.9–6.2)

ART, antiretroviral therapy; CDC, Centers for Disease Control and Prevention; IDU, injecting drug user; IQR, interquartile range; MSM, men who have sex with men.
Values are *n* (%), unless otherwise stated.
*Missing data (numbers) for column 2 (Zurich centre November 2007 to December 2009) to column 5 (Total): 14, 460, 848, 447 and 1755, respectively.
†Framingham risk is defined for individuals aged 30–74 years, and is available for (column 2 to column 5, respectively): 1561, 2209, 4370, 3135 and 9714 individuals.

Smoking cessation intervention at the Zurich centre

During the intervention at the Zurich centre from November 2007 to December 2009, 1689 participants had 6068 cohort visits, and 46% smoked at their last visit (Table 1). Smoking status checklists were not available for 739 of 6068 visits (12%) and incomplete for 208 (3.4%), so that 5121 (84%) completed checklists were available. Visits with missing checklists were more likely to arise for nonsmoking participants (56%) than for currently smoking participants (44%). There was variation in the number of missing checklists between physicians (data not shown). Current smoking was declared in 44.5% of the completed checklists.

Among the 2374 checklists for those currently smoking, motivation was assessed as: 85 (3.6%) intended to stop immediately; 262 (11%) intended to stop within 6 months; 804 (33.9%) would stop later; 784 (33%) did not intend to stop; and 439 (18.5%) did not answer.

Smoking cessation counselling was carried out in 1888 of 2374 visits (80%) for current smokers. Reasons for not counselling were: other priorities (50%), patient refusal (19%), lack of time (12%) and other reasons (18%). Among counselled participants, the following types of additional support were given (multiple types per patient possible): distribution of handout (8.1%), detailed counselling (6.5%), varenicline prescription (3.8%), nicotine substitution (2.5%), follow-up date arranged (2.4%), agreed upon stop date (1.5%), bupropion prescription (0.9%), and referral to specialized institution (0.2%).

Changes in motivation were very common (Table 2), with the exception of persons who did not smoke, of whom 95%

Table 2 Transition probabilities from the Markov chain model

Current smoking status and motivation	Status at next visit					
		Motivation level of smokers				
	Not smoking	Immediate stop	Stop in next 6 months	Stop later	Not motivated to stop	Motivation not assessed
Not smoking	95① (94–96)	0.41 (0.20–0.82)	0.71 (0.41–1.21)	1.4 (0.97–2.1)	1.3 (0.88–1.9)	0.88 (0.54–1.4)
Immediate stop	14② (7.1–25)	3.5 (0.87–13)	24 (15–37)	36 (24–49)	16 (8.7–28)	7.1 (2.7–17)
Stop in next 6 months	13③ (8.9–19)	4.7 (2.4–9.1)	23 (17–30)	32 (25–39)	13 (8.8–19)	15 (10–21)
Stop later	5.3④ (3.8–7.5)	3.9 (2.5–5–8)	9.9 (7.7–13)	47 (43–52)	21 (18–25)	12 (9.6–15)
Not motivated	5.1 (3.5–7.4)	1.4 (0.66–2.9)	5.8 (4.1–8.2)	20 (17–24)	49 (45–54)	18 (15–22)
Motivation not assessed*	7.5 (4.9–11)	1.8 (0.8–4.3)	5.6 (3.4–9.1)	30 (25–36)	34 (29–40)	21 (16–26)

Probabilities (95% confidence intervals) of a change in smoking status and motivation from the current visit to the next visit are shown. The most stable categories with the highest probabilities not to change between two visits are on the diagonal (shaded) for not smoking (95%), not motivated (49%), stop later (47%) and stop in 6 months (23%).
*Motivation for smoking cessation was not assessed during 428 of 2374 (18%) visits for current smokers because of other medical priorities (50%), patient refusal (19%), lack of time (12%) and other reasons (19%).
①-④Illustrative examples. ①The probability that a current nonsmoker indicates smoking at the next visit is 100 − 95 = 5%. The probability of a current smoker not smoking at the next visit decreases from 14%② if he/she is motivated for an immediate stop, to 13%③ if he/she would like to stop in the next 6 months, to 5.3%④ if he/she indicates the wish to stop later.

remained nonsmokers. In smokers, the probability of a change in motivation level between two visits was more than 50% (diagonal elements in Table 2). The probability of changing from smoking to not smoking between two visits strongly depended on the motivation level, with 14% among persons ready for an immediate stop and 13% among those intending to stop within the next 6 months, but only 5.3% for persons who indicated to stop later, and 5.1% for those who were not motivated at all. When compared with 'no motivation', the odds ratios (95% confidence intervals) for not smoking at the next visit were 1.9 (0.85–4.2) for 'immediate stop', 2.1 (1.2–3.8) for 'stop within 6 months', and 1.0 (0.61–1.7) for 'stop later'.

Prevalence of smoking in the SHCS

The prevalence of smoking in the SHCS (Fig. 2a) decreased substantially with time, from 60% in 2000 to 43% in 2010. Smoking prevalence was lower in participants in the care of private physicians. Observed patterns were very different among the HIV transmission group categories (Fig. 2b).

In the year 2000, the prevalence of smoking at the Zurich SHCS centre (64%) was higher than at all other centres (61%), or among participants in the care of private physicians (55%), and it decreased in all care settings, with a more pronounced decrease at the Zurich centre (–22.5%) than in other centres (–16.5%) or in private practices (–14.5%) (Fig. 2a).

Smoking prevalence among HIV-positive persons has always been higher than in the general population in Switzerland (Fig. 2c) [30,31]. Some of these differences may be attributable to differences in age distributions, with older persons, who are less likely to smoke, being underrepresented in the SHCS. For example, in 2009 only 14% of SHCS participants were aged 55 years or above, compared with 40% in the general Swiss population [31].

Smoking status in the SHCS *vs.* the Zurich centre

Smoking cessation was observed 2019 times during 29 541 person-years for 5805 SHCS participants; and smoking relapses occurred 1390 times during 12 055 person-years for 1953 participants from 2000 to 2010. The resulting incidences were 6.8 [95% confidence interval (CI) 6.5–7.1] per 100 patient-years for smoking cessation, and 11.5 (95% CI 10.9–12.2) per 100 patient-years for relapses. Incidences varied considerably across settings and over time: values for smoking cessation in 2004, 2007 (just prior to the intervention) and 2010 (after 3 years of the intervention) were 5.0 (95% CI 3.6–6.9), 6.1 (95% CI 4.6–8.1) and 10.8 (95% CI 7.9–14.6) per 100 patient-years at the Zurich centre, 5.2 (95% CI 4.2–6.6), 4.4 (95% CI 3.5–5.5) and 6.2 (95% CI 4.7–8.2) at other centres, and 5.4 (95% CI 4.2–7.0), 7.5 (95% CI 6.1–9.2) and 7.6 (95% CI 5.7–10.1) for private practices, respectively. Values for cessation relapses in 2004, 2007 and 2010 were 11.2 (95% CI 7.7–16.2), 8.7 (95%

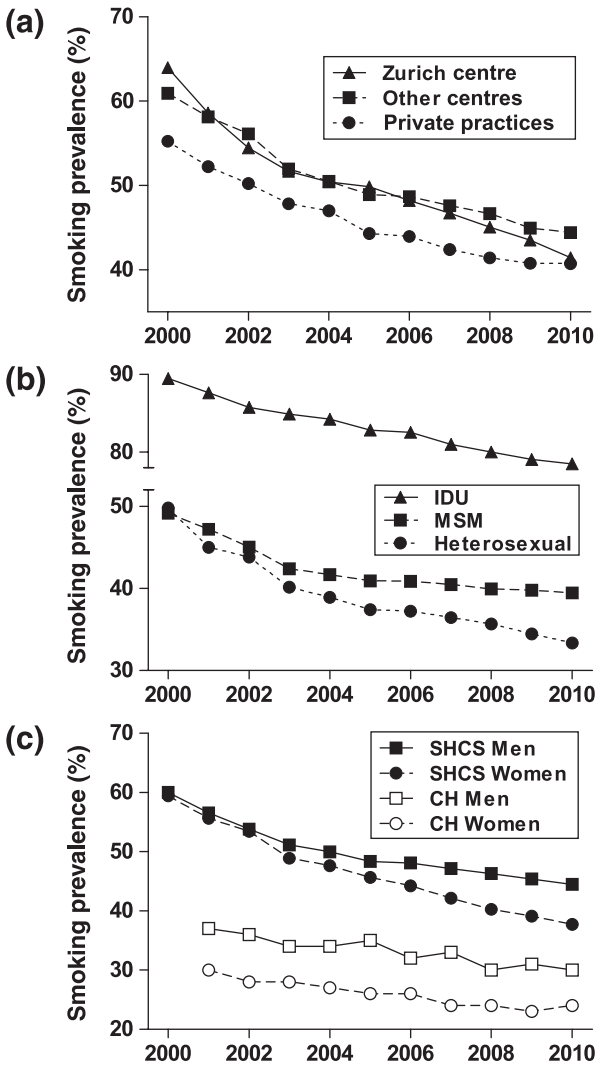

Fig. 2 Prevalence of smoking among HIV-positive and HIV-negative persons in Switzerland between 2000 and 2010. (a) Prevalence among Swiss HIV Cohort Study (SHCS) participants in different care settings. (b) HIV-positive persons, by transmission category (MSM, men who have sex with men; IDU, injecting drug users). (c) SHCS participants *vs.* Swiss population aged 14–65 years (CH). (Data are from Keller *et al.* [31].)

CI 6.1–12.4) and 2.9 (95% CI 1.3–6.5) per 100 patient-years at the Zurich centre, whereas incidences were 10.5 (95% CI 7.8–14.2), 10.9 (95% CI 8.4–14.1) and 9.2 (95% CI 6.6–12.9) for other centres, and 10.8 (95% CI 8.1–14.4), 10.6 (95% CI 8.4–13.5) and 7.3 (95% CI 4.7–11.4) for private practices, respectively.

Results from marginal logistic regression models are displayed in Table 3 for smoking cessation and Table 4 for relapses. Although the models for cessation events and relapse events include partly different person groups, effect estimates for the different covariables are very symmetrical across all models (i.e. factors which are negatively associated with cessation events were positively associated with relapse events). Therefore, only the models for cessation events are described in more detail. Univariable models showed significantly different levels for the three care settings, with participants from private practices and from the Zurich centre being more likely to stop smoking [odds ratio (OR) 1.47 and 1.25, respectively] compared with those from other centres. The effect for the duration of the intervention appeared to be stronger than the calendar time effect (OR 1.19 *vs.* 1.04 per year, respectively). Further, middle-aged persons, IDUs, and persons with psychiatric problems or with higher alcohol consumption were less likely to stop smoking. In contrast, cardiovascular events in the previous 2 years or high Framingham risk scores increased the probability of stopping smoking. Multivariable models allowed us to assess different levels of associations with care setting, calendar time, and an interaction term of the two. Further, we included a variable for the duration of the intervention at the Zurich centre which would capture a change of slope in the association with calendar time. The positive effect of the duration of the intervention at the Zurich centre was confirmed, and was very stable across all multivariable models: OR 1.24 [1.08–1.43 (multivariable model 1)], 1.23 [1.07–1.42 (multivariable model 2)] and 1.24 [1.07–1.45 (multivariable model 3)] per year. Thus, observed effects can probably not be explained by differences in population characteristics in different cohort institutions.

Discussion

We found that structured training in smoking cessation counselling of all HIV care physicians at the Zurich SHCS centre led to increased smoking cessation (OR 1.23; 95% CI 1.07–1.42; $P = 0.004$), and fewer relapses of smoking (OR 0.75; 95% CI 0.61–0.92; $P = 0.007$), compared with participants at other SHCS institutions without similar training activities. The half day of training was conducted in a standardized way by specialized trainers whose theoretical background was based on the Prochaska/Di Clemente model of behavioural change [18,19,25], and the training was well accepted. At SHCS centres, cohort visits are part of routine care, and are carried out by the same physicians providing HIV care. Smoking cessation counselling activities at the Zurich centre were monitored at the cohort visits using a short structured checklist for physicians, which was completed in 84% of visits. Overall, physicians' compliance with counselling was high, approaching 80%, indicating that counselling of smokers can be well integrated into routine care. Assessment of motivation in smokers at the

Table 3 Smoking cessation: univariable and multivariable results from generalized estimating equations (GEEs) analysing the odds of smoking cessation, which was defined as at least two consecutive semiannual visits without smoking after a visit with smoking

	Univariable models			Multivariable model 1*			Multivariable model 2†			Multivariable model 3†		
	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*
Setting (constant)												
Zurich centre	1.25	(1.09–1.43)	0.001									
Other centres	1											
Private practices	1.47	(1.31–1.65)	< 0.001									
Calendar time (per year)	1.04	(1.02–1.05)	< 0.001									
Interaction of setting and calendar time												
Zurich centre				1.03	(0.84–1.26)	0.77	0.99	0.80–1.21)	0.90	0.95	(0.76–1.18)	0.63
Other centres				1			1			1		
Private practices				1.49	(1.31–1.69)	< 0.001	1.42	(1.24–1.62)	< 0.001	1.41	(1.22–1.63)	< 0.001
Interaction terms												
Zurich × time (per year)				0.96	(0.91–1.01)	0.10	0.96	(0.91–1.01)	0.15	0.96	(0.91–1.02)	0.17
Other centres × time (per year)				1.03	(1.01–1.06)	0.005	1.02	(0.99–1.04)	0.12	1.02	(0.99–1.05)	0.16
Private practices × time (per year)				1.01	(0.97–1.04)	0.65	1.01	(0.98–1.05)	0.42	1.01	(0.98–1.05)	0.49
Duration of intervention (per year)§	1.19	(1.10–1.29)	< 0.001	1.24	(1.08–1.43)	0.002	1.23	(1.07–1.42)	0.004	1.24	(1.07–1.45)	0.006
Sex Female	0.89	(0.79–1.00)	0.048				1.06	(0.92–1.22)	.45	1.03	(0.89–1.19)	0.69
Age												
16–29 years	1						1			1		
30–49 years	0.74	(0.61–0.90)	< 0.001				0.81	(0.67–0.99)	.040	0.75	(0.47–1.19)	0.22
≥ 50 years	1.22	(0.99–1.52)	0.068				1.12	(0.90–1.40)	.30	1.00	(0.61–1.62)	0.99
Transmission category												
MSM	1.07	(0.95–1.21)	0.25				1.02	(0.88–1.18)	.77	1.05	(0.90–1.24)	0.52
Heterosexual	1						1			1		
Former IDU	0.47	(0.40–0.55)	< 0.001				0.50	(0.43–0.59)	0.001	0.55	(0.46–0.65)	< 0.001
Current IDU	0.17	(0.12–0.25)	< 0.001				0.20	(0.14–0.28)	0.001	0.25	(0.17–0.37)	< 0.001
Other	1.12	(0.82–1.52)	0.47				1.12	(0.82–1.52)	.48	1.18	(0.84–1.68)	0.52
Psychiatric treatment/depression	0.67	(0.58–0.77)	< 0.001				0.71	(0.61–0.82)	0.001	0.79	(0.68–0.93)	0.003
Alcohol use‡												
None	1									1		
Light	1.19	(1.04–1.35)	0.012							1.12	(0.96–1.30)	0.15
Moderate	0.80	(0.66–0.96)	0.019							0.77	(0.63–0.95)	0.013
Severe	0.47	(0.37–0.60)	< 0.001							0.51	(0.40–0.66)	< 0.001
Cardiovascular event during last 2 years	2.32	(1.75–3.09)	< 0.001				2.22	(1.65–2.99)	0.001	2.29	(1.67–3.14)	< 0.001
Framingham risk in upper quartile for‡												
Cardiovascular disease	1.46	(1.30–1.62)	< 0.001							1.06	(0.84–1.32)	0.63
Coronary heart disease	1.44	(1.29–1.60)	< 0.001							1.10	(0.77–1.59)	0.59
Myocardial infarction	1.40	(1.26–1.57)	< 0.001							0.91	(0.63–1.30)	0.60

Results from univariable and marginal logistic regression models are based upon 2019 stop-smoking events during 40 072 person-years for 5805 individuals from 2000 to 2010.
CI, confidence interval; IDU, injecting drug user; OR, odds ratio; MSM, men who have sex with men.
*Multivariable model 1 is adjusted for calendar time, setting and duration of intervention.
†Multivariable model 2 is also adjusted for potential case-mix characteristics (sex, age, transmission category, psychiatric disorders and previous cardiovascular events).
‡Sensitivity analysis including maximum alcohol use (introduced in 2005) and Framingham risks which are limited to individuals aged 30–74 years. Models are based on 1675 events during 16 454 visits for 4504 individuals.
§To allow for a time-dependent change in the association with calendar year for the Zurich centre coded as 2000 to 2007 = 0, 2008 = 1, 2009 = 2, 2010 = 3, and 0 for the other settings.

Zurich centre showed that approximately half of them considered smoking cessation, but the intent to stop immediately was low (3.6%).

The prevalence of smoking has decreased in the general population in Switzerland in recent years [29,30]. The prevalence has also decreased among HIV-positive persons – overall from 60% (2000) to 43% (2010) – but has still remained significantly higher than in the general population.

Several limitations of our study should be noted. It was not a randomized trial, but a prospective long-term observational study including a comparison of different institutions within the SHCS network. This might cause confounding because patterns of smoking behaviour may be different in different geographical regions of our country. However, a prospective long-term observational study of such a large unselected population may better reflect routine care than would a randomized trial including selected patients. Smoking activity indicated by patients was not verified using biomarkers, such as cotinine measurement. However, most other community-based studies on this topic used self-declaration [32]. Motivation

Table 4 Relapse of smoking after cessation: univariable and multivariable results from generalized estimating equations (GEEs) analysing the odds of smoking relapse, which was defined as a visit with smoking after at least two consecutive semiannual visits without smoking

	Univariable models			Multivariable model 1*			Multivariable model 2†			Multivariable model 3†		
	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*	OR	(95% CI)	*P*
Setting (constant)												
Zurich centre	0.69	(0.58–0.83)	0.001									
Other centres	1											
Private practices	0.84	(0.73–0.97)	0.019									
Calendar time (per year)	1.00	(0.98–1.02)	0.90									
Interaction of setting and calendar time												
Zurich centre				0.85	(0.66–1.10)	0.21	0.89	(0.68–1.16)	0.38	1.02	(0.77–1.35)	0.90
Other centres				1			1			1		
Private practices				0.87	(0.74–1.02)	0.084	0.88	(0.75–1.04)	0.13	0.93	(0.79–1.10)	0.41
Interaction terms												
Zurich × time (per year)				1.04	(0.96–1.12)	0.35	1.03	(0.95–1.11)	0.46	1.03	(0.95–1.12)	0.45
Other centres × time (per year)				1.00	(0.96–1.03)	0.80	1.01	(0.97–1.05)	0.69	1.01	(0.97–1.05)	0.65
Private practices × time (per year)				1.03	(0.98–1.08)	0.31	1.02	(0.97–1.07)	0.45	1.03	(0.97–1.09)	0.32
Duration of intervention (per year)§	0.76	(0.67–0.86)	< 0.001	0.75	(0.61–0.91)	0.004	0.75	(0.61–0.92)	0.007	0.73	(0.59–0.91)	0.005
Sex Female	1.07	(0.93–1.23)	0.34				0.92	(0.78–1.10)	0.36	0.88	(0.73–1.07)	0.21
Age												
16–29 years	1						1			1		
30–49 years	0.62	(0.49–0.78)	< 0.001				0.60	(0.47–0.76)	< 0.001	0.82	(0.46–1.46)	0.49
≥ 50 years	0.38	(0.30–0.50)	< 0.001				0.37	(0.29–0.48)	< 0.001	0.58	(0.32–1.06)	0.076
Transmission category												
MSM	0.94	(0.82–1.09)	0.41				0.97	(0.82–1.16)	0.76	1.01	(0.84–1.22)	0.91
Heterosexual	1						1			1		
Former IDU	1.18	(0.97–1.44)	0.10				1.13	(0.91–1.39)	0.26	1.11	(0.89–1.39)	0.36
Current IDU	3.80	(2.00–7.22)	< 0.001				3.58	(1.83–7.03)	< 0.001	3.30	(1.60–6.80)	0.001
Other	1.12	(0.82–1.53)	0.46				1.03	(0.76–1.40)	0.85	1.15	(0.81–1.65)	0.43
Psychiatric treatment/depression	1.36	(1.11–1.66)	0.003				1.34	(1.09–1.65)	0.005	1.25	(1.00–1.57)	0.050
Alcohol use‡												
None	1									1		
Light	0.94	(0.80–1.11)	0.49							1.02	(0.86–1.22)	0.85
Moderate	1.44	(1.15–1.80)	0.002							1.57	(1.23–2.00)	< 0.001
Severe	1.64	(1.20–2.23)	0.002							1.69	(1.22–2.35)	0.002
Cardiovascular event during last 2 years	1.12	(0.75–1.69)	0.58				1.33	(0.86–2.05)	0.20	1.31	(0.82–2.08)	0.26
Framingham risk in upper quartile for‡												
Cardiovascular disease	0.63	(0.53–0.74)	< 0.001							0.60	(0.42–0.86)	0.005
Coronary heart disease	0.72	(0.62–0.85)	< 0.001							1.47	(0.90–2.40)	0.13
Myocardial infarction	0.72	(0.61–0.84)	< 0.001							0.91	(0.57–1.45)	0.68

Results from univariable and marginal logistic regression models are based upon 1390 smoking relapse events during 15 928 person-years for 1953 individuals from 2000 to 2010.
CI, confidence interval; IDU, injecting drug user; OR, odds ratio; MSM, men who have sex with men.
*Multivariable model 1 is adjusted for calendar time, setting and duration of intervention.
†Multivariable model 2 is also adjusted for potential case-mix characteristics (sex, age, transmission category, psychiatric disorders and previous cardiovascular events).
‡Sensitivity analysis including maximum alcohol use (introduced in 2005) and Framingham risks which are limited to individuals aged 30–74 years. Models are based on 1174 events during 4951 visits for 1670 individuals.
§To allow for a time-dependent change in the association with calendar year for the Zurich centre coded as 2000 to 2007 = 0, 2008 = 1, 2009 = 2, 2010 = 3, and 0 for the other settings.

levels to change behaviour were not assessed using standardized questionnaires but rather discussed between patients and physicians. Unfortunately, prescribed medications to support smoking cessation were not covered by health insurance, whereas medication was free in other studies showing efficacy of counselling including pharmacological support [23,33]. Furthermore, the majority of physicians in our setting are in postgraduate training and spend a limited period of around 1 year in HIV care. Behavioural change counselling needs a physician–patient relationship which often does not develop in a short time frame. Furthermore, the possibility cannot be excluded that the rather complex field of HIV care is so demanding for physicians beginning their training that there is not sufficient capacity or time to approach topics such as smoking cessation. Finally, our intervention was not compared with no intervention. CVD risk factors have been considered in standard-of-care for many years in all SHCS institutions, and many centres reported some counselling activities, but no other centre had a structured smoking cessation

programme. The strength of our approach is that we integrated structured smoking cessation counselling into routine HIV care, provided at our institution by physicians in infectious diseases postgraduate education and by infectious diseases specialists.

Various approaches to introduce tobacco cessation programmes into standard HIV care are essential, and smoking cessation efforts should be a topic of discussion in any physician–patient contact [34]. Previous studies have shown the feasibility of smoking cessation programmes in HIV care, but mostly evaluated selected or highly motivated smokers, or were of a pilot character [20,22,23], and the effects of interventions were contradictory [19,35,36]. Our approach of an institution-wide training programme for infectious diseases physicians to improve smoking cessation counselling can be well integrated into routine HIV care, was well accepted by patients and physicians, and can support patients' efforts to stop smoking.

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Appendix

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