Factors associated with successful vs. unsuccessful smoking cessation: Data from a nationally representative study

Fabienne El-Khoury Lesueur, Camille Bolze, Maria Melchior

Factors associated with successful vs. unsuccessful smoking cessation: data from a nationally representative study

Fabienne El-Khoury Lesueur[1]; Camille Bolze[1]; Maria Melchior[1]

1 Department of Social Epidemiology, INSERM UMR_S 1136, Pierre Louis Institute of Epidemiology and Public Health, Paris, France. Sorbonne Universités, UPMC University of Paris 06, Paris, France.

Corresponding author: Fabienne El-Khoury Lesueur, fabienne.khoury@inserm.fr; Faculté de Médecine Pierre et Marie Curie - pôle Saint-Antoine, 27 rue de Chaligny, 75012, Paris, France. 0033 1 85 56 02 43

ABSTRACT

Introduction

A substantial proportion of smokers who attempt to stop smoking relapse in the first months. Yet to date, there is limited understanding of the predictors of smoking attempts and their success. We examine the role of tobacco use characteristics, other substance-related factors, as well as socio-demographic characteristics in relation to successful and unsuccessful smoking cessation.

Methods

DePICT (*Description des Perceptions, Images, et Comportements liés au Tabagisme*) is a nationally representative sample of adults aged between 18 and 64 years residing in metropolitan France, who were interviewed by telephone survey (n= 4,342). Among current or former smokers (n=2,110) we distinguished participants characterized by: a) no quit attempt or quit <6 months; b) unsuccessful smoking cessation (current smokers who previously quit smoking ≥6 months); c) successful smoking cessation (≥6 months). Factors associated with successful vs. unsuccessful smoking cessation were studied using multivariate multinomial logistic regression analyses.

Results

Successful and unsuccessful smoking cessation share some predicting factors including no cannabis use, older age, and intermediate or high occupational grade. Factors specifically associated with successful smoking cessation included no e-cigarette use, no environmental tobacco exposure, fear of the health consequences of smoking, perceived harmfulness of smoking, and high educational attainment and a good overall health.

Conclusions

Smokers' environmental tobacco exposure, concurrent cannabis use, and the perception of the health consequences of smoking should be taken into account in efforts aiming to promote smoking cessation at the individual as well as collective levels. Our data also suggest that e-cigarette use is associated with unsuccessful rather than successful smoking cessation, which should be verified in additional, longitudinal, studies.

Highlights

- Tobacco exposure and cannabis use were inversely associated with smoking cessation.
- E-cigarette use was associated with unsuccessful smoking cessation.
- Successful smoking cessation was more likely among people with higher education.

Keywords

Smoking cessation; electronic cigarettes; cessation relapse.

1. INTRODUCTION

In any given year, up to one third of regular smokers attempt to quit tobacco (Zhuang, Cummins, Sun, & Zhu, 2016). Among former smokers who are abstinent for 2 weeks, more than half relapse after one year, mainly in the first 6 months .(Agboola, Coleman, McNeill, & Leonardi-Bee, 2015)

While motivation is an important predictor of the desire to quit smoking, it does not always translate to volition sufficient to elicit actual behavior change, and its maintenance over time is sometimes difficult (Borland et al., 2010; Schwarzer, 2008).

Smoking cessation could therefore be conceptualized into a two-stage process; first making a quit attempt and then succeeding in maintaining it. A systematic review has previously examined the determinants of attempts to quit smoking and their success (Vangeli, Stapleton, Smit, Borland, & West, 2011), identifying different sets of determinants for each stage (Vangeli et al., 2011). They found that cigarette dependence consistently predicted a successful quit attempt, while smoking relapse was in part explained by the addictive nature of nicotine, but also by individuals' psychological, health and socioeconomic characteristics. However the predictors and different measures of quit attempts studied in the review were highly heterogeneous between the different studies, also many predictors like the use of nicotine replacement products as well as electronic cigarettes were not examined. Electronic cigarette – commercialized since approximately 2010 – is associated with quit attempts but its role with regard to long-term smoking cessation in the community is not yet established (Beard, West, Michie, & Brown, 2016; Brose, Hitchman, Brown, West, & McNeill, 2015).

To help design strategies that will achieve long-term smoking cessation at the individual as well as the collective levels, there is therefore need to improve understanding of determinants of smoking relapse.

In the present study, we examine associations between characteristics of tobacco as well as electronic cigarettes, nicotine substitutes, and other substance use, perceptions of tobacco use, as well as demographic and socio-economic factors in relation to successful vs. unsuccessful smoking cessation.

2. METHODS

2.1.DEPICT: study design and recruitment

We use data from DePICT (*Description des Perceptions, Images, et Comportements liés au Tabagisme)*, a nationally representative telephone survey of adult (18-64 years) residents of Metropolitan France. The primary aim is to evaluate perceptions of tobacco and smokers, as well as patterns of tobacco use. DePICT was approved by the ethical review committee of the French National Institute of Health and Medical Research (INSERM, CEEI-IRB 00003888). Participants were recruited via a computer-assisted telephone interview (CATI) system and interviewed via landline or mobile telephone between August 15 and November 15, 2016.

Telephone lists were randomly generated and cross-checked to remove inexistent or professional numbers. This method has the advantage of including both listed and unlisted phone numbers and therefore provides maximum population representativeness. All phone numbers were dialed up to 30 times in different periods of the day and week. In households reached by landline, one participant was randomly selected by the CATI system (Kish method). Of the eligible adults solicited 62% completed the interview.

2.1.1. Interview

Telephone interviews (average duration: 25 minutes) were conducted by 30 trained interviewers who administered the questionnaire from a call center equipped with computerized telephone stations. After a brief description of study aims and participants'

verbal consent, data were collected on characteristics including: demographics, smoking status, smoking-related behaviors and perceptions.

2.2. Outcome variable and covariates

2.2.1. Smoking cessation and quitting relapse

Current smokers were asked whether they had ever attempted to quit smoking for at least one week, and if yes, the duration of their longest quit attempt. Based on this information, our study outcomes were defined as follows: 1) current smokers who never quit or quit <6 months; 2) current smokers who previously quit smoking ≥6 months; 3) former smokers who quit smoking ≥6 months. Six months of abstinence has been proposed, and is commonly used, as a standardized criteria to define smoking cessation.(West, Hajek, Stead, & Stapleton, 2005) Current smokers were asked about the daily number of cigarettes smoked, while former smokers were asked whether they had smoked 'less than 10 cigarettes', '10 to 20' or 'more than 21 cigarettes' a day when their smoking was at its highest.

2.2.2. Characteristics associated with smoking cessation

We considered characteristics of tobacco and other substance use, including: the number of cigarettes smoked daily (0-9,10-19,≥20), lifetime electronic cigarette use (yes/no), lifetime use of nicotine replacement products (yes/no), environmental tobacco use (living alone, no, yes, partner, yes, someone else than the partner), alcohol and cannabis use in the preceding month (yes/no). Perceptions of smoking (Patrick Peretti-Watel, Legleye, Guignard, & Beck, 2014): fear of the health consequences of smoking (yes/no), the harmfulness of smoking (yes/no), the importance of being a non-smoker (yes/no), friends' opinion regarding smoking (rather positive/rather negative) and knowing someone who quit smoking (yes/no). Sociodemographic characteristics: sex (female/male), age (grouped into categories in order to examine nonlinear relationship with study outcomes:18-24, 25-34 , 35-44 , 45-54 , 55-64 years), educational attainment (< high school degree, high school degree, university degree), occupational grade (out of the labor market, low occupational grade such as manual worker or clerk, intermediate occupational grade such as technician or administrative assistant, high occupational grade such as engineer or manager); and overall perceived health status (less than good/at least good).

2.3. Statistical analyses

The probability of being solicited through a landline or mobile phone was calculated for each participant by the polling company charged with carrying out the study, taking into account the Kish method (number of eligible individuals/ telephone lines in the household/owned by the person). Data were then weighted based on the inverse probability of being solicited . Additionally, weights were used to render participants representative of the French population in terms of sex, age, educational attainment, region of residence and population density, based on data from the French National Institute of Statistics and Economic Studies (INSEE).

Reported sample sizes refer to the actual number of respondents, percentages to weighted data. In the present analysis only regular and former smokers were included (n= 2 110).

To identify factors that influence smoking cessation and distinguish successful vs. unsuccessful cessation, we selected characteristics that were potentially associated with quit attempts in bivariate analyses and included them in a multinomial logistic regression model. The reference category for the outcome variable was "never quitter" characterizing smokers who never attempted to quit. In additional analyses, the reference category was changed to "unsuccessful smoking attempt".

All analyses were conducted using SAS 9.4.

3. RESULTS

Table 1 shows characteristics of DePICT participants included in our study: 39.7% never attempted to quit smoking or quit <6 months, 16.7% quit smoking ≥6 months and 43.6% achieved long-term smoking cessation. Among smokers (mean age = 38 years (sd=13), mean number of daily cigarettes = 16 (sd=13)) who quit for <6 months, 58% quit smoking for at least 1 week with an average duration of 1.3 months (sd=1.3) for the longest period of abstinence. Among current smokers (mean age =44 years sd=(11), mean number of daily cigarettes = 13 (sd=9)) who previously quit for ≥6 months, the average duration of smoking cessation was 27.8 months (sd=37.0). Among former smokers (mean age=47 years (sd=12), the average duration of smoking abstinence was 12 years (149.0 months, sd=141.0).

TABLE 1: Characteristics of study participants in relation to smoking cessation attempts (DePICT, 2016, n=2110), % p-value.

Characteristics		Never quitter (n=709, 39.7%)	Unsuccessful smoking cessation (n=371, 16.7%)	Successful smoking cessation (n=1030, 43.6%)	p-value
Tobacco and other substance use					
Number of cigarettes smoked per day	0-9 cig/day	23.7%	32.4%	29.6%	<.0001
	10-19 cig/day	59.7%	58.2%	45.5%	
	20-29 cig/day	16.6%	9.4%	24.9%	
Lifetime electronic cigarette use	No	17.2%	18.2%	63%	<.0001
	Yes	35.9%	24.3%	2.9%	
	Attempt before 2012	46.9%	57.5%	34.2%	
Lifetime use of nicotine replacement products	No	80.7%	72.0%	88.0%	<.0001
	Yes	19.3%	28.0%	12.0%	
Environmental tobacco exposure	Living alone	39%	36%	26.7%	<.0001
	No	27.5%	27%	58.6%	
	Partner is a smoker	22.8%	28.5%	9.2%	
	Living with a smoker (other than the partner)	10.7%	8.4%	5.5%	
Alcohol consumption	Less than once a week	67.7%	71.4%	70.5%	<.0001
	At least once a week	32.3%	28.6%	29.5%	
Cannabis use	No	82.9%	94.9%	98.3%	<.0001
	Yes	17.1%	5.1%	1.7%	
Perceptions of smoking					
Fear of the health consequences of smoking	No	58.7%	53.1%	31%	<.0001
	Yes	41.3%	46.9%	69%	
Perceived harmfulness of smoking	No	30.5%	23.5%	26.1%	0.02
	Yes	69.5%	76.5%	73.9%	
Importance of being a non-smoker	No	52%	40.3%	22.7%	<.0001
	Yes	48%	59.7%	77.3%	
Friends' opinion of smoking	Rather positive	24.8%	22.2%	19.7%	0.03
	Rather negative	75.2%	77.8%	80.3%	
Knowing someone who quit smoking	Yes	81.7%	88.7%	83.9%	0.02
	No	18.3%	11.3%	16.1%	
Sociodemographic characteristics					
Sex	Female	38.8%	52.4%	48.1%	<.0001
	Male	61.2%	47.6%	51.9%	
Age (in years)	18-24	22.8%	4.4%	3.2%	<.0001
	25-34	25.0%	18.7%	15.3%	
	35-44	17.7%	32.9%	21.2%	
	45-54	23.1%	28.3%	27.6%	
	55-64	11.4%	15.8%	32.8%	
Educational attainment	< High school degree	22.5%	18.5%	18.3%	<.0001
	High school degree	57.2%	51.7%	47.9%	

	University degree	20.3%	29.8%	33.8%	
Occupational grade	Low	43.2%	40.1%	33.4%	<.0001
	Intermediate	20.2%	26.9%	29.3%	
	High	14.4%	24.5%	26.1%	
	Out of the job market	22.2%	8.6%	11.2%	
Health status					
Overall health status	< good	43.9%	40.9%	33.4%	<.0001
	≥ good	56.1%	59.1%	66.6%	

TABLE 2 : Factors associated with attempts to quit smoking (DePICT study, n=1997, 2016): multivariate multinomial analysis (OR, 95% CI).

Characteristics		Never quitter (n=630)	Unsuccessful smoking cessation (n=353)	Successful smoking cessation (n=1008)
Tobacco and other substance use				
Number of cigarettes smoked per day	0-9 cig/day	*REF*	*REF*	*REF*
	10-19 cig/day	*REF*	**0.52 (0.38- 0.72)**	**0.70 (0.51- 0.95)**
	≥20 cig/day	*REF*	**0.35 (0.21- 0.57)**	**2.06 (1.37- 3.08)**
Lifetime electronic cigarette use	Yes	*REF*	*REF*	*REF*
	No	*REF*	1.29 (0.96- 1.72)	**6.05 (4.62- 7.92)**
Lifetime use of nicotine replacement products	Yes	*REF*	*REF*	*REF*
	No	*REF*	**0.67 (0.48- 0.93)**	**1.77 (1.25- 2.50)**
Environmental tobacco exposure	Living alone	*REF*	*REF*	*REF*
	No	*REF*	0.89 (0.63- 1.25)	**2.77 (2.07- 3.72)**
	Partner is a smoker	*REF*	1.19 (0.82- 1.71)	**0.62 (0.41- 0.92)**
	Living with a smoker (other than the partner)	*REF*	1.04 (0.65- 1.67)	1.25 (0.78- 2.01)
Alcohol consumption	Less than once a week	*REF*	*REF*	*REF*
	At least once a week	*REF*	1.02 (0.75- 1.40)	0.86 (0.64- 1.14)
Cannabis use	Yes	*REF*	*REF*	*REF*
	No	*REF*	**2.39 (1.38- 4.14)**	**4.73 (2.5- 8.96)**
Perceptions of smoking				
Fear of the health consequences of smoking	No	*REF*	*REF*	*REF*
	Yes	*REF*	0.82 (0.60- 1.13)	**3.54 (2.59- 4.83)**

Perceived harmfulness of smoking	Yes	*REF*	*REF*	*REF*
	No	*REF*	0.77 (0.55- 1.09)	**1.92 (1.38- 2.68)**
Importance of being a non-smoker	No	*REF*	*REF*	*REF*
	Yes	*REF*	1.24 (0.92- 1.66)	**1.89 (1.43- 2.49)**
Friends' opinion of smoking	Rather negative	*REF*	*REF*	*REF*
	Rather positive	*REF*	0.77 (0.56- 1.07)	0.8 (0.59- 1.09)
Knowing someone who quit smoking	No	*REF*	*REF*	*REF*
	Yes	*REF*	**1.64 (1.08- 2.49)**	0.85 (0.6- 1.22)
Sociodemographic characteristics				
Sex	Male	*REF*	*REF*	*REF*
	Female	*REF*	**1.69 (1.27- 2.26)**	**1.34 (1.02- 1.75)**
Age (in years)	18-24	*REF*	*REF*	*REF*
	25-34	*REF*	**2.92 (1.52- 5.62)**	**3.68 (1.88- 7.19)**
	35-44	*REF*	**7.08 (3.71- 13.51)**	**5.30 (2.7- 10.4)**
	45-54	*REF*	**4.31 (2.26- 8.25)**	**4.95 (2.54- 9.65)**
	55-64	*REF*	**5.10 (2.54- 10.25)**	**12.75 (6.36- 25.54)**
Educational attainment	< High school degree	*REF*	*REF*	*REF*
	High school degree	*REF*	0.94 (0.65- 1.35)	1.36 (0.98- 1.90)
	University degree	*REF*	1.17 (0.74- 1.86)	**2.73 (1.78- 4.19)**
Occupational grade	Out of the job market	*REF*	*REF*	*REF*
	Low	*REF*	**1.72 (1.05- 2.79)**	1.24 (0.80- 1.92)
	Intermediate	*REF*	**1.93 (1.15- 3.24)**	**2.03 (1.27- 3.24)**
	High	*REF*	**2.06 (1.17- 3.62)**	**2.18 (1.3- 3.65)**
Health status				
Overall health status	< good	*REF*	*REF*	*REF*
	≥ good	*REF*	1.17 (0.88- 1.56)	**1.62 (1.24- 2.12)**

Table 2 shows the results of multivariate regression models in which smokers who never attempted to quit smoking served as the reference category. Smoking more than 9 cigarettes per day (OR 10-19 cig/day =0.52 , 95% CI, 0.38- 0.72; OR ≥20 cig/day =0.35 , 95% CI, 0.21- 0.57), and no lifetime use of nicotine replacement products (OR=0.67, 95% CI, 0.48-0.93) were associated with a decreased likelihood of unsuccessful smoking cessation compared to never quitter. Compared to smokers who never attempted to quit, a higher likelihood of

unsuccessful smoking cessation was associated with no cannabis use (OR=2.39, 95% CI,1.38-4.14), knowing someone who successfully quit smoking (OR=1.64, 95% CI,1.08- 2.49), and sociodemographic characteristics such as female sex (OR=1.69, 95% CI,1.27- 2.26), being older than 24 years (OR $_{25\text{-}34y}$=2.92 , 95% CI,1.52- 5.62) and being employed (OR $_{\text{High SES}}$ =2.06 , 95% CI,1.17- 3.62).

Compared to smokers who never attempted to quit, successful smoking cessation was associated with smoking 10-19 cigarettes daily (OR =0.70, 95% CI, 0.51- 0.95). Other substance use factors associated with a higher likelihood of successful smoking cessation, as compared with no attempt to quit smoking, included characteristics of tobacco and other substance use: smoking more than 19 cigarettes per day (OR =2.06,95% CI, 1.37- 3.08), no lifetime use of e-cigarettes (OR = 6.05, 95% CI, 462- 7.92), , no lifetime use of nicotine replacement products (OR $_{\text{never use}}$=1.77, 95% CI, 1.25- 2.50), no exposure to environmental tobacco (OR $_{\text{not living with a smoker}}$= 2.77 , 95% CI, 2.07- 3.72), and no cannabis use (OR = 4.73 , 95% CI, 2.50- 8.96) . Factors related to 'perceptions of smoking' associated with successful smoking cessation were fear of the health consequences of smoking (OR= 3.54, 95% CI, 2.59-4.83), the perception of smoking as dangerous (OR=1.92, 95% CI, 1.38- 2.68), or thinking that being a non-smoker is important (OR= 1.89, 95% CI, 1.43- 2.49). Sociodemographic characteristics associated with successful smoking cessation were: female sex (OR= 1.34, 95% CI, 1.02- 1.75), age older than 24 years (OR$_{25\text{-}34y}$=3.68, 95% CI, 1.88- 7.19), a university degree (OR= 2.73, 95% CI, 1.78- 4.19) and at least an intermediate occupational grade (OR $_{\text{High SES}}$ =2.18, 95% CI, 1.3- 3.65).

In supplementary analysis **(Supplementary Table S1)** where participants who were not successful in quitting smoking served as the reference category of a multivariate multinomial regression model, factors that were associated with successful smoking cessation were : smoking more than 20 cigarettes daily, no lifetime electronic cigarette use, no lifetime use of nicotine replacement products, no exposure to environmental tobacco, fear of the health consequences of smoking, perceived harmfulness of smoking, the perception that being a non-smoker is important, being older than 55 years, and reporting rather good health.

4. DISCUSSION

4.1.Main findings

Studying a nationally representative sample of former and current smokers, we found that successful and unsuccessful smoking cessation share some predicting factors (e.g. no cannabis use, employment, age above 24 years, and female sex) compared to smokers who never attempted to quit. However, many factors, which previously had rarely been studied, distinguish successful from unsuccessful smoking cessation .

Heavy smoking is associated with a higher likelihood of successful smoking cessation and a lower likelihood of unsuccessful smoking cessation. Lifetime use of e-cigarettes predicts a lower probability of successful cessation and the use of nicotine replacement therapy is associated with unsuccessful smoking cessation. Living with a smoker is associated with a lower likelihood of successful smoking cessation; to the contrary negative perceptions of smoking (fear of the health consequences, high perceived harmfulness of smoking, and a high importance given to smoking cessation) are specifically associated with successful smoking cessation. Finally, a high educational level, and poor overall health are especially prevalent among successful quitters but not among quitters who relapsed to smoking.

4.2.Interpretation

Tobacco and other substance use

In our study, participants who smoked more than 20 cigarettes daily prior to quitting smoking were more likely to quit successfully, and less likely to quit unsuccessfully as compared to smokers who never attempted to quit. This may seem counterintuitive and appears contrary to findings of some other studies (Vangeli et al., 2011). There are several possible explanations. First, heavy smokers are less likely to attempt smoking cessation (Vangeli et al., 2011), which could explain their decreased likelihood of experiencing unsuccessful quit attempts. Second, in France - as in other countries -, the average number of cigarettes smoked daily among active smokers has decreased over time (Beck, Guignard, Richard, Wilquin, & Peretti-Watel, 2010). Because former smokers are overall older than

active smokers, it may be that their level of tobacco consumption prior to cessation was higher than that of contemporary smokers, who are less likely to quit. Third, former smokers were asked to report the number of cigarettes they smoked at their highest level of use, which could artificially contribute to differences in use between current and former smokers. Fourth, heavy smokers could be more afraid of the consequences of smoking, or experience more smoking-related symptoms and therefore be more motivated to quit smoking than lower-level or occasional smokers (P. Peretti-Watel et al., 2007).

Persons who relapsed to smoking and those who never quit had similar, whereas former smokers had significantly lower, rates of e-cigarette use. This could partly reflect the recent commercialization of e-cigarettes (since approximately 2010). Moreover, e-cigarettes are not always used as an aid to quit smoking (Kalkhoran & Glantz, 2016). Additionally, much like most nicotine replacement therapy products, e-cigarettes can be bought over the counter without medical guidance or follow-up.

Cannabis use is associated with a lower likelihood of experiencing successful smoking cessation or relapse to smoking after quitting. This is primarily because cannabis users are less likely to quit smoking. Cannabis use characterizes young people who are less likely to quit smoking. Additionally, it influences motivation and can reduce the will to quit tobacco (Twyman et al., 2016). Finally, when mixed with tobacco, its use could reinforce nicotine dependence. Our results suggest that cannabis use should be addressed by physicians aiming to help persons who smoke quit tobacco as it constitutes a barrier to smoking cessation.

Finally, we found that environmental tobacco exposure – particularly living with a smoking partner - is associated with a lower likelihood of successful smoking cessation – hence smoking interventions should consider targeting couples and other persons in smokers' environment (e.g. parents, close friends) (Manchón Walsh et al., 2007).

Perceptions of smoking

Negative perceptions of the consequence of smoking were more prevalent among former compared to current smokers. It is plausible that those negative perceptions, especially the perceived harmfulness of smoking, contributed to smoking cessation. However, the perceptions of smoking could also have changed after quitting. Previous

studies have shown that smokers have strategies to reduce cognitive dissonance in relation to the health effects of smoking (Glock & Kneer, 2009), and there is need for additional research to understand the ways in which perceptions translate into behavior change.

Sociodemographic characteristics

We observed that younger persons were significantly less likely to quit smoking - successfully or not. This may be due to lifestyle differences, younger people experiencing more opportunities to smoke (e.g. festive occasions) while simultaneously experiencing fewer health problems associated with smoking and a lower motivation to change smoking behavior. Research shows that smokers who quit prior to age 40 years have similar life expectancy as non-smokers, indicating that encouraging smoking cessation among young adults should be a public health priority (Khati et al., 2015).

In terms of socioeconomic characteristics, we found that former smokers have higher educational level and occupational grade than active smokers regardless of cessation history. This is in line with previous studies showing that smokers belonging to the most deprived socioeconomic groups have higher levels of nicotine dependence, are more exposed to environmental tobacco, and experience more life stresses which can negatively influence smoking cessation (Graham, Inskip, Francis, & Harman, 2006).

4.3.Limitations :

First, our study is cross-sectional, which makes a thorough scrutiny of the chronological order in which certain factors influenced smoking status difficult (e.g. smoking perceptions, e-cigarette use). However this is unlikely to be the case for the main factors influencing the likelihood of smoking cessation (e.g. the level of smoking, cannabis use, employment and educational level). Second, some variables could be influenced by recall bias (e.g. the number of cigarettes smoked by former smokers). However, the overall level of smoking reported by study participants is consistent with data from other nationally representative studies (Berthier et al., 2016). However, the social pressure and the recall bias while reporting smoking-related behaviors are considerate low in population surveys (Wong, Shields, Leatherdale, Malaison, & Hammond, 2012). Lastly, around one third of

eligible adults did not accept to participate in our study. Even if this response rate is rather satisfactory and comparable with response rates of other general population studies in France,(Andler et al., 2016) selection bias cannot be ruled out. We minimized such bias by weighting our analyses to ensure that our sample is representative of the French population.

5. CONCLUSION

Our study, based on a representative sample of the population living in France, shows that factors associated with successful as well as unsuccessful smoking cessation are diverse. Individuals' demographic and socioeconomic characteristics, as well as concomitant cannabis use, appear to constitute barriers to smoking cessation.

Role of funding sources

This research was funded by a grant from the French National Cancer Institute (INCa). INCa had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication

Contributors

Maria Melchior is the PI of the DePICT study. All authors were implicated in designing the study, analyzing the data and in the manuscript preparation. FEKL wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Acknowledgements

We thank members of the DePICT scientific committee: François Beck (OFDT), Renaud Crespin (CNRS), Karine Gallopel-Morvan (EHESP), Gwenn Menvielle (INSERM), Brigitte Metadieu (Association Charonne), Viet Nguyen-Than (ANSP), and Patrick Peretti-Watel (INSERM) for their help in discussing the study protocol, questionnaire, and planned analyses. We also want to acknowledge Carla Estaquio and Antoine Deutsch from the French National Cancer Institute (INCa).

We also like to acknowledge “MV2” polling institute, as well as “CDA” for monitoring and auditing the study’s execution.

6. REFERENCES

Agboola, S. A., Coleman, T., McNeill, A., & Leonardi-Bee, J. (2015). Abstinence and relapse among smokers who use varenicline in a quit attempt-a pooled analysis of randomized controlled trials: Relapse and abstinence in smokers treated with varenicline. *Addiction*, *110*(7), 1182–1193. https://doi.org/10.1111/add.12941

Andler, R., Guignard, R., Wilquin, J.-L., Beck, F., Richard, J.-B., & Nguyen-Thanh, V. (2016). Electronic cigarette use in France in 2014. *International Journal of Public Health*, *61*(2), 159–165. https://doi.org/10.1007/s00038-015-0773-9

Beard, E., West, R., Michie, S., & Brown, J. (2016). Association between electronic cigarette use and changes in quit attempts, success of quit attempts, use of smoking cessation pharmacotherapy, and use of stop smoking services in England: time series analysis of population trends. *BMJ*, *354*, i4645. https://doi.org/10.1136/bmj.i4645

Beck, F., Guignard, R., Richard, J.-B., Wilquin, J.-L., & Peretti-Watel, P. (2010). Premiers résultats du baromètre santé 2010 Evolutions récentes du tabagisme en France. *Institut National de Prévention et d'Education Pour La Santé*, *10*. Retrieved from http://asset.rue89.com/files/Evolutions-recentes-tabagisme-barometre-_sante-2010.pdf

Berthier, N., Guignard, R., Richard, J.-B., Andler, R., Beck, F., & Nguyen-Thanh, V. (2016). Comparaison régionale du tabagisme et de l'usage de cigarette électronique en France en 2014 - com.trend.iwss.user.servlet.sendfile. *BEH*. Retrieved from https://134.157.220.28:9091/servlet/com.trend.iwss.user.servlet.sendfile?downloadfile=IRES-2051771543-CEEE2758-22526-22497-117

Borland, R., Yong, H.-H., Balmford, J., Cooper, J., Cummings, K. M., O'Connor, R. J., … Fong, G. T. (2010). Motivational factors predict quit attempts but not maintenance of smoking cessation: Findings from the International Tobacco Control Four country project. *Nicotine & Tobacco Research*, *12*(suppl_1), S4–S11. https://doi.org/10.1093/ntr/ntq050

Brose, L. S., Hitchman, S. C., Brown, J., West, R., & McNeill, A. (2015). Is the use of electronic cigarettes while smoking associated with smoking cessation attempts, cessation and reduced cigarette consumption? A survey with a 1-year follow-up. *Addiction*, *110*(7), 1160–1168. https://doi.org/10.1111/add.12917

Glock, S., & Kneer, J. (2009). Are Deterrent Pictures Effective? The Impact of Warning Labels on Cognitive Dissonance in Smokers. *Applied Psychology: Health and Well-Being*, *1*(3), 356–373. https://doi.org/10.1111/j.1758-0854.2009.01019.x

Graham, H., Inskip, H. M., Francis, B., & Harman, J. (2006). Pathways of disadvantage and smoking careers: evidence and policy implications. *Journal of Epidemiology & Community Health*, *60*(suppl 2), ii7-ii12. https://doi.org/10.1136/jech.2005.045583

Kalkhoran, S., & Glantz, S. A. (2016). E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. *The Lancet Respiratory Medicine*, *4*(2), 116–128. https://doi.org/10.1016/S2213-2600(15)00521-4

Khati, I., Menvielle, G., Chollet, A., Younès, N., Metadieu, B., & Melchior, M. (2015). What distinguishes successful from unsuccessful tobacco smoking cessation? Data from a study of young adults (TEMPO). *Preventive Medicine Reports*, *2*, 679–685. https://doi.org/10.1016/j.pmedr.2015.08.006

Manchón Walsh, P., Carrillo, P., Flores, G., Masuet, C., Morchon, S., & Ramon, J. M. (2007). Effects of partner smoking status and gender on long term abstinence rates of patients receiving smoking cessation treatment. *Addictive Behaviors*, *32*(1), 128–136. https://doi.org/10.1016/j.addbeh.2006.03.027

Peretti-Watel, P., Constance, J., Guilbert, P., Gautier, A., Beck, F., & Moatti, J.-P. (2007). Smoking too few cigarettes to be at risk? Smokers' perceptions of risk and risk denial, a French survey. *Tobacco Control*, *16*(5), 351–356. https://doi.org/10.1136/tc.2007.020362

Peretti-Watel, P., Legleye, S., Guignard, R., & Beck, F. (2014). Cigarette smoking as a stigma: Evidence from France. *International Journal of Drug Policy*, *25*(2), 282–290. https://doi.org/10.1016/j.drugpo.2013.08.009

Schwarzer, R. (2008). Modeling Health Behavior Change: How to Predict and Modify the Adoption and Maintenance of Health Behaviors. *Applied Psychology*, *57*(1), 1–29. https://doi.org/10.1111/j.1464-0597.2007.00325.x

Twyman, L., Bonevski, B., Paul, C., Kay-Lambkin, F. J., Bryant, J., Oldmeadow, C., … Guillaumier, A. (2016). The association between cannabis use and motivation and intentions to quit tobacco within a sample of Australian socioeconomically

disadvantaged smokers. *Health Education Research*, *31*(6), 771–781. https://doi.org/10.1093/her/cyw049

Vangeli, E., Stapleton, J., Smit, E. S., Borland, R., & West, R. (2011). Predictors of attempts to stop smoking and their success in adult general population samples: a systematic review. *Addiction*, *106*(12), 2110–2121. https://doi.org/10.1111/j.1360-0443.2011.03565.x

West, R., Hajek, P., Stead, L., & Stapleton, J. (2005). Outcome criteria in smoking cessation trials: proposal for a common standard. *Addiction*, *100*(3), 299–303. https://doi.org/10.1111/j.1360-0443.2004.00995.x

Wong, S. L., Shields, M., Leatherdale, S., Malaison, E., & Hammond, D. (2012). Assessment of validity of self-reported smoking status. *Health Reports*, *23*(1), 47–53.

Zhuang, Y.-L., Cummins, S. E., Sun, J. Y., & Zhu, S.-H. (2016). Long-term e-cigarette use and smoking cessation: a longitudinal study with US population. *Tobacco Control*, *25*(Suppl 1), i90–i95. https://doi.org/10.1136/tobaccocontrol-2016-053096