Year : 2012

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(avec la co-direction du Professeure Jennifer O'Loughlin)

et présentée à la Faculté de biologie et de médecine de
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DOCTEUR EN MEDECINE

par

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UNIL | Université de Lausanne
Faculté de biologie
et de médecine

Ecole Doctorale
Doctorat en médecine

Imprimatur

Vu le rapport présenté par le jury d'examen, composé de

Directeur de thèse	*Monsieur le Professeur* ***Jacques Cornuz***
Co-Directeur de thèse	*Madame le Professeur* ***Jennifer O'Loughlin***
Expert	*Monsieur le Professeur* ***John-Paul Vader***
Directrice de l'Ecole doctorale	*Madame le Professeur* ***Stephanie Clarke***

la Commission MD de l'Ecole doctorale autorise l'impression de la thèse de

Madame Semanur Cengelli

intitulée

A systematic review of longitudinal population-based studies on the predictors of smoking cessation in adolescent and young adult smokers

Lausanne, le 20 novembre 2012

pour Le Doyen
de la Faculté de Biologie et de Médecine

Madame le Professeur Stephanie Clarke
Directrice de l'Ecole doctorale

Revue systématique d'études longitudinales sur les prédicteurs de cessation du tabagisme chez les adolescents et les jeunes adultes fumeurs

Le tabagisme est responsable de plus de 5 million de décès par an à travers le monde. En Suisse (2010), la prévalence de fumeurs chez les 14-19 ans était de 22% et la prévalence d'ex-fumeurs de 3%, taux qui reste relativement stable au fil des dernières années. La plupart des jeunes fumeurs désirant arrêter de fumer rencontrent des difficultés pour y parvenir. Les revues empiriques ont conclu que les programmes ayant pour but l'arrêt du tabagisme chez les jeunes ont une efficacité limitée.

Afin de fournir une base solide de connaissances pour les programmes d'interventions contre le tabagisme, les déterminants de l'auto-cessation ont besoin d'être compris.

Nous avons systématiquement recherché dans PUBMED et EMBASE des études longitudinales, basées sur la population, portant sur les déterminants de l'auto-cessation chez des adolescents et des jeunes adultes fumeurs. Nous avons passé en revue 4'502 titres et 871 abstracts, tous examinés indépendamment par deux et trois examinateurs, respectivement. Les critères d'inclusion étant : articles publiés entre janvier 1984 et août 2010, concernant les jeunes entre 10 et 29 ans et avoir une définition de cessation de fumer d'au moins 6 mois.

Neuf articles ont été retenus pour une analyse détaillée. Les données suivantes ont été extraites de chaque article : le lieu de l'étude, la période étudiée, la durée du suivi, le nombre de collecte de données, la taille de l'échantillon, l'âge ou l'année scolaire des participants, le nombre de participants qui arrêtent de fumer, le status tabagique lors de la première collecte, la définition de cessation, les co-variantes et la méthode analytique. Le nombre d'études qui montrent une association significativement significative entre un déterminant et l'arrêt du tabagisme a été tabulé à partir de toutes les études qui ont évalués ce déterminant.

Trois des neufs articles retenus ont défini l'arrêt du tabagisme comme une abstinence de plus de 6 mois et les six autres comme 12 mois d'abstinence. Malgré l'hétérogénéité des méthodes utilisées, cinq facteurs principaux ressortent comme prédicteur de l'arrêt du tabagisme : 1) ne pas avoir d'amis qui fument, 2) ne pas avoir l'intention de continuer de fumer dans le futur, 3) résister à la pression sociale, 4) être âgé de plus de 18 ans lors de la première cigarette, et 5) avoir un avis négatif au sujet du tabagisme. D'autres facteurs sont significatifs mais ne sont évalués que dans peu d'articles.

La littérature au sujet des prédicteurs de cessation chez les adolescents et les jeunes adultes est peu développée. Cependant, nous remarquons que les facteurs que nous avons mis en évidence ne dépendent pas que de l'individu, mais aussi de l'environnement. La prévention du tabagisme peut se centrer sur les bienfaits de l'arrêt (p.ex., par rapport à l'asthme ou les performances sportives) et ainsi motiver les jeunes gens à songer d'arrêter de fumer. Une taxation plus lourde sur le prix des cigarettes peut être envisagée afin de retarder l'âge de la première cigarette. Les publicités anti-tabagiques (non sponsorisées par les entreprises de tabac) peuvent influencer la perception des jeunes par rapport au tabagisme, renforçant ou créant une attitude anti-tabagique. Les prochaines campagnes anti-tabac devraient donc tenir compte de ces différents aspects.

A systematic review of longitudinal population-based studies on the predictors of smoking cessation in adolescent and young adult smokers

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► An additional table is published online only. To view this file please visit the journal online (http://tobaccocontrol.bmj.com/content/21/3.toc).

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Received 12 March 2011
Accepted 6 July 2011
Published Online First 16 August 2011

ABSTRACT

Objective To describe the determinants of self-initiated smoking cessation of duration of at least 6 months as identified in longitudinal population-based studies of adolescent and young adult smokers.

Methods A systematic search of the PubMed and EMBASE databases using smoking, tobacco, cessation, quit and stop as keywords was performed. Limits included articles related to humans, in English, published between January 1984 and August 2010, and study population aged 10–29 years. A total of 4502 titles and 871 abstracts were reviewed independently by 2 and 3 reviewers, respectively. Nine articles were retained for data abstraction. Data on study location, timeframe, duration of follow-up, number of data collection points, sample size, age/grade of participants, number of quitters, smoking status at baseline, definition of cessation, covariates and analytic method were abstracted from each article. The number of studies that reported a statistically significant association between each determinant investigated and cessation were tabulated, from among all studies that assessed the determinant.

Results Despite heterogeneity in methods across studies, five factors robustly predicted quitting across studies in which the factor was investigated: not having friends who smoke, not having intentions to smoke in the future, resisting peer pressure to smoke, being older at first use of cigarette and having negative beliefs about smoking.

Conclusions The literature on longitudinal predictors of cessation in adolescent and young adult smokers is not well developed. Cessation interventions for this population will remain less than optimally effective until there is a solid evidence base on which to develop interventions.

INTRODUCTION

In spite of considerable declines in the prevalence of smoking in the past decade, tobacco use remains the leading preventable threat to public health in many Western countries. Further, the steady decline in the prevalence of youth smoking since the mid 1990s seems to have stalled in several countries.[1] In 2006–2007, nearly 50 000 Canadian youth in grades 5–9 were current smokers.[2] Clearly more research is needed to inform evidence-based tobacco control interventions for young smokers.

One of the cornerstones of tobacco control is cessation. While many young smokers express the desire to quit, most have a great deal of difficulty in doing so.[3] Approximately 70% of adolescent smokers try to quit each year.[4] Many make multiple cessation attempts, but 90% of those who try to quit relapse within 1 year. The probability of relapse is higher among older adolescents and among those who smoke daily.[4] A recent investigation of the natural course of cessation suggests that cessation in youth may be understood as a progression of phases and that novice smokers lack awareness of the difficulty that they will experience as they attempt to quit, at least during the early phases.[3] Specifically, the first phase occurs 1–2 months after the first puff, as young smokers increase exposure to nicotine through inhalation and smoking a first whole cigarette. This phase is characterised by naïve certainty about the ability to quit, when young smokers confidently declare that they have stopped smoking completely and forever. This is followed rapidly by expression of a conscious desire to quit and the growing realisation that quitting requires serious effort. Over the next 2 years as cravings, withdrawal symptoms and tolerance set in and as smoking escalates to monthly cigarettes use, novice smokers gradually lose confidence in their ability to quit. Approximately 1 year after reporting loss of confidence and after escalation to daily smoking, young smokers come to realise that they now smoke because it is very hard to quit. Full-blown WHO *International Statistical Classification of Diseases and Related Health Problems*, 10th Revision (ICD-10) tobacco dependence manifests approximately 14 months thereafter.

While intensity, frequency and duration of cigarette use along with concomitant nicotine dependence are likely strong determinants of successful cessation in youth as well as in adults, little is known about other determinants of self-initiated cessation in young smokers. There are at least four reviews to date[5–8] that attempt to synthesise the literature on the determinants of cessation in young smokers, but the results of these reviews may not be optimal because they did not use systematic methods to identify articles to retain for analysis,[5] the definition of cessation varied widely across studies retained for review,[5–8] they included studies from one calendar year only,[6 7] and/or they focused on cross-sectional,[6–8] intervention and clinical studies.[6]

The objective of the current paper was therefore to systematically summarise the empirical evidence across longitudinal population-based studies on the determinants of longer-term self-initiated cessation in adolescents and young adults. Because longitudinal studies by definition assure that exposure

precedes outcome, we opted to restrict our review to longitudinal data to the exclusion of cross-sectional studies, thereby providing relatively stronger evidence for causal associations. In addition, we opted to include only those studies in which participants had quit smoking for 6 months or longer in order to preclude obscuring the determinants of short-term versus longer-term cessation, because smoking cessation of at least 6 months of abstinence corresponds to the recommended definition of successful abstinence among untreated smokers,[9] and because relapse most often occurs during the first 6 months of abstinence[4 10] especially among youth.[11]

Methods

We carried out a systematic search using the PubMed and EMBASE databases to identify longitudinal studies published in English language journals between January 1984 and August 2010 that described the determinants of self-initiated smoking cessation among young persons aged 10–29 years, in five steps: (1) keyword searches of the PubMed and EMBASE databases; (2) scan of titles to eliminate clearly irrelevant articles; (3) review of abstracts and selection of articles for in-depth analysis and data abstraction; (4) citation search of articles retained for analysis; and (5) in-depth review of articles with data abstraction. Figure 1 describes the results of the search and the following paragraphs describe each step in more detail.

Keyword search

Search terms used in the PubMed database search included: (smoking (MeSH Major Topic) OR tobacco (MeSH Major Topic)) AND (cessation OR quit OR stop) AND (longitudinal OR prospective OR cohort), with the following limitations: 'humans', 'English', 'child: 6–12 years', 'adolescent: 13–18 years', 'young adults: 19–24 years', 'adult: 19–44 years' and 'publication date from 1 January 1984 to 31 August 2010'. This search, carried out in September 2010, yielded 1468 titles. Search terms used in the EMBASE database search included: (smoking cessation ('smoking cessation' as keyword; 'smoking cessation' as subject heading) OR tobacco cessation ('tobacco cessation' as keyword; 'smoking cessation' as subject heading) OR quit smoking ('quit smoking' as keyword; 'smoking cessation' as subject heading) OR stop smoking ('stop smoking' as keyword; 'smoking cessation' as subject heading)) AND (longitudinal ('longitudinal' as keyword; 'longitudinal study' as subject heading) OR prospective cohort ('prospective cohort' as keyword; 'cohort analysis', 'prospective study' and 'follow-up' as subject heading)). Limitations included: 'human', 'English language', 'publication year: from 1984 to current', 'school child: 7 to 12 years', 'adolescent: 13 to 17 years' and 'adult: 18 to 64 years'. This search, carried out in September 2010, yielded 2239 titles.

Title scan

Two authors (SC, BL) screened the 3707 titles retained from these database searches to eliminate all articles that were not longitudinal, not population based, or that did not relate to the identification or description of the determinants of self-initiated smoking cessation in adolescents or young adults.

Abstract review

A total of 176 of the 787 abstracts retained for review after title screening were duplicates. Three authors (SC, BL, JOL) reviewed the 611 unique abstracts retained. Articles excluded during this step included sufficient information in the abstract to ascertain that the study:

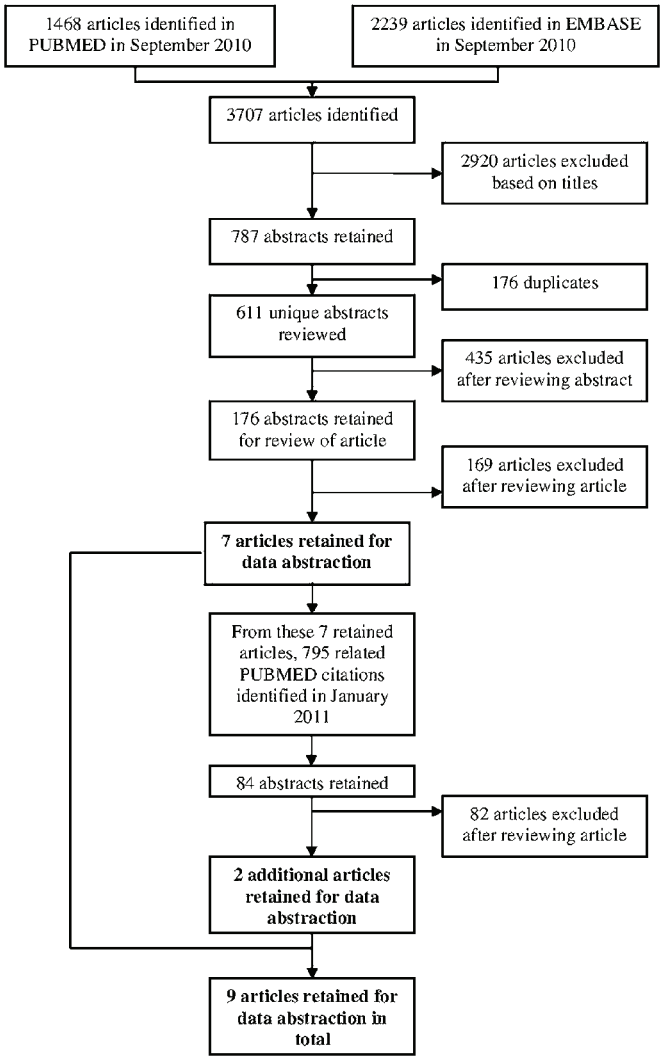

Figure 1 Results of a systematic search in the PubMed and EMBASE databases for longitudinal population-based studies on the predictors of self-initiated smoking cessation in adolescents and young adults.

1. Was cross-sectional or clearly not prospective (or that the exposure did not precede the outcome).
2. Pertained to the evaluation of a cessation intervention that was successful (in order to assure that the evidence was not obscured by exposure to a cessation intervention). We did however retain evaluation studies in which the intervention had no impact on cessation, as well as data from comparison or control groups within an intervention study that were not exposed to any intervention.
3. Pertained to select clinical study populations (ie, pregnant women, alcoholics, HIV positive individuals, trauma patients, drug abusers, patients with psychiatric disorders, pulmonary disease, heart disease, or in remission from a cancer). Our intent was to focus on population-based samples in order to maximise external generalisability of the findings.
4. Did not include data that pertained specifically to young persons aged 10–29 years.
5. Did not assess cessation as an outcome (ie, the outcome was prevalence of smoking, relapse, initiation of smoking, cessation attempts, reduction of smoking, maintained cessation, nicotine dependence, resistance to smoking, retraction of smoking status).

6. Reported qualitative data only. While qualitative data provide rich descriptions in population subgroups, the findings are not necessarily externally generalisable. In addition, qualitative data do not lend themselves easily to reportable quantitative estimates of the strength of an association.
7. Was based on the analysis of trajectories and/or used the transtheoretical model as a conceptual underpinning. Our intent was to study a discrete outcome (ie, cessation period of a duration of at least 6 months), which was often not explicitly identifiable in the studies that described trajectories or used the transtheoretical model.

Discrepancies between authors in the decision to eliminate an article from further review were discussed among three authors (SC, BL, JOL), and final decisions were reached through consensus.

Article review

A total of 176 articles from among the 611 abstracts reviewed were retained for review either because they clearly addressed the study topic or because the abstract did not incorporate sufficient information to allow its exclusion. Two authors (SC, BL) read each article in depth. In addition to the exclusion criteria described above, inclusion criteria applied during this step included that:

1. The outcome was defined as abstinence from smoking for at least 6 months.
2. The study assessed all potential determinants prior to cessation.
3. The data were collected prospectively.
4. The data were analysed quantitatively.
5. The study population was population-based.

Discrepancies between the authors in terms of which articles to retain were discussed among the three authors (BL, SC, JOL), and final decisions were reached through consensus. Of the 176 articles reviewed, 169 were excluded after in-depth review. A total of seven articles met the inclusion criteria and were retained for data abstraction.

Citation review

In January 2011, two authors (SC, BL) searched all related citations from the seven articles retained for data abstraction in the PubMed database using the same limitations mentioned above ('humans', 'English', 'child: 6–12 years', 'adolescent: 13–18 years', 'young adults: 19–24 years', 'adult: 19–44 years' and 'publication date from 1 January 1984 to 31 August 2010'). We retained 795 titles that were not reviewed during our earlier (ie, in September 2010) PubMed search. The abstracts for all 795 titles were reviewed, and 84 articles were retained for review using the exclusion and inclusion criteria described above. Of the 84 articles 2 were retained, yielding a final total of 9 articles retained for data abstraction.

Data abstraction

To examine the evidence for specific predictors of self-initiated smoking cessation in adolescents and young adults, the following data were extracted from each article: study location, timeframe (ie, the years during which the study took place), duration of follow-up (ie, calendar time period used in the analysis), number of data collection points after baseline, sample size, age/grade of participants at baseline, number of quitters, smoking status at baseline, definition of cessation, the list of covariates adjusted for in the multivariate analyses and the analytic method. In order to facilitate comparison of results across studies, potential predictors identified within each study were stratified into five groupings: (1) sociodemographic factors; (2) psychosocial factors; (3) social influences; (4) behavioural factors; and (5) smoking related variables. For the purposes of this review, results that were marginally statistically significant (ie, p=0.057) were considered to be non-statistically significant. To facilitate interpretation, we elected to exclude results on interaction effects from three articles.[12–14]

RESULTS

Our database search identified nine articles that used longitudinal study designs to identify factors associated with self-initiated cessation in population-based samples of adolescents and young adults. Four articles described data originating from the same cohort: Project ALERT was a drug use prevention programme targeted to grades 7 and 8 students in the USA, which had no impact on cigarette smoking once the intervention was discontinued.[15] These four articles identified factors related to cessation at different ages (ie, in grade 10,[13] grade 12,[12] at age 18,[16] and at age 23[17]). Table 1 overviews the characteristics of the nine articles retained for analysis.

Eight of the nine studies were conducted in the USA; one was conducted in Taiwan. The study populations in all articles retained were school-based. Study populations ranged in age from 12[19] to 23 years[17] at baseline, and from 14[19] to 29 years[17] at the final follow-up. For each study, we confirmed that the relevant cessation outcome occurred prior to age 29 years. Length of follow-up ranged between 15 months[20] and 14 years[14] across studies. Most studies[12 13 16 18 21] referred to psychosocial theory as the conceptual underpinning for the investigation and the selection of potential determinants of cessation. Specifically, these included cognitive theory,[23 24] social learning theory,[25 26] the theory of planned behaviour,[27–29] problem behaviour theory,[30] the theory of reasoned action,[28 31] the social development model,[32] and self-efficacy theory.[23 33]

The definition and method of measuring smoking differed across studies. Specifically, several studies defined a smoker either by the number of times a participant smoked per year[12 13] or per month,[17] or by frequency of smoking (ie, monthly,[19] weekly[18] and daily).[14 18] Two studies[16 21] defined smoking status as cigarette use during the past year. Mittelmark *et al*[19] was the only study that validated self-reports of smoking using biological markers including carbon monoxide and saliva thiocyanate levels. Hansen *et al*[20] did not define smoking status explicitly.

Similarly, smoking cessation was defined differently across studies. Three of the nine studies defined smoking cessation as abstinence of duration ≥6 months, and six studies defined cessation as abstinence of duration ≥12 months. More specifically, Bricker *et al*,[18] Tucker *et al*,[12 17] Ellickson *et al*[13 16] and Chang *et al*[21] specified the duration of cessation (ie, not smoked in the last year, at least 6 months of abstinence or most recent quit attempt lasted ≥6 months), while Mittelmark *et al*[19] and Hansen *et al*[20] reported cessation as being a non-smoker at two consecutive surveys separated by 6 months. Rohde *et al*[14] asked participants older than age 25 if they had not smoked during the 12 months prior to reaching 25 years of age.

There was wide variability across studies in the potential determinants of cessation investigated, as well as in the definitions and methods of measuring the determinants. Most determinants were studied only once or twice across the nine studies. In addition, there were differences in the analytic approaches used to identify predictors of cessation. Most studies used logistic regression; two studies used discriminant analysis; and one study used the generalised estimating equation approach.

Table 1 Characteristics of nine longitudinal studies investigating the determinants of self-initiated smoking cessation of a duration of at least 6 months in population-based samples of adolescents and young adults

First author, date of publication (reference)	Study location (timeframe)	Duration of follow-up; surveys after baseline	Sampling frame, sampling method	Sample size, participant age/ grade range at baseline	Number of quitters (%)	Participant smoking status at baseline	Definition of cessation	Adjustment	Analytical method
Bricker, 2009[18]	Washington State, USA (1984–2004)	11 years; once	School based (convenience), from the combined control and intervention cohorts of the HSPP*	991 students whose parents were ever regular smokers; 17 years	233 daily smokers (23.5%) plus 257 weekly smokers (25.9%)	At least weekly and daily smokers	At least 6 months of abstinence	Gender, parental education	Multivariate logistic regression
Mittelmark, 1988[19]	Minneapolis/ St. Paul metropolitan area, USA (not mentioned)	2 years; three times (each spring and autumn over 2 academic years)	School based (convenience)	72; 7th–11th grade	32 (44.4%)	Identified on the first and/or second surveys to be current cigarette smokers†	Report of non-smoking on the third and fourth surveys	–	Discriminant analysis to develop a multivariate model
Tucker, 2005[17]	California and Oregon, USA (1985–2001)	Calendar time period used for analysis: 1995–2001: 6 years; once	School based (representative), from the project ALERT‡	360; 23 years	103 (26%)	In 1995, smoked in the past month and on at least 40 occasions in the past year	Most recent quit attempt lasted 6 months or longer	Controlling for gender, race/ethnicity, income, and education+for all predictors+for age at first use and quantity/ frequency of smoking (average number of cigarettes smoked per day during the past 30 days)	Multivariate logistic regression analysis
Ellickson, 2001[16]	California and Oregon, USA (1985–1995)	Calendar time period used for analysis 1985–1995: 10 years; twice	School based (representative), from the project ALERT‡	1093; 18 years	–	Defined as smokers (cigarette use during the last year) in 1990	Not smoked in last year	–	Logistic regression analysis (univariate or multivariate analysis undefined)
Ellickson, 2001[13]	California and Oregon, USA (1985–1990)	Calendar time period used for analysis 1988–1990: 2 years; once	School based (representative), from the project ALERT‡	827; Grade 10	100 (12.1%)	Smoking at least 11–20 times during the past year at grade 10	Not smoking during the past year at grade 12	Six separate models tested§+controlling for age at first use and for smoking quantity	Multivariate logistic regression analysis
Tucker, 2002[12]	California and Oregon, USA (1985–1995)	Calendar time period used for analysis 1990–1995: 5 years; once	School based (representative), from the project ALERT‡	711; Grade 12	106 (14.9%)	Smoking at least 10–19 times during the past year	Not smoked at all during the past year	Six separate models tested§+controlling for age at first use and for smoking quantity	Multivariate logistic regression analysis
Hansen, 1985[20]	USA (1981–1982)	15 months; twice	School based (convenience)	392; 15–16.5 years	44 (11.2%)	Smokers	Maintaining quitting: smoker at wave 1 and non-smoker at wave 2 and 3	–	Discriminant and multivariate analysis
Chang, 2006[21]	Taiwan (2000–2002)	2 years; once or twice	School based (convenience)	494; Grade 10	76 (15.4%)	Smoked in the past year	Smoked in the past 12 months in the 10th grade survey but not in the 11th±12th grades surveys	All psychosocial factors in 10th grade¶	Generalised estimating equation in univariate and multivariate analysis

Continued

Table 1 Continued

First author, date of publication (reference)	Study location (timeframe)	Duration of follow-up; surveys after baseline	Sampling frame, sampling method	Sample size, participant age/ grade range at baseline	Number of quitters (%)	Participant smoking status at baseline	Definition of cessation	Adjustment	Analytical method
Rohde, 2004[14]	Western Oregon, USA (1987–1998/ 2001)	11–14 years; four times	School based (representative)	242; 14–18 years	53 (22%)	Daily smokers at survey T3	No smoking during the 12 months prior to turning age 25 years	Variables demonstrating significant effects (MDD, antisocial personality disorder scores, family history of drug and alcohol use disorders, history of ND, gender× ND, male gender)	Univariate and multivariate logistic regression analysis

*Bricker *et al*[18] used a study sample which came from the combined control and intervention cohorts of the Hutchinson Smoking Prevention Project (HSSP), a group-randomised trial of school-based smoking prevention in third grade. The authors had previously reported that there was no intervention impact relative to the prevalence of daily smoking or for other smoking outcomes either at grade 12 or at 2 years after high school.[22]
†Current cigarette smokers: report of smoking monthly or more, carbon monoxide level of 8 ppm or greater and saliva thiocyanate level of 85 µg/ml or greater.
‡Project ALERT was implemented in seventh and eighth grade, but this multiyear drug use prevention programme had no impact once the prevention lessons stopped. At grade 10 and 12, there was no significant effect on smoking behaviour.[15]
§(1) Demographic variables (age, ethnicity and parental education), (2) smoking environment, (3) smoking beliefs, (4) rebelliousness, substance use, and problem behaviours, (5) social bonds and (6) health status (for (2)–(6), demographic variables were included).
¶Psychosocial factors in six domains: (1) smoking and substance use behaviours: frequency and quantity of tobacco and other substance use, (2) individual factors: demographics, working status, academic achievement, antismoking attitude, beliefs, refusal self-efficacy, deviance, problem behaviours, (3) family factors: family structure, socioeconomic status, parental communication, supervision, attachment, parents' smoking disapproval attitude, (4) peer factors: peer tobacco and other substance use, peer smoking attitudes, peer deviance behaviours, (5) school factors: proportion of student smoking, teachers' smoking disapproval attitude, teacher supervision and (6) community factors: community identity, the availability of tobacco and other substances and community smoking disapproval attitude.

Six of nine studies provided details about which covariates were adjusted for in the multivariate analyses. Two reports[12 13] stratified the analyses by sex. Finally, the threshold between a statistically significant and a marginally statistically significant effect was not the same across studies. Thus for Tucker *et al*[12] peer smoking (controlling for age at first use) was considered 'marginally statistically significant' with a p value of 0.05, while another article[13] considered that peer smoking (controlling for smoking quantity) was statistically significant with a p value of 0.05.

Online table S1 summarises the univariate and multivariate results across the nine studies in terms of whether or not a specific factor was statistically significantly associated with self-initiated smoking cessation. The table, which is available at the *Tobacco Control* website (http://tc.bmj.com), describes the results of the nine studies retained in more detail, including ORs and p values (when available) for all variables investigated.

Despite the wide variability across studies in design features and methods, with the single exception of parental education, there were no discrepancies across studies in the direction of associations detected for those determinants that were detected as statistically significantly related to cessation. For parental education, one study[13] reported that higher levels of parental education were associated with cessation in adolescents, while a second article[16] suggested that lower levels of parental education were positively associated with cessation in young adults. In general, no strong patterns emerged in terms of the five groupings of potential determinants (ie, none of the groupings of sociodemographic, psychosocial, behavioural, social influences, or smoking-related factors appeared to be consistently or more or less strongly associated with smoking cessation across variables within the grouping).

Two of the nine articles[12 13] carried out sex-specific analyses, and reported that females were more likely to quit smoking when they did not have friends who smoke, while males who were older at first use of cigarettes were more likely to quit. The results reported according to sex were discordant between studies. For example, parental disapproval of cigarette use was significant for males in one article only, while the reverse was true in the second. One article examined a possible interaction between gender and nicotine dependence, and reported that women were less likely to quit than men when they were nicotine dependent (data not shown).[14]

Table 2 summarises the number of studies that reported that a variable was statistically significantly associated with cessation, from among all the studies that examined the variable. Peer smoking was the factor most often investigated, followed by age at first cigarette use, beliefs about smoking, perceived prevalence of smoking among peers, parental support, alcohol use, education and ethnicity. Five variables were statistically significantly associated with cessation in at least three studies, including not having friends who smoke, not having intentions to smoke in the future, resisting pressure to smoke, being older at first use of cigarettes and having negative beliefs about smoking. Peer smoking was statistically significant in five of seven studies, and intentions to smoke and cigarette resistance self-efficacy were statistically significant in three of three and in three of four studies, respectively. Age at first use of cigarettes and beliefs about smoking were statistically significant in three of five studies. If marginally statistically significant effects were redefined as statistically significant, having no friends who smoke, age at first use of cigarettes and frequency of smoking became statistically significantly associated with cessation in six of seven studies, four of five studies and three of three studies, respectively.

Table 2 Number of longitudinal studies that identified a specific factor as statistically significantly associated with self-initiated smoking cessation of a duration of at least 6 months among adolescents and young adults, from among all population-based studies that investigated the variable

Factor	No. of studies in which factor was statistically significantly associated with cessation/no. of studies which investigated the factor
Sociodemographic factors	
Age	0/3
Gender	1/3
Ethnicity	1/5
High socioeconomic status	0/2
Higher/poor levels of parental education	2/3
Higher education	2/5
Good raising children	0/1
Attending fewer different schools	1/2
Living with both biological parents	2/4
Parent communication	0/1
Married	1/2
No part-time work	0/2
Psychosocial factors	
Good mental health	1/3
No major depressive disorder	0/1
No dysthymia	0/1
No anxiety disorders	0/1
No attention-deficit hyperactivity disorder/ disruptive behaviour disorder	0/1
No borderline personality disorder scores	0/1
No antisocial personality disorder scores	0/1
No intentions to smoke cigarettes	3/3
High cigarette resistance self-efficacy	3/4
Negative beliefs about smoking	3/5
Antismoking beliefs	1/1
Positive consequences of smoking	0/3
Less rebellious	1/4
No thrill seeking	0/1
Less delinquent	1/3
Less deviant	0/1
Not being victimised (sexual and non-sexual)	0/1
Behavioural factors	
No problem behaviours	0/1
No alcohol use	1/6
No drug use	1/3
No drug selling	1/1
No criminal behaviour	0/1
Good physical health	2/3
Academic intentions	0/1
Pregnancy	0/2
Social influences	
No friends smoking	5/7
No perceived prevalence of smoking	0/5
No parents smoking	1/3
Late parents' quitting	0/1
Early parents' quitting	1/1
No siblings smoking	1/3
No household smoking (parents or siblings)	0/1
Friend disapproval of cigarette use	0/3
Parent disapproval of cigarette use	2/3
Parents/friends' disapproval of cigarettes	0/1
Community disapproval of cigarette use	0/1
Friend support	1/3
Parental support	1/5
No cigarette offers	2/3
Exemplars	0/4
School attachment	0/1
Community attachment	0/1
Living without children	1/1
Moving in with spouse or partner	0/1
Becoming parents	0/1
Becoming parents x gender	0/1
No family history of affective disorder	0/1
No family history of anxiety	0/1
No family history of drug and alcohol use	0/1
No familial history of externalising	0/1
Smoking related variables	
Older age at first cigarette use	3/5
Older age at first daily smoking	0/1
Low frequency of smoking	2/3
No nicotine withdrawal	0/1
No nicotine dependence	1/1
No cigarette availability	0/1

Several factors (ie, gender, attending fewer different schools, being married, good mental health, being less rebellious or less delinquent, not using drugs, having no parents or siblings who smoke and friend support) were identified as statistically significant predictors of cessation in one or two studies, but were not statistically significant or they were not evaluated in others. Good physical health, low frequency of smoking, living with both parents, no cigarette offers and parental disapproval of cigarette use were statistically significant in two of the three or four studies which examined these factors. However, there were differences between females and males for living with both parents and parental disapproval. Among the two, three, four or five studies that examined socioeconomic status, part time work, pregnancy, perceived prevalence of smoking among peers, having exemplars who modelled cigarette use, having friends who disapproved of cigarette use, thinking that smoking has positive consequences and age, none reported a statistically significant association with cessation. The remaining variables listed in table 2 were only examined only once.

DISCUSSION

Empirical reviews generally conclude that smoking cessation programmes for young smokers have limited efficacy.[34–36] This is perhaps not surprising since the determinants of cessation beyond those linked to smoking and nicotine dependence are not well understood, and the development of effective cessation approaches may be limited by incomplete understanding of the factors that influence cessation in this population. In this current review of nine longitudinal studies on the determinants of cessation in adolescent and young adults, we found evidence across studies that having no friends who smoke, having no intention to smoke in the future, resisting peer pressure to smoke, being older at first cigarette use and having negative beliefs about smoking predict longer-term cessation.

Sussman *et al*[5] published the only similar review on this topic. Specifically his review, published in 2002, incorporated 17 longitudinal studies on self-initiated quitting published between

1972 and 2001, including 6 studies in which youth were exposed to a drug prevention programme. The results reported in the Sussman *et al* review agree with our results in that both identified having no friends who smoke, having negative beliefs about smoking and having no intention to smoke in the future as predictors of youth cessation. The Sussman *et al* review also identified lower pretest smoking and having less experience with smoking, believing that society should step in to place controls on smoking, feeling relatively hopeful about life and having parents and/or siblings who smoked, as predictors of successful cessation. Also inconsistent with our review, Sussman *et al* did not identify resisting peer pressure to smoke or being older at first cigarette use as significant predictors of youth cessation.

Differences in findings between Sussman *et al* and our review may relate to timing (ie, the Sussman *et al* review covered 1972 to 2001, while ours covered 1984 to 2010) and to the fact that Sussman *et al* did not define a minimal duration of abstinence as an inclusion criterion. Further these authors did not specify any inclusion or exclusion criteria for articles to be retained; nor did they clearly describe the method(s) or search criteria used to identify studies. Three other reviews published in 2000,[7] 2004,[6] and 2004,[8] respectively included studies from one calendar year only,[6 7] and they incorporated results across cross-sectional,[6–8] interventional and clinical studies.[6]

The predictors identified in our review seem credible as possibly causally related to cessation. Being older at first cigarette use likely relates to lower lifetime exposure to cigarettes, which may link with lower levels of nicotine dependence and in turn, with a higher likelihood of quitting in adolescence or young adulthood. Psychosocial indicators including intention to smoke in the future, resisting peer pressure to smoke and having negative beliefs about smoking align with social learning theory and may be key underpinnings of behaviour choices and useful targets for intervention. Finally friends' smoking is a strong and well established predictor of youth smoking as well as cessation, and highlights the importance of social norms in this domain.

It is notable that few studies examine nicotine dependence as a possible physiological determinant of cessation. In one of the few studies that did so, Rhode *et al*[14] reported that young adults who were nicotine dependent were less likely to quit smoking. An analysis of possible interaction effects within the same study revealed that women who were nicotine dependent were six times less likely to quit smoking than men. Given accumulating evidence that many young smokers begin to experience symptoms of nicotine dependence such as cravings early on in the natural course of smoking onset,[37 38] increased understanding of the extent to which nicotine dependence relates to cessation in novice smokers may be critical in the development of effective cessation strategies for youth.

In addition to difficulty synthesising across studies that span 1981 to 2004 and that differ in design and methods, limitations of this review include that most studies retained were conducted in the US, so that external generalisability of the findings to other countries, and in particular, to low and middle income countries, may be limited. Second, we restricted the review to population-based studies so that the results are likely not generalisable to select study populations (ie, young people who are homeless, street-involved, mentally ill, substance using, traumatised, school leavers, youth in transition, Aboriginal, low income). Four of the nine articles were based on Project ALERT. Despite possibly further limiting external generalisability, we opted to include all four ALERT articles because there were so few eligible studies available. Our review was limited to studies that report on cessation of a duration of at least 6 months rather than permanent lifetime cessation. Only two of the nine studies addressed differences in the predictors of cessation by sex, so that whether or not programmes and policy need to take sex and/or gender into account cannot be established. Finally, the age ranges covered in this review are wide. Individuals in these age ranges differ markedly in developmental stage and have widely variable life experience. Longitudinal studies may be needed to examine effect modification in the predictors of cessation by age, if the predictors of cessation are dependent on age.

CONCLUSIONS

The literature on the longitudinal determinants of cessation in adolescents and young adults is relatively undeveloped and subject to numerous limitations. It is likely that cessation interventions for young smokers will remain less than optimally effective until there is a solid evidence base to inform the development of effective cessation interventions for youth. Development of the evidence will comprise, among other concerns, more complete understanding of the determinants of long-term cessation in this population. In the meantime, given that many young smokers want to quit, practitioners may want to consider incorporating the results of this review on the determinants of cessation (ie, that not having friends who smoke, not having intentions to smoke in the future, resisting pressure to smoke, being older at first use of cigarettes and having negative beliefs about smoking relate to youth cessation) into cessation programmes and policy targeted to adolescents and young adults.

Funding This study was funded by the Canadian Cancer Society. JO'L holds a Canada Research Chair in the Early Determinants of Adult Chronic Disease.

Competing interests None.

Contributors BL and SC reviewed the titles, abstracts and articles, and wrote sections of the article. JOL designed the study, reviewed the abstracts and articles, and wrote sections of the paper. JC provided commentary on the article. All authors read and approved the final version of the article.

Provenance and peer review Not commissioned; externally peer reviewed.

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