A Systematic Review of Randomized Controlled Trials of Youth Smoking Cessation Interventions

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Abstract

Background: *Cigarette use remains common among young people but little is known about how to help adolescent smokers quit. There are few systematic reviews of randomized controlled trials (RCTs) that evaluate the effectiveness of cessation interventions for youth.*

Objective: *To synthesize knowledge on the effectiveness of cessation interventions targeted to youth based on evidence from RCTs.*

Selection of studies and data extraction: *We retained all published RCTs with intention to treat analyses that evaluated cessation interventions targeted to youth aged ≤ 20 years. Relevant studies were identified from eight review articles of smoking cessation intervention studies published between 2002 and 2006, and from a search conducted in PubMed and PsycINFO databases from 2001 to November 2006. The outcome of primary interest was abstinence at the longest reported follow-up. Extraction of data was by consensus of the authors.*

Results: *We identified 16 RCTs with a total of 6623 participants; 11 studies that included 5764 participants evaluated behavioural interventions, four with 529 participants evaluated pharmacological interventions, and one with 330 participants evaluated a laser acupuncture intervention. Three of four behavioural interventions conducted in school settings, and one of four conducted in a health care setting significantly increased abstinence four weeks to 24 months after the interventions. Of four RCTs that evaluated pharmacological interventions using either bupropion or nicotine patch or gum, one study using the nicotine patch coupled with cognitive-behavioural counselling showed a marked albeit non-significant increase in abstinence six months after quit date.*

Conclusion: *There is still limited evidence demonstrating the efficacy of smoking cessation interventions in youth. Four school-based programs and one intervention in a health care setting have shown efficacy, while results for pharmacological therapy are inconsistent across studies.*

Keywords: *youth, tobacco, cessation, smoking, better practice*

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Introduction

Despite widespread tobacco control programs and important decreases over the past decade in the proportion of young people who smoke, in 2005 23% of students in grades 9-12 in the US reported smoking in the last month, a prevalence that has remained unchanged since 2003 (US Centers for Disease Control and Prevention). In Canada, declines in youth smoking have been observed each year since 1999, at which time 28% of young people smoked (Health Canada, 1999-2006). However the prevalence remains high in 2006 with 15% of youth aged 15-19 years still current smokers. However, 66% of young daily smokers reported having made at least one quit attempt in the past year. In Quebec, the prevalence of smoking among youth decreased from 36% in 1999 to 18% in 2006. Data from the longitudinal US Teenage Attitudes and Practices Survey 1 (1989) and II (1993) (TAPS) (Allen et al.,1993, MMWR 1994), show that only 4% of adolescent smokers quit each year (Zhu et al., 1999). Several recent reports suggest that symptoms of nicotine dependence such as cravings and withdrawal occur within months of first puff and may signal the beginning of a process leading to escalating cigarette use, tobacco dependence, and increased difficulty quitting (DiFranza et al., 2000; Gervais et al., 2006;.O'Loughlin et al., 2003; Wellman et al., 2004). This suggests that, in addition to programs directed to more established youth smokers, cessation interventions may also be needed for those whose cigarette consumption is low or sporadic.

Eight reviews on cessation interventions for young smokers published between 2002 and 2006 (Backinger et al., 2003; Garrison et al., 2003; Grimshaw et Stanton, 2006; McDonald et al., 2003; Mermelstein, 2003; Milton et al., 2004; Sussman, 2002; Sussman et al., 2006) describe publications dating between 1975 and 2005. Sussman (2002) reported an overall mean quit proportion of 12% in the intervention groups at 3-12 months follow-up, compared to 7% in the control groups. McDonald et al. (2003), the Youth Tobacco Cessation Collaborative, (Milton et al., 2004), Mermelstein (2003), and Backinger et al. (2003) each concluded that the literature was too sparse and methodologically diverse to allow well-grounded recommendations on effective youth cessation interventions. However these latter reviews did suggest that cognitive-behavioural approaches, school-based clinics, and interventions delivered in health care settings were promising. In 2003, Garrison conducted a systematic review of six controlled trials of current smokers aged 10-21 years, and concluded that more randomised controlled trials (RCTs) with better defined and biochemically validated cessation outcomes were needed (Garrison et al., 2003). Recently Sussman et al. (2006) conducted a meta-analysis of 48 controlled studies, only 19 of which were RCTs, and concluded that smoking cessation programs gave smokers an absolute advantage in quitting of almost 3% and increased the likelihood of quitting by approximately 46%. Programs based in schools and those that included motivation enhancement, cognitive-behavioural techniques and social influence approaches, and that lasted at least five sessions yielded higher quit rates. A recent Cochrane collaboration reviewed six RCTs, seven cluster-randomised controlled trials, and two non randomised controlled trials that evaluated cessation programs with follow-ups of smoking status of at least six months. Trials that tested the transtheoretical model approach achieved moderate long-term success persisting at two years follow-up. Cognitive behavioural therapy interventions showed modest effectiveness when results were pooled across studies. As in

the other reviews, the evidence for pharmacological approaches was viewed as inconclusive.(Grimshaw et Stanton, 2006). All reviews to date recommended more research and in particular, more RCTs with at least six months follow-up, with rigorous definitions of cessation that are biochemically validated.

In this report we describe a systematic review that includes only RCTs of cessation interventions targeted to youth, in order to update recommendations about the potential of specific interventions to help young smokers quit. While previous reviews have used systems to rate the quality of the evidence in all publications identified, we focused on RCTs because the evidence for making causal inferences derived from RCTs is generally considered stronger than evidence based on other study designs.

Methods

Youth cigarette smoking cessation interventions published in the peer-reviewed English literature were identified by one author (ED) by: (i) reviewing all references reported in eight extant review articles with study populations that included youth aged 20 years or younger; (Backinger et al., 2003; Garrison et al., 2003; Grimshaw et Stanton, 2006; McDonald et al., 2003; Mermelstein, 2003; Milton et al., 2004; Sussman, 2002; Sussman et al., 2006) (ii) identifying published articles recorded in the PubMed and PsychINFO databases from 2001 to 2006 using "youth," "adolescents," "smoking," "tobacco," and "cessation" as search terms; and (iii) scanning references listed in all publications identified for additional relevant studies.

Two authors (ED, AG) independently reviewed the publications, identified and extracted 27 RCTs that reported results on cigarette smoking cessation. Among these 27 RCTs, studies were further excluded if they did not report: (i) point prevalence abstinence outcomes, defined as self-report of no smoking for

five or more days before follow-up assessment (ii) the proportion of smokers at baseline that reported having quit at follow-up; and (iii) an intention to treat analysis, or data provided in the report enabling to compute adjusted point prevalence outcome. Authors were contacted for additional information if necessary.

Information extracted from each RCT included sample size, baseline characteristics of participants (i.e., age, gender, cigarettes smoked per day, level of dependence), and descriptions of the intervention tested (including its theoretical basis), the control condition, and the time of assessment of the outcome. Since the proportion of youth that stopped smoking was usually reported based on the time at which intervention ended in the behavioural RCTs, and from the quit date in the pharmacological RCTs, information was extracted on the exact time of smoking cessation in relation to the duration of the intervention, to allow calculation of the proportion of youth that stopped smoking based on the actual quit date.

Copies of the 27 RCTs and the tabulated results were distributed to all authors of this review for verification of the reasons for excluding specific studies, as well as accuracy of data extracted. Consensus on discrepant results was attained through discussions amongst the authors.

Results

Of the 27 RCTs identified, 16 met the inclusion criteria (Adelman et al., 2001; Bauman et al., 2000; Brown et al., 2003; Colby et al., 2005, 1998; Hanson et al., 2003; Hollis et al., 2005; Killen et al. 2004; Lipkus et al., 2004; Moolchan et al. 2005; Pbert et al., 2006; Robinson et al. 2003; Roddy et al., 2006; Rodgers et al., 2005; Sussman et al., 2001; Yiming et al., 2000), and 11 studies (Albrecht et al., 1998; Aveyard et al., 1999; Bosworth et al., 1994; Brown et al., 2002; Flay et

al. 1995; Forster et al. 1998; Mc Cambridge et Strang, 2004; Niederhofer et Huber, 2004; Perry et al., 1980; Stoddard et al., 2005; Sussman et al., 1995) were excluded for the following reasons: there was no definition of the 5 (or more)-day point prevalence abstinence as self-report of no smoking for five or more days before follow-up assessment (6 studies); the proportion of smokers who quit was not reported (4 studies); or the selection of the control group was not based on randomisation (1 study). Two studies were excluded for multiple reasons.

The 16 studies retained included a total of 6,623 participants. Eleven trials with 5,764 participants evaluated behavioural interventions, four trials with 529 participants evaluated pharmacological interventions, and one trial with 330 participants evaluated a laser acupuncture intervention. Table 1 describes the number of participants, and the intervention and control conditions in each trial. Abstinence was validated by expired CO levels in five of the 16 studies (Moolchan et al., 2005; Robinson et al., 2003; Roddy et al., 2006; Sussman et al., 2001; Yiming et al., 2000), by saliva cotinine in four studies, (Colby et al., 2005, Lipkus et al., 2004; 1998; Rodgers et al., 2005), and by both expired CO and saliva cotinine in four studies (Adelman et al., 2001; Brown et al., 2003; Hanson et al., 2003; Killen et al., 2004). Four studies did not incorporate biochemical validation of the results (Bauman et al., 2000; Hollis et al., 2005; Pbert et al., 2006; Rodgers et al., 2005). Drop-out rates were not systematically reported in all studies, but in eight of 16 studies that did report drop-outs, the proportion varied substantially from 8% in a 1-month behavioural program for students caught smoking (Robinson et al., 2003), to 64% in a 6-week study on the nicotine patch in socio-economically deprived young smokers (Roddy et al., 2006).

The eleven studies evaluating behavioural approaches (Adelman et al., 2001; Bauman et al., 2000; Brown et al., 2003; Colby et al., 1998, 2005; Hollis et al., 2005; Lipkus

et al., 2004; Pbert et al. 2006; Robinson et al. 2003; Rodgers et al., 2005; Sussman et al., 2001; Yiming et al., 2000) included four RCTs testing cessation interventions based in school settings, (Adelman et al., 2001; Pbert et al., 2006; Robinson et al., 2003; Sussman et al., 2001) four based in health care settings, (Brown et al., 2003; Colby et al., 2005, 1998; Hollis et al., 2005) one using mobile phone text messaging (Rodgers et al., 2005), one using telephone counselling (Lipkus et al., 2004) and one family-directed program using booklets and telephone contacts with a health educator. (Bauman et al., 2000) One intervention used laser acupuncture. (Yiming et al., 2000) Control conditions included informational pamphlets, brief advice, standard care in schools, a diet intervention in a health care setting and sham acupuncture.

Pharmacological interventions (Hanson et al., 2003; Killen et al., 2004; Moolchan et al., 2005; Roddy et al., 2006) were assessed in four double-blind RCTs; one compared the nicotine patch to the nicotine gum to a placebo patch and gum, (Moolchan et al., 2005) two compared the nicotine patch to a placebo, (Hanson et al., 2003; Roddy et al., 2006) and one compared the nicotine patch combined either to bupropion or to a placebo. (Killen et al., 2004). Both the medication and control conditions included cognitive-behavioural therapy (CBT); three trials offered financial compensation for completing the study.

Table 2 describes baseline characteristics of participants, and the proportion that quit based on 5-, 7-, or 30-day point-prevalence abstinence rates. The mean age of participants in each study was 15-17 years; only two studies included participants aged 12-14 years. There was a higher proportion of females in 13 of the 16 RCTs. When reported, participants smoked 9-18 cigarettes per day on average, and were moderately to heavily dependent on nicotine.

Table 1 : Description of intervention and control conditions in 16 RCTs of youth smoking cessation interventions

Author Year (Name of intervention)	n	Intervention description	Control
Based in schools			
Sussman 2001 (Project EX)	335	CBT for students in alternative high schools with school-based clinics 8 classroom-based sessions, 6 weeks OR 8 classroom-based sessions, 6 weeks with School-As-Community	No intervention
Robinson 2003 (Start to Stop)	261	Behavioral intervention for students caught smoking, based on social influence model and stage of change 50 min individual stage-based intervention x 4wks + monthly calls x 12months	"I Quit" pamphlet+ monthly calls x 12 months
Adelman 2001	74	Smoking cessation curriculum based on American Lung Association Tobacco Free Teens and American Cancer Society FreshStart 8 classroom-based sessions x 50min, 6wks	Information pamphlet
Pbert 2006	1148[a]	CBT based on US Public Health Service "5 A model" delivered by school nurses 2 X 30-min and 2 X 15-min sessions over 1 mo	Usual smoking cessation care

Based in health care settings			
Brown 2003	191	Motivational interviewing for adolescents in psychiatric hospital 2 individual 45min individual sessions + relapse prevention + "I Quit" pamphlet + offered NRT+ FC	Brief advice x 5-10min +"I Quit" pamphlet + offered NRT+ FC
Colby 1998	40	Motivational interview for outpatients (emergency room, outpatient clinics) and hospital inpatients. 30min individual session + FC	Brief advice x 5min + FC
Colby 2005	85	Motivational interviewing for patients in emergency room and outpatient clinics 35min individual session + 20min telephone booster 1 wk later + FC	5min standardized brief advice + telephone call 1 wk later reminding of follow-up visit + FC
Hollis 2005	2526[a]	Physician directed program for teens in well care visits: 30-60 sec advice from physicians + encouragement to talk with health counselor + 10-12 min computerized Pathways To Change session + 3-5 min motivational counseling + 2 booster sessions over 11 months	Diet intervention: 3-5 min motivational counseling + nutritional brochure + snack packs

CBT cognitive-behavioral therapy
CM contingency management
FC financial compensation for follow-up
NRT nicotine replacement therapy

Author Year (Name of intervention)	n	Intervention description	Control
Self-help and telephone			
Rodgers 2005	617[n]	Mobile phone text messaging starting on quit day during 1 month	Mobile phone text messaging starting six months after quit day to encourage follow up
Lipkus 2004 (X-Project)	402	Written self-help material; video + telephone counseling based on transtheoretical model + motivational interviewing (3 calls 2-3 weeks apart)	Written self-help material; video
Bauman 2000 (Family Matters)	85[a]	Program for randomly selected teens: 4 activity booklets mailed @ intervals & followed by brief phone contact from health educator	No treatment; Baseline and follow-up interviews only
Laser acupuncture			
Yiming 2000	330	Laser ear acupuncture x 4min (3 sessions/wk x 4wks)	Sham x 4min (3 sessions/wk x 4wks)

Pharmacological			
Killen 2004	211	Bupropion SR 150mg x 9wks+ Nicotine patch[b] x 8 wks + 45min group skills training x 8 wks + FC	Placebo x 9wks + Nicotine patch[b] x 8wks + 45min group skills training x 8 wks+ FC
Moolchan 2005	120	Nicotine patch[b] + placebo gum x 12wks + 45min group CBT x 11 wks + FC Nicotine gum[c] + placebo patch x 12 wks + 45min group CBT x 11 wks + FC	Placebo patch + placebo gum x 12wks +45min group CBT x 11wks + FC
Hanson 2003	100	Nicotine patch[b] x 10 wks + individual 10-15 min CBT x 10 wks; CM	Placebo patch x 10wks; group + individual 10-15 min CBT x 10 wks; CM
Roddy 2006 (Zone youth project)	98	Nicotine patch[d] x 6 wks + 15 min individual or group behavioural counseling	Placebo patch x 6 wks + 15 min individual or group behavioural counseling

CBT cognitive-behavioral therapy
CM contingency management
FC financial compensation for follow-up
NRT nicotine replacement therapy

[a] Studies without biochemical validation
[b] Nicotine patch 21 or 14 mg, depending on cigarette consumption, stepped down to 7 mg after 6 weeks
[c] Nicotine patch 21 or 14 mg/nicotine gum 4 or 2 mg, depending on body weight & cigarette consumption
[d] Nicotine patch 15 mg/10 mg/5 mg x 2 wks each

Table 2 : Characteristics of the participants and results of 16 RCTs on youth smoking cessation interventions.

	Baseline characteristics of participants					Seven-day point prevalence abstinences			
Study	Age Range or Mean	Female %	Mean CPD % daily smokers	Measure of dependence % or mean	Time of assessment post interven-tion (post quit date)	Intervention	Control	P -value	Effect size[h]
School-basede									
Sussman 2001	16.8	36	8.8 85%	mFTQ moderate to heavy 75%	3.7 months (5 months)	17[a]	8[a]	< .05	9
Robinson 2003	15.8	36.4	NR 69%	mFTQ moderate to heavy 72%[a]	12 months (NR)	6[b]	6[b]	> .05	0
Adelman 2001	15.9[a]	64.5[a]	9.7[a] NR	mFTQ 4.2[a]	4 weeks (NR)	52[c]	20[c]	.01	32
Pbert 2006	16.9	62.5	15 NR	mFTQ 4.7	3 months [d]	24[a]	5[a]	< .05	19
Health care setting									
Brown 2003	15.4	62.3	14.48 64%	mFTQ 4.9	12 months (NR)	14	9.9	> .3	4.1
Colby 1998	16.1[b]	57.5[b]	9[a] NR	FTQ 6.1[b]	3 months (NR)	20	10	.78	10
Colby 2005	16.3	71	10.5 NR	FTQ 5.9	6 months (NR)	9	2	> .05	7
Hollis 2005	14-17	59	NR NR	None	24 months[d]	30[a]	21[a]	< 0,05	9

Self help and telephone									
Rodgers 2005	16-19	66	14 100%	FS 4.5	26 weeks[d]	25[g]	21[g]	> .05[g]	4
Lipkus 2004	15-18	51	10 NR	mFTQ heavy 8%	3.5months (NR)	7[b]	6[b]	NR[f]	1
Bauman 2000	12-14	53	NR 9.8	None	12 months[d]	37.8[g]	31.3[g]	.7[b]	6.5
Acupuncture									
Yiming 2000	12-18	NR	5 per day or more NR	NR	3 months (NR)	22[b, e]	24[b, e]	.95	-2
Pharmacologic									
Killen 2004	17.32	31	15.4 NR[a]	mFTQr 16.6[a]	16 weeks (24 weeks)[a]	8	7	> .05	1
Moolchan 2005	15.2	70	17.7 NR	FTND 7.0	3 months (6 months)	Patch 20.6 Gum 8.7	5.0	.058 .51	15.6 3.7
Hanson 2003	16.8	57	16.8 NR	FTND NR	End-of-treatment (10 weeks)	28	24	.65	4
Roddy 2006	14.8	60	NR NR	FS NR	7 weeks (13 weeks)	0[a]	0[a]	NR	0

CPD Cigarettes per day
NR not reported
mFTQ modified Fagerstrom Tolerance Questionnaire adapted by Prokhorov et al 1996
FTQ Fagerstrom Test Questionnaire Fagerstrom 1978
mFTQr modified Fagerstrom Tolerance Questionnaire adapted by Rojas et al 1998
FTND Fagerstrom Test for Nicotine Dependence
FS Fagerstrom score,

[a] 30-day point prevalence abstinence
[b] calculated by the authors
[c] 5-day point prevalence abstinence
[d] Studies without biochemical validation
[e] complete abstinence during three months
[f] no statistical analysis reported
[g] obtained from author.
[h] proportion in intervention – proportion in a control group

The length of post-intervention follow-up varied among studies. One pharmacological study (Hanson et al., 2003) assessed abstinence immediately at the end of a 12-week intervention. Abstinence was assessed 12 months post intervention in one school–based setting, one health-care setting, and one family-directed study (Brown et al., 2003; Bauman et al., 2000; Robinson et al., 2003), and at 24 months in one trial conducted in a health-care setting (Hollis et al., 2005).

Abstinence varied from 0% (Roddy et al., 2006) to 52% (Adelman et al., 2001). Although 14 of the 16 RCTs reported higher levels of abstinence in the intervention compared to the control condition, quit rates were statistically significantly different in only four trials, including three of the four that tested school-based programs (Adelman et al., 2001; Pbert et al., 2006; Sussman et al., 2001). Although higher abstinence rates were observed in the intervention arms of all four studies in health care settings (Brown et al., 2003; Colby et al., 2005, 1998; Hollis et al., 2005), only one that employed motivational interviewing (Hollis et al., 2005) attained statistical significance. Results in two of the four studies (Hollis et al., 2005; Pbert et al., 2006) in which the results were statistically significant, were not biochemically validated. Results for an intervention targeted to students caught smoking at school (Robinson et al., 2003), and three studies that used self help and telephone interventions (Bauman et al., 2000; Hollis and al., 2005; Lipkus et al., 2004; Rodgers et al., 2005) indicated that these programs were ineffective, as was laser acupuncture. (Yiming et al., 2000)

Among the pharmacological interventions, Moolchan et al. (2005) demonstrated that the nicotine patch increased point prevalence abstinence at six months post quit date (albeit not significantly) and that the gum was not effective. Two other studies using the nicotine patch did not report it to be effective (Hanson et al., 2003; Roddy et al., 2006). Killen et al. (2004) reported that the addition of 9 weeks of bupropion to the nicotine

patch did not improve quit rates over patch alone 16 weeks after the end of the medication.

Discussion

In this report, we systematically reviewed 16 RCTs that evaluated youth cigarette smoking cessation interventions. In addition to wide variability in the methods used to evaluate efficacy, the interventions tested were too diverse in terms of theoretical underpinnings, content, and delivery setting to allow a quantitative meta-analysis of effect size. Three (Pbert et al., 2006; Rodgers et al., 2005; Roddy et al., 2006) of the 16 studies were not included in any previous review. Eight (Adelman et al., 2001; Bauman et al., 2000; Colby et al., 1998; Hanson et al., 2003; Pbert et al., 2006; Roddy et al., 2006; Rodgers et al., 2005; Yiming et al., 2000) were not included in a recent Cochrane review because follow-up was less than six months. Our review includes only RCTs that used an intention to treat analysis and that reported a 5-(or more) day point prevalence abstinence. We recorded abstinence as measured at the last follow-up reported in each study. Cessation rates were biochemically validated in 12 of the 16 RCTs. Our review thus provides the strongest evidence to date on currently used smoking cessation methods in adolescents.

Cessation interventions tested in this review included school-based programs, motivational interviewing in health-care settings, self-help and telephone interventions, laser acupuncture and pharmacological therapy. Abstinence rates varied widely across, as well as within, delivery setting. This wide variability likely relates to differences between studies in the characteristics of participants, the type and intensity of the intervention, the time of assessment of abstinence, and whether or not a biochemical measure was used to validate the results.

Despite different intervention approaches, three of the four school-based studies demonstrated short-term positive effects. The only school-based program with an extended follow-up, the Start to Stop program, showed low quit rates in both the intervention and control groups. However this study enrolled students caught smoking, a group that may be less likely to quit with or without intervention, which may explain the low quit rates (Robinson et al., 2003). The fourth school-based study evaluated a cognitive behavioral therapy program (based on the US Public Health Service "5 A model") delivered by school nurses. High abstinence rates were observed three months after the intervention, but the results were not validated biochemically (Pbert et al., 2006).

Three of the four motivational interventions undertaken in health care settings increased abstinence at 3-12 months, but these trials had limited numbers of participants and therefore did not attain statistical significance. Advice from a physician in well care visits with a health counselor, motivational counseling, and use of a computerized session, resulted in positive outcomes at 24 months, but the results were not biochemically validated (Hollis et al., 2005). Self help material with telephone interventions failed to improve cessation over control conditions in two studies (Bauman et al., 2000; Lipkus et al., 2004). In one of these two studies that evaluated the Family Matters program, high abstinence rates were reported at 12 months in both the intervention and control conditions, but no biochemical measures were used to validate self-reports of cessation obtained in telephone interviews. Although mobile phone text messaging improved cessation significantly in an adult population, (Rodgers et al., 2005), these results were not replicated in 16-19 year olds. Nicotine replacement therapy and the antidepressant, bupropion, have now been evaluated in four RCTs in youth (Hanson et al., 2003; Killen et al., 2004; Moolchan et al., 2005; Roddy et al., 2006). Only one trial that tested

the nicotine patch in combination with cognitive-behavioural therapy showed improved results over placebo. (Moolchan et al., 2005). The 0% abstinence rate reported in the nicotine patch Zone Youth Project is explained by the high proportion of participants lost to follow-up, who were presumed to have remained smokers at follow-up (Roddy et al., 2006).

Overall these results suggest that interventions carried out in institutional settings such as schools and medical clinics, may hold more promise than those that are not conducted within an institutional context. It may be that institutional environments facilitate sustained access, that youth are more comfortable in settings that are familiar to them, or perhaps that interventions offered in these settings are more credible to youth, which in turn encourages sustained or more committed participation. However without systematic data on level of participation, commitment and satisfaction with various types of programs delivered in various settings, it will be difficult to ascertain precisely why interventions carried out in institutional settings seem to have more impact.

The limited effectiveness of the interventions reviewed herein may relate at least in part to two findings that have recently emerged in the literature. First, several reports now suggest that symptoms of nicotine dependence appear early after the onset of smoking (DiFranza et al., 2000; Gervais et al., 2006; O'Loughlin et al., 2003; Wellman et al., 2004). Cessation interventions targeted to novice smokers well before daily smoking is established, may prove more effective than those reported in this review. Second, there is some evidence to suggest that both behavioural and pharmacological cessation interventions may need to be tailored according to gender. Perkins et al. (1999) reported gender differences in the self administration of nicotine, as well as in its effects. The effectiveness of nicotine patches and bupropion is related to genotype in adult women (Lerman et al., 2002; Yudkin et al., 2004), and pooled results for

the Not On Tobacco (NOT) program (which did not meet the inclusion criteria for this review) suggest that same-sex group to same-sex facilitator may be important in group-based youth cessation interventions (Grimshaw et Stanton, 2006).

Limitations of this review include a small and diverse literature. Most studies reviewed had small samples sizes, the study populations were primarily female and few studies included non-daily smokers or smokers less than age 16 years. Follow-ups were short (usually less than six months), abstinence was variably defined across studies, and some studies lacked biochemical validation of the outcome. Self-report quit rates in the four studies included in this review that lacked biochemical validation (Bauman et al., 2000: Hollis et al., 2005; Rodgers et al., 2005; Pbert et al., 2006) tended to be higher than in those that included biochemical validation.

Conclusion

While there is still limited evidence demonstrating the efficacy of smoking cessation interventions in youth, some consistency is beginning to emerge in this literature. School-based interventions and those delivered in health care settings have shown efficacy, even in the longer-term, while results related to pharmacological therapy are inconsistent. Overall this current review suggests that more RCTs are needed and in particular, school- and clinic-based interventions should be tested across contexts and study populations in well-designed and well-powered RCTs.

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