

Interventions for preventing tobacco sales to minors (Review)

Stead LF, Lancaster T



**THE COCHRANE
COLLABORATION®**

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2008, Issue 3

<http://www.thecochranelibrary.com>



TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	2
OBJECTIVES	2
METHODS	3
RESULTS	3
DISCUSSION	7
AUTHORS' CONCLUSIONS	10
ACKNOWLEDGEMENTS	10
REFERENCES	10
CHARACTERISTICS OF STUDIES	16
DATA AND ANALYSES	34
WHAT'S NEW	46
HISTORY	46
CONTRIBUTIONS OF AUTHORS	46
DECLARATIONS OF INTEREST	46
SOURCES OF SUPPORT	47
INDEX TERMS	47

[Intervention Review]

Interventions for preventing tobacco sales to minors

Lindsay F Stead¹, Tim Lancaster¹

¹Department of Primary Health Care, University of Oxford, Oxford, UK

Contact address: Lindsay F Stead, Department of Primary Health Care, University of Oxford, Rosemary Rue Building, Old Road Campus, Oxford, OX3 7LF, UK. lindsay.stead@dphpc.ox.ac.uk.

Editorial group: Cochrane Tobacco Addiction Group.

Publication status and date: New search for studies and content updated (no change to conclusions), published in Issue 3, 2008.

Review content assessed as up-to-date: 30 April 2008.

Citation: Stead LF, Lancaster T. Interventions for preventing tobacco sales to minors. *Cochrane Database of Systematic Reviews* 2005, Issue 1. Art. No.: CD001497. DOI: 10.1002/14651858.CD001497.pub2.

Copyright © 2008 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

Laws restricting sales of tobacco products to minors exist in many countries, but young people may still purchase cigarettes easily.

Objectives

The review assesses the effects of interventions to reduce underage access to tobacco by deterring shopkeepers from making illegal sales.

Search strategy

We searched the Cochrane Tobacco Addiction group trials register, MEDLINE and EMBASE. Date of the most recent searches: April 2008.

Selection criteria

We included controlled trials and uncontrolled studies with pre- and post-intervention assessment of interventions to change retailers' behaviour. The outcomes were changes in retailer compliance with legislation (assessed by test purchasing), and changes in young people's smoking behaviour and their perceived ease of access to tobacco products.

Data collection and analysis

Studies were prescreened for relevance by one person and assessed for inclusion by two people independently. Data from included studies were extracted by one person and checked by a second. Study designs and types of intervention were heterogeneous so results were synthesised narratively, with greater weight given to controlled studies.

Main results

We identified 35 studies of which 14 had data from a control group for at least one outcome. Giving retailers information was less effective in reducing illegal sales than active enforcement and/or multicomponent educational strategies. No strategy achieved complete, sustained compliance. In three controlled trials, there was little effect of intervention on youth perceptions of access to tobacco products or prevalence of youth smoking.

Authors' conclusions

Interventions with retailers can lead to large decreases in the number of outlets selling tobacco to youths. However, few of the communities studied in this review achieved sustained levels of high compliance. This may explain why there is limited evidence for an effect of intervention on youth perception of ease of access to tobacco, and on smoking behaviour.

PLAIN LANGUAGE SUMMARY

Can illegal cigarette sales to underage youth be prevented, and does it change their smoking behaviour

If young people are unable to purchase cigarettes it may reduce the number who start to smoke. Various interventions including warnings and fines for retailers who illegally make sales to underage youth have been shown to reduce the proportion of retailers who are willing to sell tobacco during compliance checks. However it has been difficult to demonstrate a clear effect on young smokers' perceptions of how easily they can buy cigarettes, or on their smoking behaviour.

BACKGROUND

Controlling access is an established strategy for reducing consumption of substances harmful to health, in particular tobacco, alcohol and illicit drugs. A national survey in the USA in 1997 showed that of adolescents who try smoking, more than a third become daily smokers in secondary school (MMWR 1998a). Successful restriction of young people's access to tobacco products could help prevent them from developing this addiction. Accordingly, many countries prohibit tobacco sales to minors.

Although young people perceive difficulties in obtaining cigarettes as a deterrent to tobacco use (Stanton 1993), poor compliance with access laws is well documented (Forster 1998). In most surveys in the past, underage young people report little difficulty when illegally purchasing cigarettes (Forster 1992; Sanson Fisher 1992; Erickson 1993; Carruthers 1995; MMWR 1996). This situation may be changing; in the USA the Monitoring the Future survey for 2007 found that 78% of 10th-graders say they would find it 'fairly easy' or 'very easy' to get cigarettes, down from 91% in 1996 (Johnston 2007). In a 1997 survey, 30% of high school smokers reported cigarette purchase in the previous month, of whom less than a third had been asked for proof of age (MMWR 1998b). By 2005, of the 13% of students who had tried to buy cigarettes in a store in the previous 30 days, just over a half had been asked for proof of age (Eaton 2006). In England a 1996 survey suggested that 25% of all secondary school children had tried to buy cigarettes in a shop in the last year. Only 38% had been refused at least once (Jarvis 1997). In a New Zealand survey in 2002, 35% of underage smokers reported that their usual source of cigarettes was

to purchase them from a shop, and 36% had not been refused in the previous month (Darling 2005).

Furthermore, commercial sources of tobacco are not the only way in which young people obtain products (Forster 1998; Emery 1999; Harrison 2000; Robinson 2006). They may also get cigarettes from parents, siblings, friends, and by theft. Reducing access to commercial sources could lead to increased use of such sources. In determining policy it is important to know both how best to restrict access, and the likely effect of successful restriction on youth tobacco consumption.

OBJECTIVES

The aim of this review was to assess the effectiveness of reducing underage access to tobacco products by deterring shopkeepers from illegal sales. We asked three questions:

1. Does intervention with retailers, by education, active enforcement of laws, or combinations of strategies lead to decreased sales to minors? Is there evidence that any of the strategies is superior to the others?
2. Do reduced sales of tobacco to minors lead to a decrease in their self-reported ease of access?
3. Do reduced sales of tobacco to minors reduce prevalence of tobacco use?

METHODS

Criteria for considering studies for this review

Types of studies

We considered studies of measures to improve compliance with laws restricting youth access to retail sales of tobacco, using one of these study designs:

1. Controlled trials randomizing retail outlets, communities or geographical regions.
2. Controlled trials without randomization allocating retail outlets, communities or geographical regions.
3. Time series studies.
4. Uncontrolled before and after studies.

We excluded uncontrolled studies with post-intervention measurements only.

Types of participants

We evaluated strategies which targeted retailers to reduce tobacco use by minors. Minors were defined by the legal age limit in the communities studied.

Types of interventions

We considered education, law enforcement, community mobilisation, or combinations of strategies that aimed to deter retailers from selling tobacco to minors.

Types of outcome measures

1. Illegal tobacco sales, assessed by attempted purchase by young people.
2. Perceived ease of access to cigarettes by young people.
3. Prevalence of tobacco use among young people. We accepted self reports of tobacco use.

Search methods for identification of studies

We searched the Tobacco Addiction Review group register of controlled evaluations for studies coded as involving restrictions on sales to minors or sales from vending machines, and interventions with retailers related to compliance with legislation. An additional search of MEDLINE (Silverplatter) and EMBASE (Ovid) was used to find any further controlled or uncontrolled evaluations. The search terms were:

MEDLINE:

Smoking cessation OR tobacco OR cigar* OR SMOKING-CES- SATION OR TOBACCO-USE-DISORDER OR TOBACCO

OR NICOTINE OR TOBACCO-SMOKELESS OR SMOK- ING/ prevention-and-control , therapy , legislation-and-jurispru- dence OR ((quit* OR stop* OR ceas* OR giv*) near smoking) AND adolescen* OR minors OR under()age OR student* OR (young near2 people) OR children OR juveniles OR girls OR boys OR teenager* OR teens OR child AND sale OR sales OR retail OR retailer* OR store OR stores OR sell OR selling OR shop OR shops OR tobacconist* OR vending OR vendor* OR merchant* OR COMMERCE/ legislation-and- jurisprudence

EMBASE:

Cigarette smoking/ or Smoking/ or Tobacco dependence/ or (To- bacco smoke/ or smoking or tobacco or cigar:).mp. AND exp adolescen/ or Juvenile/ or ((minor or teen: or (young adj people) or student)).mp. AND exp legal aspect/ or Law/ or Law enforcement/ or Law suit/ or (legislation or sale or retail or retailer: or store or sell or selling or shop or tobacconist: or vending or vendor or merchant).mp. Terms in capitals are MeSH headings. We searched MEDLINE, EMBASE and the specialised register in April 2008.

Data collection and analysis

The review was conducted in four stages:

1. One reviewer prescreened reports for relevance.
2. Two reviewers assessed relevant studies independently. To be included they had to meet all the criteria listed above for study design, type of participant and intervention and outcomes assessed.
3. One reviewer extracted, and the second checked, data from included studies.
4. Studies were combined using qualitative narrative synthesis. We chose narrative rather than quantitative synthesis because we expected heterogeneity in the study designs, type of interventions and outcomes measured.

RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

We identified 35 studies that met the inclusion criteria. Of these, 13 used some form of control group. In six studies the store was the unit of randomization ([Erie County 1987](#); [Santa Clara 1988](#); [Sydney 1992](#); [Chicago 1993](#); [Harlem 1993](#); [New South Wales 1994](#)). One ([Sydney 1992](#)) identified the retailers who made illegal sales to minors at baseline. These retailers were then randomly allocated to receive a warning letter threatening prosecution, or no letter. One ([Gateshead 1996](#)) carried out test purchasing around

one school and not around another. Six studies compared interventions in different communities. Forster and colleagues' Tobacco Policy Options for Prevention study (TPOP 1996) randomized 14 Minnesota communities after stratification on baseline variables. Altman and colleagues allocated two pairs of Monterey communities on the basis of a coin toss (Monterey 1994). Cummings and colleagues assigned six matched pairs of communities to intervention or control status; within the intervention communities the stores were randomly allocated to different schedules of enforcement checks (Erie County 1995). The other three community studies (San Diego 1991; Massachusetts 1994; Sydney 1995a) compared the intervention communities with a control community in which similar baseline and follow-up assessments were conducted, but without random assignment. In Massachusetts, intervention communities were those in which active enforcement of tobacco sales regulations was intended. The control communities were not planning active enforcement, although by the end of the study some enforcement was being conducted. One study (Central Coast 1996) had no formal control area, but compared local smoking prevalence with state surveys, so we include it amongst the control group studies when discussing the impact on smoking prevalence.

One study (Illinois 1999) was a randomized trial comparing community sales law enforcement alone to enforcement of youth possession laws as well. Since the intervention is not relevant to this review we report only the pre/post change in sales law compliance for each group of communities and do not classify it as controlled study.

The remaining uncontrolled studies compared rates of illegal sales or smoking behaviour before and after an intervention. In some, only the outlets that allowed purchase at baseline were followed up. In Ontario a series of interventions were implemented in neighbouring health units and the follow up ranged from two weeks to 21 months (Ontario 1992). In Oregon, implementation occurred in eight communities at different time points (Oregon 1995). In one Sydney study, retailers who were prepared to make sales at baseline were randomized to receive warning letters either by post or from an environmental health officer, but there was no non-intervention control (Sydney 1995b).

All the studies were set in the USA, apart from two Canadian studies (Alberta 1991; Ontario 1992), three British studies (Bristol 1983; Gateshead 1996; Stirling 1997), and eight Australian studies (Sydney 1992; New South Wales 1994; Perth 1994; Manly 1995; Sydney 1995a; Sydney 1995b; Central Coast 1996; Sydney 2000).

Types of intervention

The main interventions were: education about legal requirements; notification of the results of compliance checks; warning of enforcement, and implementation of enforcement by police or health officials. Some studies tested different frequencies of enforcement activity, and different channels of information. In some the intervention included the introduction of new legislation or local ordinances such as a licensing system or a formal requirement

for compliance checking. Local ordinances might include components such as bans on self-service displays, and also restrictions on minors' possession and use (Larimer County 1999).

The TPOP campaign in Minnesota aimed "to make tobacco access by youth a salient community issue, to change local ordinances ... to change retailers' and other adults' practices ... and to promote enforcement of tobacco age-of-sale laws". The campaign used a direct action community organising model so communities differed in the specific ordinances introduced. These included an increased licence fee for tobacco outlets, penalties for the vendor and the clerk, a requirement for unannounced compliance checks, and bans on vending machines and self-service displays. Other studies also included elements to raise community awareness and support (Santa Clara 1988; Solana County 1990; San Diego 1991; Woodridge 1991; Monterey 1994; Perth 1994; Manly 1995; Oregon 1995; Sydney 1995a).

In some studies, the intervention had to be modified because of local attitudes. Altman and colleagues were unable to bring about enforcement action because of legal concern about the use of 'sting' operations and an unwillingness to prosecute clerks (Monterey 1994).

In most studies there was dissemination of information to retailers about their legal obligations, including reminders of the age at which purchase was legal, that proof of age should be required before sale, or that warning notices should be displayed. Usually this information was posted, but sometimes mass media channels were used.

Outcome assessment

Thirty-one studies assessed retailer compliance with the law using test purchasers. Most studies focused on 'over the counter' sales but some also assessed ease of purchase from vending machines. Some distinguished between sales in shops with behind the counter or locked displays and self service (Willey 1995). One study investigated vending machine purchases only (St Paul 1990).

Twelve studies assessed the effect of an intervention on the smoking behaviour of underage youth. Six of these compared intervention and control areas. Three also assessed retailer behaviour in all areas (Massachusetts 1994; Monterey 1994; TPOP 1996). Two reported smoking prevalence in both areas but retailer behaviour only in the intervention area (Central Coast 1996; Gateshead 1996), one did not assess retailer behaviour (Sydney 1995a). One study provided data on smoking behaviour in a follow-up paper and used data on retailer behaviour to compare communities with high and low compliance, not intervention and control communities (Erie County 1995; Cummings 2003). The four other studies were uncontrolled and measured smoking behaviour before and after a change in enforcement practice. Two assessed retailer behaviour as well (Leominster 1991; Woodridge 1991). Eleven of these studies also asked underage smokers about purchase attempts, or where they obtained their cigarettes and how difficult it was to buy them.

Excluded studies

Two surveys have assessed the effect of the tobacco industry spon-

sored voluntary compliance programme *It's the Law (Its The Law 1; Its The Law 2)*. We did not include them because there was no baseline assessment of retailers before they joined the programme. The authors found no evidence that those participating in the scheme were less likely than other retailers to make illegal sales. One study investigated ease of purchase of tobacco over the Internet and the use of a filter for blocking site access (Bryant 2002). We have not included it here since the setting and intervention are so distinct from other studies. One study evaluated the use of electronic age verification (EAV) devices to help store personnel use ID information more appropriately (Krevor 2003). They did not find that EAVs increased the frequency of age verification. Some econometric studies have included measures of youth access restriction along with other measures of public policy and cigarette price to model youth cigarette demand using cross-sectional survey data. This type of study does fall within our inclusion criteria, but some findings and limitations are covered in the discussion. Reasons for excluding other studies are described in the table [Characteristics of excluded studies](#).

Risk of bias in included studies

As we considered a heterogeneous range of study designs, we made no attempt at statistical meta-analysis. In uncontrolled studies, background secular change may be incorrectly attributed to an intervention. We therefore gave greater weight in our synthesis to the three controlled studies that measured the behaviour of retailers and minors in the community (Massachusetts 1994; Monterey 1994; TPOP 1996).

Although randomization by community is a less biased method for assessing the effect of intervention, statistical analysis of such studies should address the issue of clustering of behaviour within communities. Clustering usually increases the required sample size (Altman 1997). Few of the included studies directly addressed this issue: another reason why formal meta-analysis could be misleading.

A further methodological concern is the measurement of outcome. In most studies compliance was judged by a single purchase attempt. However, when multiple purchase attempts were made, the estimates of compliance were lower when retailers were classified as non-compliant only if they never sold. Junck and colleagues (Manly 1995) found that compliance after intervention was 74% on the basis of a single purchase attempt at each store, but only 45% if three attempts were made. This bias may overestimate compliance rates in studies using only one purchase attempt. The characteristics of the assessor also affect measurement of compliance. Older youths and females are generally more likely to make successful purchases (DiFranza 1996; Clark 2000) and rates may also be affected by the ethnicity of the purchasers (Landrine 2000). Sales rates may also be underestimated if test purchasers act differently from true underage purchasers (DiFranza 2001a). All the studies which gave details noted that the youths engaged in test-

ing were to state their true age if challenged, and to say that the cigarettes were for their own use.

Effects of interventions

1. Does intervention with retailers lead to decreased sales to minors?

Eleven controlled trials assessed the effect of an intervention on illegal sales, measured by compliance checks. Six found that intervention reduced the level of illegal sales compared to the control group (San Diego 1991; Sydney 1992; Chicago 1993; Harlem 1993; Massachusetts 1994; Monterey 1994).

Active enforcement was used in three of the successful interventions. In Chicago sales fell marginally in the month after all merchants who had sold cigarettes received a warning, but enforcement produced a much larger fall in sales rates (Chicago 1993). Media coverage of the study at one point during the follow-up period caused a further substantial drop in sales in all groups. This study showed that two-monthly enforcement visits were more effective than four- and six-monthly schedules, giving a sales rate of 19% in the final six months of the intervention. In Harlem enforcement produced a substantial decrease in sales, not found after an educational visit alone. However the rate still fell only to 47% (Harlem 1993). In Massachusetts compliance rates improved from 35% to 82% in the intervention communities and from 28% to 45% in the control areas (Massachusetts 1994).

Three interventions without enforcement produced greater improvements in compliance than in control areas. Project Trust (San Diego 1991) used multicomponent community and retailer education with personal visits. Sales fell significantly between pre- and post-intervention measurement in four out of six intervention areas and in none of the control areas. The sales rate was reduced from 70% to 32%, an effect sustained at six month follow up. In Monterey education and community organisation eliminated successful test purchases by the end of a three-year project in two communities compared to a 39% sales rate in the comparison communities (Monterey 1994). In Sydney warning letters threatening prosecution to retailers who had made illegal sales led to a second offence rate of 31%, compared to 60% amongst those not warned (Sydney 1992).

Other controlled trials did not find a difference. The comprehensive community approach used in Minnesota reduced successful 'over the counter' purchases in intervention communities from 36.7% to 3.1%, but the net change was not significantly different from the control communities where the rate fell from 41% to 8.8% (TPOP 1996). In Santa Clara there was no additional effect of mailed or personally delivered educational materials without enforcement. However, the community and merchant education media had some short-term effect, with sales rates reduced from 74% to 39% (Santa Clara 1988).

In Erie County there was no effect of education alone (Erie County 1987) or active enforcement (Erie County 1995). In the

second study the lack of effect could have been because all stores were sent letters warning of possible random checks. The news of 'sting' operations also spread rapidly to the non-enforcement communities. An Australian study (New South Wales 1994) used education and the threat of enforcement. Youths old enough to buy cigarettes, but looking younger, were used for compliance checks so the outcome was requiring proof of age before making a sale. There was an overall improvement from 17% to 43% in the proportion of retailers requiring such proof, but no difference between intervention and control retailers.

All the uncontrolled studies showed reduction in illegal sales following intervention, but the size of the pre/post difference was variable, and not always consistent across communities (Alberta 1991). There was some evidence that effects declined over time (Leominster 1991; Oregon 1995). In Oregon, advising retailers whether they had or had not complied with the law at a test purchase had an effect (Oregon 1995). In Solana County a merchant education programme had such a limited effect that a second phase of police enforcement was initiated. This reduced 'over the counter' sales from 74% to 24% (Solana County 1990). The highest compliance rates were in Woodridge (over 95%), Central Coast (over 92%), Leominster (84%), Illinois (83% to 96%), Fort Morgan (100%), which all used enforcement, and in Manly (86%), Ontario (94%), Wisconsin (82%) and Larimer County (94%) which did not. The lowest were 49% for baseline non-compliers in Cook County and 48% in Philadelphia which included stores being checked because of reports of violations.

In the study of vending machines, a locking device policy resulted in fewer locations selling cigarettes to minors than a policy of no restriction (St Paul 1990). However, the authors concluded that it was probably less effective than the major policy alternative, a ban on vending machines.

2. Do reduced sales of tobacco to minors lead to a reduction in minors' self-reported ease of access?

Eleven studies assessed self-reported actual or perceived ease of access. In four (Woodridge 1991; Massachusetts 1994; Monterey 1994; Central Coast 1996), intervention was associated with decreased test sales. In Monterey self-reported recent purchase of tobacco was less frequent among 7th graders in the intervention than in the control communities. In the other two grades there were large baseline differences in the proportion reporting a purchase in the last three months, so longitudinal changes were difficult to interpret. However, at the final follow up recent purchase was significantly less common amongst intervention community 9th graders (Monterey 1994). After intervention in Woodridge, 69% of students said that the law would make cigarettes harder to obtain. In 1996 more Woodridge smokers felt it was difficult or moderately difficult to get cigarettes than smokers from another community (20 versus 14.3%, NS) (Woodridge 1991; Jason 1999). In Massachusetts, despite an effect of intervention on sales there was no difference in perceived ease of access. There were significant falls in the proportion who had tried to buy tobacco in the previous six

months, and increases in those who were refused at least half the time. Since these occurred in all communities they could not be attributed to the active enforcement programme. There were also similar changes across intervention and control communities in reported source of cigarettes. Fewer youths bought tobacco in their own city or town and more bought it elsewhere or had someone buy it for them (Massachusetts 1994). In Australia (Central Coast 1996) the proportion of smokers reporting purchase attempts fell from 83% to 44% over nine years

In Minnesota, the proportion who perceived high availability decreased in the intervention communities whilst increasing in the control communities, despite similar levels of retailer compliance. The proportion of adolescents reporting at least one purchase attempt in the previous month declined in the intervention communities while it increased in the control communities. The authors suggested that these changes might be attributable to the community awareness and mobilisation campaigns that were a part of the intervention (TPOP 1996).

In Erie County there was little change in reported ease of access to cigarettes, and it was unrelated to either community intervention status or change in measured compliance (Erie County 1995). In Sydney there was a significant reduction in the proportion of male students who rated purchasing cigarettes from petrol stations as 'easy' or 'very easy' post-intervention, but no other significant changes for the six categories of purchase source (Sydney 1995a). In a later study in the same area (Sydney 2000), access remained easy, but there were no data on compliance levels achieved by enforcement and they may have remained low. In Everett more students reported that retailers asked for proof of age. Neither of these studies directly assessed retailer behaviour. In Gateshead few children reported being refused, with no change over time. In Fort Morgan active smokers became less likely to have ever bought cigarettes, but those who had attempted recent purchase were still not consistently asked for proof of age. About half said they were never refused purchase.

3. Do reduced sales of tobacco to minors decrease prevalence of tobacco use?

Four (Monterey 1994; Sydney 1995a; Central Coast 1996; TPOP 1996) of seven trials where smoking prevalence was compared against a control area found some evidence of an effect of intervention on youth smoking behaviour. Altman and colleagues (Monterey 1994) found a lower smoking prevalence in those who were in 7th grade at baseline, but the effect was not sustained at the end of the 32 month study. There were no significant differences among the other age groups.

In Minnesota (TPOP 1996) there was a lower rate of increase in all measures of smoking prevalence in seven areas with a comprehensive community-based intervention than in seven control communities. The net difference in prevalence was significant for daily but not weekly or monthly smoking. They concluded that refusals by sellers at the time of purchase attempts by young people did not account for the lower adolescent smoking rates seen

in the intervention communities, since all communities showed increases in compliance. Other components of the intervention may have changed young people's behaviour. Businesses in the intervention communities were more likely to post warning notices and to store cigarettes behind the counter. Longer term follow up showed a decline in prevalence in both communities that was sharper in the controls so that by 2000 there was no significant difference. This may have been due to the adoption of similar ordinances in control communities (reported in [Chen 2006](#)).

Staff and colleagues assessed a community intervention in Sydney with education of retailers and local publicity, measuring smoking behaviour and reported ease of purchase but not illegal sales. There was an effect of intervention only in the youngest students ([Sydney 1995a](#)).

Tutt and colleagues compared monthly prevalence in an area where compliance had reached over 90% to state survey data. Smoking rates fell steadily over a nine year period in the intervention area, whilst staying at first stable and then starting to decline in the state during the period for which data were available ([Central Coast 1996](#)).

One further controlled study where no effect of enforcement was detected on compliance did not report data on prevalence originally. A further report analysed changes in smoking prevalence over a four-year period, comparing six communities where compliance had exceeded 80%, with the six others that had not reached the same threshold ([Erie County 1995](#); [Cummings 2003](#)). This found evidence of a decrease in frequent smoking in above-threshold communities compared to an increase in the remainder ($P = 0.04$). There was also a differential change in 30-day smoking prevalence that did not reach significance. There was no effect of exposure to the intervention programme on smoking levels.

Two studies did not find evidence of change in smoking behaviour. In Massachusetts there was no difference in the rate of change of prevalence of 'any tobacco use' or 'daily tobacco use' between the intervention and control communities. The rate of 'current tobacco use' rose marginally in the intervention communities but remained stable in controls, with borderline statistical significance for the comparison between group trends ([Massachusetts 1994](#)). In Gateshead, an intervention of test purchases in the intervention area resulted in full compliance and hence no prosecutions, although children in the area reported buying cigarettes with ease. There was no change in smoking prevalence ([Gateshead 1996](#)).

In the light of these findings, five uncontrolled studies should be interpreted with caution. Three reported a decrease in smoking prevalence in students associated with a reduction in illegal sales in single intervention communities ([Leominster 1991](#); [Woodridge 1991](#); [Fort Morgan 2007](#)). In Woodridge the proportion of regular smokers in 7th-8th grade students fell from 16% to 5%. In this study access was very successfully restricted, and possession of tobacco by a minor was also an offence. Longer term assessments in this community using older youths showed higher rates of sales, although still below 20%. A survey in 1996 found a lower propor-

tion of smokers amongst Woodridge students than students from a community not conducting regular enforcement ([Jason 1999](#)). In Leominster there was a fall in smoking prevalence in three out of four age groups. In Fort Morgan prevalence fell significantly in 14-15-year olds. In Everett there was no significant change in overall reported tobacco use after introduction of a local ordinance, but there was a significant decrease amongst girls. In Sydney there was no reduction in adolescent smoking, but a possible increase in never smoking. In this study there was no compliance checking to confirm that access had been reduced ([Sydney 2000](#)).

DISCUSSION

This review provides evidence about the relative effectiveness of different interventions for reducing tobacco sales by retailers. Simply giving information to retailers about the law is not effective. DiFranza and colleagues showed that merchant participation in voluntary compliance programmes was low ([DiFranza 1992](#); [DiFranza 1996](#)). There is evidence that interventions to educate retailers can improve compliance, but the successful interventions used a variety of strategies, including personal visits and mobilising community support ([Monterey 1994](#)).

Enforcement, or warnings of it, generally had an effect on retailer behaviour. Sustaining compliance requires regular enforcement, and the existing evidence suggests reduced effectiveness if checking occurs much less than four to six times a year ([Jason 1996](#)). The penalty for infringement may also be important, although there is little direct evidence of the relative deterrent effect of different penalties. If fines for offenders are low, retailers may become inured to the threat of a prosecution, diminishing the effect of warnings or prosecutions. Removal of a license to sell tobacco could be more effective, if the licensing itself is strictly monitored ([Chapman 1994](#)). Imposing too harsh a penalty may, however, be counter-productive if community attitudes are not supportive. In one study using enforcement, judges were inclined to give suspended sentences because they felt that imposing a heavy fine or criminal record on the clerks making the sale was inappropriate ([Solana County 1990](#)). Enforcement may produce a backlash against tobacco control activities if the value of reducing sales has not been adequately publicised. A graduated system of penalties from a warning to a fine and then loss of licence may be most appropriate where legal systems allow it. The combination of enforcement and fines on youth users was associated with high compliance rates in Woodridge, but punishing the user is a controversial policy which may not gain widespread acceptance ([Mosher 1995](#); [CCS 2001](#)). The importance of penalties for violation is supported by a US study comparing best and worst performing states and their correlation with enforcement strategies ([DiFranza 2005](#)).

Retailer interventions may not work if neighbouring districts have discordant policies. Retailers who make illegal sales argue that minors will simply go elsewhere, depriving them of revenue without benefiting the community (Landrine 1994). Uniform enforcement policies may help retailers to comply by reassuring them that their competitors will do the same. Similarly, fitting locks to vending machines is probably less effective than banning them (Forster 1992).

The main methodological problem in evaluating retailer interventions is that assessment of retailer behaviour during compliance checks does not show whether smoking behaviour by minors has changed, or even how easy it is for them to buy tobacco. Retailers may be able to identify 'test' purchasers, especially if they know or suspect that checks are being made. 'Real' purchasers may be known to the sales clerks, may lie about their age or may behave differently. A study comparing purchase rates between experienced underage smokers and inexperienced nonsmokers showed that smokers were six times more likely to be successful, although absolute rates were still low (DiFranza 2001c). In compliance checks, asking for ID proof of age is a strong predictor of refusal to sell (Clark 2000), however studies show that invalid ID may still allow successful purchase (DiFranza 2001a; Landrine 2001). If retailers are aware of the possibility of compliance checks they may sell only to young people they know. Young people may also change their source, by going to another community or by asking someone else to make the purchase for them (Rigotti 1997; Jones 2002) or stealing them or obtaining in some other way (MMWR 2002). Measuring changes in self-reported ease of access to tobacco is important to demonstrate that an intervention has had an impact on purchasing behaviour. If minors do not perceive that buying tobacco has become more difficult, then it is unlikely that they have changed their use of tobacco. Conversely, a change in smoking behaviour can most confidently be attributed to a change in retailer behaviour if the intermediate outcome of a change in perception of ease of access has also been observed. This is an important message for future research in this area. The results of compliance checks are generally reported as the proportion of retailer selling/not selling tobacco. It has been suggested that a more realistic measure would be the number of retailers who made sales per 1000 youths, thus allowing for the density of retail outlets in different communities (Jason 2003). Places where there are many retailers may provide easier access (Hagquist 2007).

There has been increasing interest in investigating the way in which minors obtain cigarettes, in an effort to understand the way in which the commercial and social market for cigarettes operates among youth (Croghan 2003; Woodruff 2003; Robinson 2006). Direct purchase is only one of the ways in which young people obtain their cigarettes and increasing attention is being given to the sources used and how these differ for older and younger and experimenting and regular smokers. Other sources include borrowing from friends, asking older friends or strangers to buy cigarettes

legally, being given them by parents, stealing from parents, and shoplifting (DiFranza 2001a; Castrucci 2002; Jones 2002). Interventions other than purchase restrictions may be important in reducing access. Media campaigns could aim to discourage older youths and adults from supplying cigarettes to younger smokers. Price increases could also make smokers less willing to share their cigarettes (Chaloupka 2003). A new way in which minors may be able to bypass purchase restrictions is to buy cigarettes from the internet (Ribisl 2003). A study has reported that successful purchase is frequent even where proof of age is asked for (Bryant 2002). This study also evaluated whether internet filtering programme could prevent purchase by blocking access to vendors. We did not formally include this study in the review; it found that two internet filters blocked 84% and 94% of identified sites respectively.

Access restrictions might have different effects on subgroups of young smokers, depending both on age, and on whether they are experimenting with smoking, or becoming regular users. It has been suggested that strong access restrictions would have more impact on regular smokers who were less likely to be able to rely on social sources. A large survey in 1996 provided data on usual source for US adolescents who had smoked in the past month (Castrucci 2002). Those who were older, or smoked more often or intensely, were more likely to usually use commercial sources. This might suggest that restricting access would have a greater impact on regular smokers. But the counter-suggestion has also been made that experienced smokers are more likely to be able to obtain cigarettes even in the face of reasonable compliance by lying about their age, using fake ID or other strategies. A longitudinal study (Robinson 2006) found that social sources were the primary source for young teens; continuing smokers increased their number of sources, so that they used both stores and friends more. Another longitudinal study found that communities where youth were more likely to rely exclusively on social access had fewer past month smokers who became weekly or more frequent smokers (Widome 2007). A cross-sectional analysis of initiation and continued smoking in 6th to 8th grade students found no association between level of retail availability and continued smoking, but there was an association between higher availability and increased odds of having initiated smoking amongst youths not living with tobacco using adults (Pokorny 2003). This is not incompatible with the suggestion that restricting commercial access is less likely to have an impact on initial experimentation, since experimenters are likely to get their cigarettes from social rather than commercial sources (Gilpin 2004). Perception of availability might be as important as actual availability, and experimental smokers might be more affected by perceived difficulty. A longitudinal study in California investigated this. Two cohorts of 12- to 15-year old never-smokers were followed in a period when access law enforcement was weak and then when it was strong. Transition to smoking in the earlier cohort was not affected by the perceived ease of access, but in the later cohort those who perceived access to be difficult were less likely to have tried cigarettes by follow up (Gilpin 2004). This

might be due to changes in social norms around access, and might support the use of access enforcement as part of a comprehensive programme for tobacco control. Another longitudinal study used surveys in Finland over the period when a tobacco sales ban to children 'apparently under age 16' was introduced in 1977 followed by an increase in the age limit to 18 in 1995. This showed a small and short-term decrease in underage tobacco purchase after 1977 and a larger persistent change after 1995. By 2003 only 67% of 14-year old daily smokers had purchased tobacco from commercial sources in the past month, although 48% had purchased from friends (Rimpelä 2004). The study indicated a shift from commercial to social sources after the ban, and only 2 to 3% of daily underage smokers obtained all their tobacco commercially. There was a sharp decrease in daily smoking between 2001 and 2003, some time after the 1995 ban, whilst experimenting was already decreasing before 1995. The authors concluded that the decrease in smoking could not be attributed to the sales ban alone and that other smoking restrictions and health promotion activities had played a role. In Sweden (Hagquist 2007) the introduction of an underage sales ban coincided with a decrease in adolescent smoking but additional factors also changed. Smoking also fell amongst adults and prices rose. Although compliance testing showed a decrease in ease of purchase from a 93% success rate in 1996, 63% of attempted purchases were still successful in 2002 (Sundh 2007).

There are a number of problems in drawing conclusions about the effectiveness of interventions with retailers for reducing youth tobacco use. In particular, effectiveness can only be assessed if tobacco sales are reduced. If some retailers continue to sell, a channel of access will exist. Many of the communities studied achieved large decreases in sales, but none achieved complete, sustained compliance. Hence it is not surprising that there is only limited evidence from controlled trials that reducing the ease with which underage youth can purchase cigarettes will reduce their use of tobacco. Some uncontrolled studies, notably Woodridge, have reported impressive reductions in youth smoking behaviour in association with interventions achieving high compliance. This might suggest that there is a threshold level of compliance above which access can be effectively reduced. This hypothesis needs testing prospectively. The findings from Massachusetts suggest that, if there is such a threshold, it must be greater than 80%; density of vendors may be another determinant of availability. The challenge for future research on the effects of restriction of underage sales is to ensure effective implementation of the intervention. Translating access restriction from research to practice is a further challenge. In the USA, despite federal legislation in 1992 (the 'Synar Amendment') requiring all states to enact and enforce a law to prohibit sale of tobacco to minors, progress towards consistent enforcement by all states is slow (DiFranza 2001a).

Evidence from other types of study

Studies of predictors of cigarette demand in young people that have included measures of youth access along with price and other measures of tobacco control activity have tended not to show a significant correlation between smoking behaviour and access control as measured by the existence of laws and provision for enforcement (Ross 2001a reviews earlier studies). In a larger study Ross and Chaloupka used measured state compliance with youth access restriction, as reported by states under the Synar agreement, in a model of youth cigarette demand using a 1996 survey of over 17,000 US high school students. They found that higher compliance was correlated with lower smoking prevalence and intensity (Ross 2001a). They also found that the impact of higher levels of compliance was greater amongst students who were further advanced in progressing to established smoking, who might be expected to be more dependent on commercial sources of cigarettes (Ross 2001b). The authors note that it is possible that good levels of compliance may reflect local antismoking sentiment, which might affect cigarette demand directly. In Massachusetts a telephone survey of almost 4,000 12- to 17-year olds asked about perceived access, attempts to purchase and tobacco use. This was correlated with characteristics of youth access ordinances in their home town. Only two significant associations were found, and only one of them in the expected direction. A ban on free-standing displays was associated with lower perceived access but not with reduced purchase attempts or tobacco use. Requiring a license to sell tobacco was unexpectedly associated with greater perceived access (Thomson 2004). Baseline nonsmokers from this study were followed up two years later, to look for associations between access ordinances and smoking initiation. No significant associations were found. Predictors of smoking initiation included older age and higher rebelliousness (Thomson 2007). Since the point estimates were consistent with stronger access regulations reducing uptake, the authors considered whether lack of power was an explanation. However the same data set demonstrated a strong association between a strong smoking policy in a local restaurant and a significantly decreased likelihood of smoking uptake (Siegel 2005). The authors suggest that this '... raises the possibility that youth smoking behavior may respond more sensitively to restaurant policy, which is not targeted to youth, than to the policies specifically targeted to youth access'. A study of communities in Oregon compared illegal sales rates and smoking prevalence in grade 8 and grade 11 students. Unexpectedly this found more evidence for a relationship in the older students, where the model predicted that a 10% increase in illegal sales rate gave rise to a 0.8% increase in 30 day prevalence and a 0.4% increase in daily smoking. Eleventh graders in communities with lower illegal sales rates made more use of social sources, but there was an opposite pattern in 8th graders (Dent 2004).

Levy and colleagues created a simulation model of the effect of tobacco youth access policies. They concluded that a high level of retail compliance is likely to be necessary, especially in densely

populated communities with large numbers of retail outlets. They recognise that there are limits to the effectiveness of purchase restriction policies because of the availability of other sources (Levy 2000; Levy 2001). Although the potential for enforcement of sales laws to reduce underage smoking may be limited, a recent cost effectiveness analysis suggested that even if it can only reduce youth tobacco use by 5% it is likely to be as cost-effective as other prevention activities (DiFranza 2001a). However alternative strategies such as tax increases do not have an implementation cost. It has been argued that price increases might have direct and indirect effects on youth smoking, by deterring youths from purchase but also by reducing availability from social sources (Chaloupka 2003).

The results of this review are consistent with those of a review and meta-analysis of the group of controlled studies that reported smoking prevalence (Fichtenberg 2002a). This detected no significant difference in youth smoking between communities with access interventions compared to those without. This meta-analysis has been criticised on methodological grounds (DiFranza 2002) but the authors have defended its conclusions (Fichtenberg 2002b). There remains considerable uncertainty about the part that restricting access should play in a comprehensive tobacco control policy (Craig 2007). Whilst some tobacco control researchers consider that using existing approaches to attempt to restrict youth access should not be a major part of tobacco control efforts (Ling 2002, Glantz 2002; Etter 2006), others argue that they are important in changing social norms, and should remain part of a comprehensive tobacco control program (Jason 2002). One area of disagreement is whether access controls send important messages about society's disapproval of youth smoking (DiFranza 2003; Jason 2003), or whether they are counterproductive because they reinforce the tobacco industry's "smoking is a way to look adult" message' (Fichtenberg 2003).

A further limitation of current research is that it is largely confined

to more developed countries. The effectiveness and feasibility of retailer interventions will depend on the attitudes and available resources in different societies. With the acceleration of tobacco use in the developing world there is a particular need for cost-effective interventions to prevent uptake of smoking by the youth of these societies.

AUTHORS' CONCLUSIONS

Implications for practice

Legislation alone is not sufficient to prevent tobacco sales to minors. Both enforcement and community policies improve compliance by retailers, but the impact on underage smoking prevalence using these approaches alone may be small if the level of compliance attained does not sufficiently restrict access.

Implications for research

Research that only assesses retailer behaviour is of limited value. Any further studies need to link change in retailer behaviour to changes in young people's perceptions of tobacco availability and their smoking behaviour. Studies examining the effects of access restrictions on youth smoking behaviour must first strive to achieve high compliance. There is a need to develop and test strategies for countries in the developing world.

ACKNOWLEDGEMENTS

Deirdre Fullerton for her work on initial stages of the review. Donald Sharp, Amanda Sowden, Lorna Arblaster and Maureen Moore for comments on drafts.

REFERENCES

References to studies included in this review

Alberta 1991 {published data only}

Abernathy TJ. Compliance for Kids: a community-based tobacco prevention project. *Canadian Journal of Public Health* 1994;**85**: 82–4.

Bristol 1983 {published data only}

Naidoo J, Platts C. Smoking prevention in Bristol, getting the maximum results using the minimum resources. *Health Education Journal* 1985;**44**:39–42.

California 1995 {published data only}

Landrine H, Klonoff EA, Reina-Patton A. Minors' access to tobacco before and after the California STAKE Act. *Tobacco Control* 2000;**9** Suppl 2:II15–II17.

Central Coast 1996 {published and unpublished data}

Cook D. Retailer education and cigarette sales to teenagers [letter]. *Australian and New Zealand Journal of Public Health* 1998;**22**(7): 842.

Tutt D. Big reduction in teen smoking - how and why a supply intervention works. Alcohol and Drug Foundation, Queensland, 16th Winter School, Brisbane. 2004.

Tutt D. Enforcing prohibition of tobacco sales to minors: an update. Alcohol and Drug Foundation, Queensland, 13th Winter School, Brisbane. 2000.

* Tutt D, Bauer L, Edwards C, Cook D. Reducing adolescent smoking rates. Maintaining high retail compliance results in substantial improvements. *Health Promotion Journal of Australia* 2000;**10**(1):20–4.

Chicago 1993 *{published data only}*

Jason L, Billows W, Schnopp Wyatt D, King C. Reducing the illegal sales of cigarettes to minors: analysis of alternative enforcement schedules. *Journal of Applied Behavioral Analysis* 1996;**29**:333–44.

Cook County 1996 *{published data only}*

McDermott SR, Scott KL, Frintner MP. Accessibility of cigarettes to minors in suburban Cook County, Illinois. *Journal of Community Health* 1998;**23**:153–60.

Erie County 1987 *{published data only}*

Skretny MT, Cummings KM, Sciandra E, Marshall J. An intervention to reduce the sale of cigarettes to minors in New York State. *New York State Journal of Medicine* 1990;**92**(12):521–5.

Erie County 1995 *{published data only}*

Cummings KM, Hyland A, Perla J, Giovino GA. Is the prevalence of youth smoking affected by efforts to increase retailer compliance with a minors' access law?. *Nicotine & Tobacco Research* 2003;**5**(4):465–71.

* Cummings KM, Hyland A, Saunders-Martin T, Perla J, Coppola PR, Pechacek TF. Evaluation of an enforcement program to reduce tobacco sales to minors. *American Journal of Public Health* 1998;**88**:932–6.

Everett 1990 *{published data only}*

Hinds MW. Impact of local ordinance banning tobacco sales to minors. *Public Health Reports* 1992;**107**:355–8.

Fort Morgan 2007 *{published data only}*

Levinson AH, Mickiewicz T. Reducing underage cigarette sales in an isolated community: The effect on adolescent cigarette supplies. *Preventive Medicine* 2007;**45**(6):447–53.

Gateshead 1996 *{published data only}*

* Bagott M, Jordan C, Wright C, Jarvis S. How easy is it for young people to obtain cigarettes, and do test sales by trading standards have any effect? A survey of two schools in Gateshead. *Child: Care, Health and Development* 1998;**24**:207–16.

Bagott M, Jordan C, Wright C, Jarvis S. Test sales do not have impact on prevalence of smoking by children. *BMJ* 1997;**315**:491.

Harlem 1993 *{published data only}*

Gemson DH, Moats HL, Watkins BX, Ganz ML, Robinson S, Heaton E. Laying down the law: reducing illegal tobacco sales to minors in central Harlem. *American Journal of Preventive Medicine* 1998;**88**:936–9.

Illinois 1999 *{published data only}*

* Jason LA, Pokorny SB, Schoeny ME. Evaluating the effects of enforcements and fines on youth smoking. *Critical Public Health* 2003;**13**(1):33–45.

Pokorny SB, Jason LA, Lautenschlager H, Smith R, Townsend SM. Measuring the quality of laws limiting youth access to tobacco. *Journal of Prevention and Intervention in the Community* 2002;**24**:15–27.

Larimer County 1999 *{published data only}*

Watson A, Grove N. Larimer County Tobacco and Youth Project. *American Journal of Public Health* 1999;**89**(4):597–8.

Leominster 1991 *{published data only}*

DiFranza JR, Carlson RP, Caisse RE. Reducing youth access to tobacco. *Tobacco Control* 1992;**1**:58.

Manly 1995 *{published data only}*

Junck E, Humphries J, Rissel C. Reducing tobacco sales to minors in Manly: 10 months follow-up. *Health Promotion Journal of Australia* 1997;**7**:29–34.

Massachusetts 1994 *{published data only}*

Rigotti NA, DiFranza JR, Chang Y, Tisdale T, Kemp B, Singer DE. The effect of enforcing tobacco-sales laws on adolescents' access to tobacco and smoking behavior. *New England Journal of Medicine* 1997;**337**:1044–51. [MEDLINE: 97449073]

Monterey 1994 *{published data only}*

Altman DG, Wheelis AY, McFarlane M, Lee H, Fortmann SP. The relationship between tobacco access and use among adolescents: a four community study. *Social Science & Medicine* 1999;**48**:759–75.

New South Wales 1994 *{published data only}*

Schofield MJ, Sanson Fisher RW, Gulliver SB. Interventions with retailers to reduce cigarette sales to minors: a randomised controlled trial. *Australian and New Zealand Journal of Public Health* 1997;**21**:590–6.

Ontario 1992 *{published data only}*

Dovell RA, Mowat DL, Dorland J, Lam M. Changes among retailers selling cigarettes to minors. *Canadian Journal of Public Health* 1996;**87**:66–8.

Oregon 1995 *{published data only}*

Biglan A, Ary D, Koehn V, Levings D, Smith S, Wright Z, et al. Mobilizing positive reinforcement in communities to reduce youth access to tobacco. *American Journal of Community Psychology* 1996;**24**:625–38.

* Biglan A, Henderson J, Humphrey D, Yasui M, Whisman R, Black C, et al. Mobilising positive reinforcement to reduce youth access to tobacco. *Tobacco Control* 1995;**4**:42–8.

Perth 1994 *{published data only}*

Mawkes L, Wood L, Markham P, Walker N, Swanson M, De Klerk N. Choking the supply: restricting the sale of cigarettes to children in Western Australia. *Health Promotion Journal of Australia* 1997;**7**:22–8.

Philadelphia 1998 *{published data only}*

Ma GX, Shive S, Tracy M. The effects of licensing and inspection enforcement to reduce tobacco sales to minors in Greater Philadelphia, 1994–1998. *Addictive Behaviors* 2001;**26**:677–87.

San Diego 1991 *{published data only}*

* Keay KD, Woodruff SI, Wildey MB, Kenney EM. Effect of a retailer intervention on cigarette sales to minors in San Diego County, California. *Tobacco Control* 1993;**2**:145–51.

Wildey MB, Woodruff SI, Agro A, Keay KD, Kenney EM, Conway TL. Sustained effects of educating retailers to reduce cigarette sales to minors. *Public Health Reports* 1995;**110**:625–9.

Santa Clara 1988 *{published data only}*

* Altman DG, Foster V, Rasenick-Douss L, Tye JB. Reducing the illegal sale of cigarettes to minors. *JAMA* 1989;**261**:80–3.

Altman DG, Rasenick-Douss L, Foster V, Tye JB. Sustained effects of an educational program to reduce sales of cigarettes to minors. *American Journal of Public Health* 1991;**81**:891–3.

Solana County 1990 *{published data only}*

Feighery E, Altman D, Shaffer G. The effects of combining education and enforcement to reduce tobacco sales to minors. A study of four northern communities. *JAMA* 1991;**266**:3168–71.

St Paul 1990 *{published data only}*

Forster JL, Hourigan ME, Kelder S. Locking devices on cigarette vending machines: evaluation of a city ordinance. *American Journal of Public Health* 1992;**82**:1217–21.

Stirling 1997 *{published data only}*

Campbell F. Youth access to tobacco: An investigation into the sale of cigarettes to young people under the age of 16 years, in the Stirling area. Forth Valley Health Board Health Promotion Department; November 1997.

Sydney 1992 *{published data only}*

Chapman S, King M, Andrews B, McKay E, Markham P, Woodward S. Effects of publicity and a warning letter on illegal cigarette sales to minors. *Australian Journal of Public Health* 1994;**18**:39–42.

Sydney 1995a *{published data only}*

Staff M, March L, Brnabic A, Hort K, Alcock J, Coles S, et al. Can non-prosecutory enforcement of public health legislation reduce smoking among high school students?. *Australian and New Zealand Journal of Public Health* 1998;**22**:332–5.

Sydney 1995b *{published data only}*

Nyhuis A, Schoenmakers I, Rissel C. Choice of denominator in studies of cigarette purchases by minors. *Australian Journal of Public Health* 1995;**19**:529–30.

* Schoenmakers I, Nyhuis A, Rissel C, Chapman S. The role of ethnicity in sales of cigarettes to minors. *Health Promotion Journal of Australia* 1997;**7**:62–6.

Sydney 2000 *{published data only}*

Staff M, Bennett CM, Angel P. Is restricting tobacco sales the answer to adolescent smoking?. *Preventive Medicine* 2003;**37**:529–33.

TPOP 1996 *{published data only}*

Blaine TM, Forster JL, Hennrikus D, O'Neil S, Wolfson M, Pham H. Creating tobacco control policy at the local level: implementation of a direct action organizing approach. *Health Education and Behavior* 1997;**24**(5):640–51.

Chen V, Forster JL. The long-term effect of local policies to restrict retail sale of tobacco to youth. *Nicotine & Tobacco Research* 2006;**8**:371–7.

* Forster JL, Murray DM, Wolfson M, Blaine TM, Wagenaar AC, Hennrikus DJ. The effects of community policies to reduce youth access to tobacco. *American Journal of Public Health* 1998;**88**:1193–8.

Forster JL, Wolfson M, Murray DM, Wagenaar AC, Claxton AJ. Perceived and measured availability of tobacco to youth in 14 Minnesota communities: The TPOP study. *American Journal of Preventive Medicine* 1997;**13**:167–74.

Wisconsin 1993 *{published data only}*

Schensky AE, Smith SS, Icenogle DL, Fiore MC. Youth tobacco sale compliance checks: impact on vendor practices and community policy. *Wisconsin Medical Journal* 1996;**95**:775–8.

Woodridge 1991 *{published data only}*

Jason LA, Berk M, Schnopp WD, Talbot B. Effects of enforcement of youth access laws on smoking prevalence. *American Journal of Community Psychology* 1999;**27**:143–60.

Jason LA, Billows WD, Schnopp-Wyatt D, King C. Long-term findings from Woodridge in reducing illegal cigarette sales to older

minors. *Evaluation and the Health Professions* 1996;**19**:3–13.

* Jason LA, Ji PY, Anes MD, Birkhead SH. Active enforcement of cigarette control laws in the prevention of cigarette sales to minors. *JAMA* 1991;**266**:3159–61.

Jason LA, Katz R, Vavra J, Schnopp WDL. Long-term follow-up of youth access to tobacco laws' impact on smoking prevalence. *Journal of Human Behaviour in the Social Environment* 1999;**2**(3):1–13.

References to studies excluded from this review**Aguirre-Molina 1995** *{published data only}*

Aguirre-Molina M, Gorman DM. The Perth Amboy Community Partnership for Youth: Assessing its effects at the environmental and individual levels of analysis. *International Quarterly for Community Health Education* 1995;**15**:363–78.

Bidell 2000 *{published data only}*

Bidell MP, Furlong MJ, Dunn DM, Koegler JE. Case study of attempts to enact self service tobacco display ordinances: a tale of three communities. *Tobacco Control* 2000;**9**:71–7.

Bryant 2002 *{published data only}*

Bryant JA, Cody MJ, Murphy ST. Online sales: profit without question. *Tobacco Control* 2002;**11**:226–27.

Cowling 2000 *{published data only}*

Cowling DW, Robins DM. Rate of illegal tobacco sales to minors varies by sign type in California. *American Journal of Public Health* 2000;**90**:1792–93.

Dent 2004 *{published data only}*

Dent C, Biglan A. Relation between access to tobacco and adolescent smoking. *Tobacco Control* 2004;**13**:334–8.

Glanz 2007 *{published data only}*

Glanz K, Jarrette AD, Wilson EA, O'Riordan DL, Jacob Arriola KR. Reducing minors' access to tobacco: eight years' experience in Hawaii. *Preventive Medicine* 2007;**44**:55–8.

Hagquist 2007 *{published data only}*

* Hagquist C, Sundh M, Eriksson C. Smoking habits before and after the introduction of a minimum-age law for tobacco purchase: analysis of data on adolescents from three regions of Sweden. *Scandinavian Journal of Public Health* 2007;**35**(4):373–9.

Sundh M, Hagquist C. Does a minimum-age law for purchasing tobacco make any difference? Swedish experiences over eight years. *European Journal of Public Health* 2007;**17**(2):171–7.

Its The Law 1 *{published data only}*

DiFranza JR, Brown LJ. The Tobacco Institute's "It's the Law" campaign: Has it halted illegal sales of tobacco to children?. *American Journal of Public Health* 1992;**82**:1271–3.

Its The Law 2 *{published data only}*

DiFranza JR, Savageau JA, Aisquith BF. Youth access to tobacco: the effects of age, gender, vending machine locks, and "It's the Law" programs. *American Journal of Public Health* 1996;**86**:221–4.

Jason 2007 *{published data only}*

Jason LA, Hunt YM, Adams ML, Pokorny SB, Gadiraju PB. Strengthening communities' youth access policies may facilitate clean indoor air action. *Preventing Chronic Disease* 2007;**4**(4):A113.

* Jason LA, Pokorny SB, Adams M, Hunt Y, Gadiraju P, Schoeny M. Do fines for violating possession-use-purchase laws reduce youth tobacco use?. *Journal of Drug Education* 2007;**37**(4):393–400.

Krevor 2003 *{published data only}*

Krevor B, Capitman JA, Oblak L, Cannon JB, Ruwe M. Preventing illegal tobacco and alcohol sales to minors through electronic age-verification devices: a field effectiveness study. *Journal of Public Health Policy* 2003;**24**(3-4):251-68.

Lovato 2007 *{published data only}*

Lovato CY, Hsu HC, Sabiston CM, Hadd V, Nykiforuk CI. Tobacco Point-of-Purchase marketing in school neighbourhoods and school smoking prevalence: a descriptive study. *Canadian Journal of Public Health* 2007;**98**:265-70.

MMWR 2002 *{published data only}*

Anonymous. Usual sources of cigarettes for middle and high school students--Texas, 1998-1999. *MMWR Morbidity & Mortality Weekly Report* 2002;**51**:900-1.

New Zealand 1997 *{published data only}*

* Laugesen M, Scragg R. Changes in cigarette purchasing by fourth form students in New Zealand 1992-1997. *New Zealand Medical Journal* 1999;**112**:379-83.

Laugesen M, Scragg R. Trends in cigarette smoking in fourth-form students in New Zealand, 1992-1997. *New Zealand Medical Journal* 1999;**112**:308-11.

Price L, Allen M. Enforcing the law on tobacco sales to minors. *New Zealand Public Health Report* 1998;**5**:1-2.

Project SCAN *{published data only}*

Cummings KM, Coogan K. Organizing communities to prevent the sale of tobacco products to minors. *International Quarterly of Community Health Education* 1992;**13**:77-86.

Siegel 1999 *{published data only}*

Siegel M, Biener L, Rigotti NA. The effect of local tobacco sales laws on adolescent smoking initiation. *Preventive Medicine* 1999;**29**(5):334-42.

Siegel 2006 *{published data only}*

Siegel JT, Alvaro EM. An evaluation of Arizona's youth tobacco access prevention media campaign. *American Journal of Preventive Medicine* 2006;**30**(4):284-91.

Teall 2001 *{published data only}*

Teall AM, Graham MC. Youth access to tobacco in two communities. *Journal of Nursing Scholarship* 2001;**33**(2):175-178.

Thomson 2004 *{published data only}*

Thomson CC, Gokhale M, Biener L, Siegel MB, Rigotti NA. Statewide evaluation of youth access ordinances in practice: effects of the implementation of community-level regulations in Massachusetts. *Journal of Public Health Management & Practice* 2004;**10**(6):481-9.

Thomson 2007 *{published data only}*

Thomson CC, Hamilton WL, Siegel MB, Biener L, Rigotti NA. Effect of local youth-access regulations on progression to established smoking among youths in Massachusetts. *Tobacco Control* 2007;**16**(2):119-26.

Wichita 1996 *{published data only}*

Lewis RK, Paine-Andrews A, Fawcett SB, Francisco VT, Richter KP, Copple B, et al. Evaluating the effects of a community coalition's efforts to reduce illegal sales of alcohol and tobacco products to minors. *Journal of Community Health* 1996;**21**:429-36.

Woodruff 1995 *{published data only}*

Woodruff SI, Wildey MB, Conway TL, Clapp EJ. Effect of a brief retailer intervention to reduce the sale of single cigarettes. *American Journal of Health Promotion* 1995;**9**:172-4.

Woodruff 2003 *{published data only}*

Woodruff SI, Candelaria JI, Laniado-laborin R, Sallis JF, Villaseñor A. Availability of cigarettes as a risk factor for trial smoking in adolescents. *American Journal of Health Behavior* 2003;**27**(1):84-8.

Zubow 1994 *{unpublished data only}*

Zubow S, Ravinale L, Benner J. Nonclassroom youth programs. Paper presented at the Annual Information Exchange Conference of the America Stop Smoking Intervention Study (ASSIST). San Francisco, CA..

Additional references**Altman 1997**

Altman DG, Bland JM. Statistics notes. Units of analysis. *BMJ* 1997;**314**:1874.

Carruthers 1995

Carruthers S, McDonald C. The availability of cigarettes to minors in Perth, Western Australia. *Tobacco Control* 1995;**4**:49-52.

Castrucci 2002

Castrucci BC, Gerlach KK, Kaufman NJ, Orleans CT. Adolescents' acquisition of cigarettes through noncommercial sources. *Journal of Adolescent Health* 2002;**31**(4):322-6.

CCS 2001

Canadian Cancer Society. *Youth Tobacco Possession Laws - Policy Analysis*. Ottawa: Canadian Cancer Society, Sept 2001.

Chaloupka 2003

Chaloupka FJ. Contextual factors and youth tobacco use: policy linkages. *Addiction* 2003;**98** Suppl 1:105-22.

Chapman 1994

Chapman S, King M, Andrews B, McKay E, Markham P, Woodward S. Effects of publicity and a warning letter on illegal cigarette sales to minors. *Australian Journal of Public Health* 1994;**18**:39-42.

Chen 2006

Chen V, Forster JL. The long-term effect of local policies to restrict retail sale of tobacco to youth. *Nicotine & Tobacco Research* 2006;**8**:371-7.

Clark 2000

Clark PI, Natanblut SL, Schmitt CL, Wolters C, Iachan R. Factors associated with tobacco sales to minors: lessons learned from the FDA compliance checks. *JAMA* 2000;**284**:729-34.

Craig 2007

Craig MJ, Boris NW. Youth tobacco access restrictions: Time to shift resources to other interventions?. *Health Promotion Practice* 2007;**8**(1):22-7.

Croghan 2003

Croghan E, Aveyard P, Griffin C, Cheng KK. The importance of social sources of cigarettes to school students. *Tobacco Control* 2003;**12**:67-73.

Cummings 2003

Cummings KM, Hyland A, Perla J, Giovino GA. Is the prevalence of youth smoking affected by efforts to increase retailer compliance

- with a minors' access law?. *Nicotine & Tobacco Research* 2003;**5**(4): 465–71.
- Darling 2005**
Darling H, Reeder A, McGee R, Williams S. . N Z Med J 2005, 118(1213):U1408. Access to tobacco products by New Zealand youth. *New Zealand Medical Journal* 2005;**118**(1213):U1408.
- DiFranza 1992**
DiFranza JR, Brown LJ. The Tobacco Institute's "It's the Law" campaign: Has it halted illegal sales of tobacco to children?. *American Journal of Public Health* 1992;**82**:1271–3. [MEDLINE: 92367835]
- DiFranza 1996**
DiFranza JR, Savageau JA, Aisquith BF. Youth access to tobacco: the effects of age, gender, vending machine locks, and "It's the Law" programs. *American Journal of Public Health* 1996;**86**:221–4.
- DiFranza 2001a**
DiFranza JR. State and federal compliance with the Synar Amendment: federal fiscal year 1998. *Archives of Pediatric and Adolescent Medicine* 2001;**155**:572–8.
- DiFranza 2001c**
DiFranza JR, Savageau JA, Bouchard J. Is the standard compliance check protocol a valid measure of the accessibility of tobacco to underage smokers?. *Tobacco Control* 2001;**10**:227–32.
- DiFranza 2002**
Fichtenberg CM, Glantz SA. Is it time to abandon youth access programmes?. *Tobacco Control* 2002;**11**:282–4.
- DiFranza 2003**
DiFranza JR. Adolescents' acquisition of cigarettes through noncommercial sources. *Journal of Adolescent Health* 2003;**32**(5): 331–2.
- DiFranza 2005**
DiFranza JR. Best practices for enforcing state laws prohibiting the sale of tobacco to minors. *Journal of Public Health Management & Practice* 2005;**11**(6):559–65.
- Eaton 2006**
Eaton DK, Kann L, Kinchen S, Ross J, Hawkins J, Harris WA, et al. Youth risk behavior surveillance--United States, 2005. *MMWR Surveillance Summaries* 2006;**55**:1–108.
- Emery 1999**
Emery S, Gilpin EA, White MM, Pierce JP. How adolescents get their cigarettes: Implications for policies on access and price. *Journal of the National Cancer Institute* 1999;**91**:184–6.
- Erickson 1993**
Erickson AD, Woodruff SI, Wildey M, Kenney EM. Baseline assessment of cigarette sales to minors in San Diego, California. *Journal of Community Health* 1993;**18**:213–4.
- Etter 2006**
Etter JF. Laws prohibiting the sale of tobacco to minors: impact and adverse consequences. *American Journal of Preventive Medicine* 2006;**31**:47–51.
- Fichtenberg 2002a**
Fichtenberg CM, Glantz SA. Youth access interventions do not affect youth smoking. *Pediatrics* 2002;**109**:1088–92.
- Fichtenberg 2002b**
Fichtenberg CM, Glantz SA. Is it time to abandon youth access programmes? authors' replies. *Tobacco Control* 2002;**11**:283–4.
- Fichtenberg 2003**
Fichtenberg CM, Glantz SA. It is premature to abandon youth access to tobacco programs - reply. *Pediatrics* 2003;**111**(4 Pt 1):921.
- Forster 1992**
Forster JL, Hourigan M, McGovern P. Availability of cigarettes to underage youth in three communities. *Preventive Medicine* 1992; **21**:320–8.
- Forster 1998**
Forster JL, Wolfson M. Youth access to tobacco: policies and politics. *Annual Review of Public Health* 1998;**19**:203–35. [MEDLINE: 98274552]
- Gilpin 2004**
Gilpin EA, Lee L, Pierce JP. Does adolescent perception of difficulty in getting cigarettes deter experimentation?. *Preventive Medicine* 2004;**38**:485–91.
- Glantz 2002**
Glantz SA. Limiting youth access to tobacco: a failed intervention. *Journal of Adolescent Health* 2002;**31**:301–2.
- Harrison 2000**
Harrison PA, Fulkerson JA, Park E. The relative importance of social versus commercial sources in youth access to tobacco, alcohol, and other drugs. *Preventive Medicine* 2000;**31**:39–48.
- Jarvis 1997**
Jarvis L. *Smoking among secondary school children in 1996: England. An enquiry carried out by the Social Survey Division of ONS on behalf of the Department of Health*. London: HMSO, 1997.
- Jason 1996**
Jason LA, Billows WD, Schnopp-Wyatt D, King C. Long-term findings from Woodridge in reducing illegal cigarette sales to older minors. *Evaluation and the Health Professions* 1996;**19**:3–13.
- Jason 1999**
Jason LA, Berk M, Schnopp WD, Talbot B. Effects of enforcement of youth access laws on smoking prevalence. *American Journal of Community Psychology* 1999;**27**:143–60.
- Jason 2002**
Jason LA, Pokorny SB, Schoeny ME. A response to the critiques of tobacco sales and tobacco possession laws. *Journal of Prevention and Intervention in the Community* 2002;**24**:87–95.
- Jason 2003**
Jason LA, Pokorny SB, Schoeny ME. It is premature to abandon youth access to tobacco programs (letter). *Pediatrics* 2003;**111**(4 Pt1):920.
- Johnston 2007**
Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. Teen smoking resumes decline. University of Michigan News and Information Services, Ann Arbor. <http://monitoringthefuture.org/press.html> (accessed 7th April 2008).
- Jones 2002**
Jones SE, Sharp DJ, Husten CG, Crossett LS. Cigarette acquisition and proof of age among US high school students who smoke. *Tobacco Control* 2002;**11**:20–5.

Landrine 1994

Landrine H, Klonoff EA, Fritz JM. Preventing cigarette sales to minors: The need for contextual, sociocultural analysis. *Preventive Medicine* 1994;**23**:322–7.

Landrine 2000

Landrine H, Klonoff EA, Campbell R, Reina-Patton A. Sociocultural variables in youth access to tobacco: replication 5 years later. *Preventive Medicine* 2000;**30**:433–7.

Landrine 2001

Landrine H, Klonoff EA, Lang D, Alcaraz R. Use of identification cards by underage youth to purchase tobacco. *JAMA* 2001;**285**:2329.

Levy 2000

Levy DT, Friend KB. A simulation model of tobacco youth access policies. *Journal of Health Politics Policy & Law* 2000;**25**:1023–50.

Levy 2001

Levy DT, Friend K, Holder H, Carmona M. Effect of policies directed at youth access to smoking: results from the SimSmoke computer simulation model. *Tobacco Control* 2001;**10**:108–16.

Ling 2002

Ling PM, Landman A, Glantz SA. It is time to abandon youth access tobacco programmes. *Tobacco Control* 2002;**11**:3–6.

MMWR 1996

US DHHS. Youth Risk Behaviour Surveillance -- United States, 1995. *MMWR CDC Surveill Summ* 1996;**45**(5):1–84.

MMWR 1998a

US DHHS. Selected cigarette smoking initiation and quitting behaviors among high school students--United States, 1997. *MMWR Morb Mortal Wkly Rep* 1998;**47**(19):386–9.

MMWR 1998b

US DHHS. Youth Risk Behaviour Surveillance -- United States, 1997. *MMWR CDC Surveill Summ* 1998;**47**(SS-5):1–90.

Mosher 1995

Mosher JF. The merchants, not the customers: resisting the alcohol and tobacco industries' strategy to blame young people for illegal alcohol and tobacco sales. *Journal of Public Health Policy* 1995;**16**:412–32.

Pokorny 2003

Pokorny SB, Jason LA, Schoeny ME. The relation of retail tobacco availability to initiation and continued smoking. *Journal of Clinical Child & Adolescent Psychology* 2003;**32**:193–204.

Ribisl 2003

Ribisl KM, Williams RS, Kim AE. Internet sales of cigarettes to minors. *JAMA* 2003;**290**:1356–9.

Rigotti 1997

Rigotti NA, DiFranza JR, Chang Y, Tisdale T, Kemp B, Singer DE. The effect of enforcing tobacco-sales laws on adolescents' access to tobacco and smoking behaviour. *New England Journal of Medicine* 1997;**337**:1044–51.

Rimpelä 2004

Rimpelä AH, Rainio SU. The effectiveness of tobacco sales ban to minors: the case of Finland. *Tobacco Control* 2004;**13**:176–74.

Robinson 2006

Robinson LA, Dalton WTI, Nicholson LM. Changes in adolescents' sources of cigarettes. *Journal of Adolescent Health* 2006;**39**:861–7.

Ross 2001a

Ross H, Chaloupka FJ, Wakfield M. Youth smoking uptake progress: Price and public policy effects. *Impacteen Research Papers*. No. 8. 2001. www.impacteen.org/generalarea_PDFs/Progress.pdf.

Ross 2001b

Ross H, Chaloupka FJ, Wakefield M. Youth smoking uptake progress: Price and public policy effects. *Impacteen Research Papers*. No. 11. 2001. www.impacteen.org/generalarea_PDFs/Progress.pdf.

Sanson Fisher 1992

Sanson Fisher RW, Schofield MJ, See M. Availability of cigarettes to minors. *Australian Journal of Public Health* 1992;**16**:354–9.

Siegel 2005

Siegel M, Albers AB, Cheng DM, Biener L, Rigotti NA. Effect of local restaurant smoking regulations on progression to established smoking among youths. *Tobacco Control* 2005;**14**:300–6.

Stanton 1993

Stanton WR, Mahalski PA, McGee R, Silva PA. Reasons for smoking or not smoking in early adolescence. *Addictive Behaviors* 1993;**18**:321–9.

Sundh 2007

Sundh M, Hagquist C. Does a minimum-age law for purchasing tobacco make any difference? Swedish experiences over eight years. *European Journal of Public Health* 2007;**17**(2):171–7.

Widome 2007

Widome R, Forster JL, Hannan PJ, Perry CL. Longitudinal patterns of youth access to cigarettes and smoking progression: Minnesota Adolescent Community Cohort (MACC) study (2000–2003). *Preventive Medicine* 2007;**45**:442–6.

Willey 1995

Willey MB, Woodruff SI, Pampalone SZ, Conway TL. Self-service sale of tobacco: how it contributes to youth access. *Tobacco Control* 1995;**4**:355–61.

References to other published versions of this review**Lancaster 1999**

Lancaster T, Stead LF. Interventions for preventing tobacco sales to minors. *Cochrane Database of Systematic Reviews* 1999, Issue 4. [Art. No.: CD001497. DOI: 10.1002/14651858.CD001497.pub2]

Stead 2000

Stead LF, Lancaster T. A systematic review of interventions for preventing tobacco sales to minors. *Tobacco Control* 2000;**9**:169–176.

Stead 2002

Stead LF, Lancaster T. Interventions for preventing tobacco sales to minors. *Cochrane Database of Systematic Reviews* 2002, Issue 1. [Art. No.: CD001497. DOI: 10.1002/14651858.CD001497.pub2]

Stead 2005

Stead LF, Lancaster T. Interventions for preventing tobacco sales to minors. *Cochrane Database of Systematic Reviews* 2005, Issue 1.[Art. No.: CD001497. DOI: 10.1002/14651858.CD001497.pub2]

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Alberta 1991

Methods	Pre/post study, no control group Setting: 3 communities in Alberta
Participants	Stratified random sample of retail outlets: Community A n=30: Community B n=40: Community C (all retail outlets) n=7. Different sample used for pre- and post-test
Interventions	Legislation and education Introduction of a city by-law combined with a retailer education programme. The education component consisted of a package including signs, a copy of the act, a letter from the mayor, staff training material. In A&B materials were delivered by mail, in the smaller community (C) they were delivered by a health unit employee.
Outcomes	Illegal sales: Single test purchase attempt by <16yrs at baseline and 3m. Retailers surveyed by telephone on knowledge of the Tobacco Restraint Act and stated willingness to sell to minors if accompanied by parental note.
Notes	'Compliance for Kids' programme

Bristol 1983

Methods	Pre/post study, no control group Site: UK city
Participants	100 tobacconists randomly selected from Yellow Pages at pre-test and 50 at post-test
Interventions	Retailer education and publicity Letter sent to all tobacconists clarifying law and offering publicity material. Press conference publicising results of test purchasing.
Outcomes	Illegal sales: Single test purchase by one of four children 'well under' 16y at baseline and 12 months. Retailers interviewed about knowledge of law.
Notes	

California 1995

Methods	Pre/post study, no control group Site: California, San Bernardino County
Participants	72 small grocery/convenience stores randomly selected in 1993 and excluded from merchant education interventions

California 1995 (Continued)

Interventions	Introduction of legislation to comply with Synar Regulation: Stop Tobacco Access to Kids Enforcement (STAKE) Act. Purchase attempts were conducted in Aug 1994 (pre-STAKE implementation), Aug 1995, Aug 1996, March 1998, Jan 1999.
Outcomes	Illegal sales: Each assessor visited every store. Assessors were aged 16, 50% M, 6 were used at time 1, 4 at times 2&3, 12 at times 4&5
Notes	

Central Coast 1996

Methods	Pre/post study, survey data from wider area used as control for smoking behaviour only Site: Central Coast, New South Wales, Australia
Participants	133 retailers situated near high schools tested in late 1994 and 6-monthly to 1996. Then random testing of 10% of retailers over wider area. Students at local schools
Interventions	From 1995, enforcement (fines) and strong publicity.
Outcomes	Illegal sales: 14-16, single attempt in each checking period Smoking behaviour: Assessed monthly smoking via survey of 4 local high schools in 1993/96/99, 2-3,000 12-17yr olds each year. Compared to other surveys of New South Wales in 1993 (N=4832) and 1996 (N=10,000). Survey wording not identical. Perceived access: (in Tutt 2004) Central Coast surveys asked about purchase attempts in past 6m.
Notes	Paper reports that after an initial period of education and publicity, compliance rates were low. Baseline rates prior to education not given.

Chicago 1993

Methods	Controlled trial with stratified randomization of stores within ethnic areas Setting: Urban communities (Caucasian, Latino and African-American neighbourhoods) in Chicago
Participants	120 stores in 3 ethnic areas were identified. 7 stores went out of business during study and are not included.
Interventions	Education and enforcement: Test of different schedules. Purchase attempts were made monthly, beginning in 12/1993. After 4/1994 assessment, merchants who sold cigs were notified and warned of programme of inspections. Other merchants given congratulatory note. All given educational materials. At enforcement visits fines of \$200. - Enforcement every 2m - Enforcement every 4m - Enforcement every 6m - No enforcement (control)

Chicago 1993 (Continued)

Outcomes	Illegal sales: Assessors judged to be aged 16-17 who gave correct age if challenged. Single attempt at each store each month. Generally unaccompanied. Different assessor each month. Monthly compliance tests continued for stores not due for enforcement checks. Period of intervention 11m.
Notes	

Cook County 1996

Methods	Pre/post study (no control group) Site: Suburban area, Illinois USA
Participants	347 retailers; 129 stores selling at baseline retested
Interventions	Education and warning Copy of state law and warning letter sent to all vendors selling at baseline (compliers sent congratulatory letter, not revisited)
Outcomes	Illegal sales: Single test purchase attempt by 14-17yr old accompanied by adult supervisor at baseline and 3m follow up
Notes	

Erie County 1987

Methods	Controlled trial with random allocation of stores to condition Setting: Buffalo, Erie county, New York
Participants	Retail outlets (supermarkets, convenience stores and pharmacies) Intervention n=60: Control n=58
Interventions	Retailer education Stores mailed educational package with letter citing the NY state law and requesting assistance in observing the law. Warning signs, and tip sheet for educating employees.
Outcomes	Illegal sales: Single test purchase by 1 of 7 minors, 14-16yrs, 2 wks after intervention (no baseline assessment)
Notes	

Erie County 1995

Methods	Controlled trial, 6 pairs of communities non-randomly assigned to enforcement or control conditions. Stores within communities randomly assigned to enforcement schedules Setting: 12 communities in Erie County, New York (varying in socioeconomic characteristics).
Participants	All retail outlets selling tobacco over the counter in each community (excluding bars). 319 outlets at follow up.

Erie County 1995 (Continued)

Interventions	Enforcement compared to warning only All licensed stores sent reminder of law and warning of random enforcement 12/1994. Stores allocated to 1, 2 or 3 enforcement checks over 8m period. Violators fined, compliers sent congratulatory letter.
Outcomes	Illegal sales: Test purchase attempt by one of 23 minors aged 15-17 (some conducted enforcement as well as compliance checks), gave true age if asked. At follow up 98% of stores checked 3 times using different assessors. Same 3 minors used in paired communities. Smoking behaviour: Survey of >4,000 9th grade students in 1992 & 1996, participation rate 84%. 30-day smoking and frequent smoking (>=20 of last 30 days). Perceived ease of getting cigs. % of current smokers usually using commercial sources.
Notes	Operation Protect Kids. Data on smoking behaviour and ease of access came from survey data reported in Cummings 2003

Everett 1990

Methods	Pre/post study, no control group Setting: City of Everett, Snohomish, Washington USA
Participants	Retailers (target of intervention) 10th grade high school students (pre-intervention n=221, post-intervention n=279). Mean age 15 yrs.
Interventions	Legislation New local ordinance: required signs, restricted vending machines, required proof of age for purchases, required a local licence, introduced penalties for violations
Outcomes	Smoking behaviour: Survey of students before and 1 yr after ordinance Perceived access: Purchasing behaviour and reports of retailers asking for proof of age
Notes	

Fort Morgan 2007

Methods	Pre/post study (no control group) Site: Isolated rural community, Colorado, USA
Participants	All 33 cig retailers in or near city limits; most visited repeatedly Pre & post survey of high school students (69% of 2004 enrolment, 70% of 2005 enrolment, total 1009)
Interventions	Enforcement. Fines for clerk and businesses after 2nd violation
Outcomes	Illegal sales: test purchases by 3 boys & 3 girls, aged 16-17, no ID carried, could be evasive about age. Smoking behaviour: Prevalence of ever- & 30-day smoking Reported access: Sources, asked for proof of age & refusal to sell (Never/Sometimes/Half the time or more). Smokers asked how often they carried cigs.
Notes	

Fort Morgan 2007 (Continued)

Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	No	Not applicable

Gateshead 1996

Methods	Controlled study Setting: Catchment areas for 2 schools in Gateshead, UK	
Participants	14-15-yr old students at both schools, (117 at baseline in intervention school, 107 at control school). (Retailers in intervention area - 13 shops surveyed, 70% of those close to intervention school)	
Interventions	Enforcement (intended) Test purchasing was carried out around the intervention school, prosecution intended for offenders. The retailers around the control school were not approached. No illegal sales were made.	
Outcomes	Smoking behaviour: Survey of yr 10 students pre- and post- intervention. Self-reported source of cigs and difficulty in purchasing. (Illegal sales assessed only as part of the intervention, not as part of assessment: Trading Standards Officer was in shop during purchase attempt by child aged <=13yr)	
Notes		

Harlem 1993

Methods	Controlled trial with random assignment of stores Setting: Urban community, USA	
Participants	152 stores licensed to sell tobacco (excludes 29 no longer selling tobacco at end of study)	
Interventions	Enforcement or Education Enforcement: stores violating regulations at baseline or 6m test fined. Education: single visit within 3m of baseline; explanation of law, leaflets. Control: no intervention There was media coverage of the result of the baseline survey of the enforcement stores.	
Outcomes	Illegal sales: Test purchases by African American m or f aged 12-14. Asked to purchase a single cig, if refused 2nd student would ask for a packet. Assessment at baseline, 6m, (violators fined) and 1 yr. (Assessment and enforcement checks were combined)	
Notes	Time from intervention to check was 6m for enforcement, approx 3m and 9m for education	

Illinois 1999

Methods	Pre/post study in 2 sets of communities both introducing enforcement (randomized trial of an intervention not relevant to the review) Setting: 8 communities in USA
Participants	All retailers in 8 communities
Interventions	Sales law enforcement; police conducted checks on every retailer 2-3 times/yr. Fine at 1st offence, 1 day licence suspension and higher fine for 2nd offence, escalating scale. (4 communities also enforced Possession law; minors issued citations for possession or use of tobacco products. Ordinances developed or strengthened if necessary. Intervention not of direct relevance to this review
Outcomes	Illegal sales: Unenforced assessments at baseline & 1 yr intervals, at all suitable retailers in every town, by F aged 15-16. Smoking behaviour: 6th grade cohort followed for 3 yrs. No control without enforcement so not interpretable for this review.
Notes	Only contributes data on change in compliance rates

Larimer County 1999

Methods	Pre/post study, no control group Setting: Larimer County, Colorado
Participants	No details of number of retailers
Interventions	Introduction of comprehensive local ordinance including prohibition on sale or provision of tobacco products to minors, eliminating self-service displays, and prohibiting minors from purchasing, possessing or consuming tobacco.
Outcomes	Illegal sales: no details of methods
Notes	

Leominster 1991

Methods	Pre/post study, no control group Setting: Single community, Leominster, Massachusetts USA
Participants	Retailers (target) Sample of students grade 7 to 12, 501 at baseline, 633 in total in 2 post-intervention surveys
Interventions	Education & Enforcement Merchant education followed by enforcement. Violators warned and repeat offenders fined. Compliers received letters of commendation.
Outcomes	Smoking behaviour: change in self-reported smoking prevalence in 3 cross-sectional surveys Illegal sales: attempted purchases on 3 occasions, 11, 15 & 19m after regulations adopted, by m&f of different ages. (No baseline before introduction of regulations.)

Leominster 1991 (Continued)

Notes	
-------	--

Manly 1995

Methods	Pre/post study, no control group Setting: community in New South Wales, Australia
Participants	All 54 tobacco retailing outlets not licensed for alcohol in Manly. Assessed at baseline, 3m and 10m.
Interventions	Community intervention including media coverage and public forum. Retailer education: Police delivered kit and verbally congratulated those not selling at baseline. Public Health Unit sent official warning letter to those selling at baseline.
Outcomes	Illegal sales: test purchase by 14-16-yr olds visiting in pairs, truthful responses. At baseline and 3m, outlets were visited up to 3 times if they refused sale. At 10m outcome based on single attempt.
Notes	Prosecution mentioned in paper, but occurred after the assessments documented in this paper.

Massachusetts 1994

Methods	Controlled study Setting: Massachusetts. Three intervention communities planned active enforcement of similar tobacco sales regulations; 3 matched control communities not planning enforcement.
Participants	Every retail outlet in each community All students in grades 9-12 aged <18 and resident in city or town where they attended school were surveyed at baseline and annually for 2 yrs.
Interventions	Enforcement All 6 local health departments distributed written information to retailers. Health departments of intervention communities began testing and penalised violators with an escalating series of warning and fines. They were encouraged to test 4 times/yr, with more frequent testing for noncompliant retailers. In control communities no compliance testing was planned.
Outcomes	Illegal sales: Test purchase (independent of any compliance testing in intervention communities) made by girls aged 16. Single attempt per store, at 6m intervals. Both over the counter and vending machine purchases attempted. True age given if asked. Smoking behaviour: Prevalence of tobacco use in past 30 days, prevalence of any tobacco use, and of regular daily use. Reported access: bought/tried to buy tobacco. Hardly ever refused/ refused at least half the time.
Notes	Intervention communities averaged 4.3 tests/vendor, control communities averaged 0.5. All analyses used mixed effects models. There were baseline differences in behaviour and reported access.

Monterey 1994

Methods	Controlled trial with allocation of 1 pair of communities to intervention by coin toss Setting: two pairs of communities (Gonzales/Soledad and Greenfield/King City) in Monterey county, California
Participants	All retailers in each community assessed All students in selected grades surveyed
Interventions	Comprehensive community intervention with retailer education All managers and staff of each retail outlet contacted directly on multiple occasions. Aimed to raise awareness, educate in methods to reduce sales and transmit community norms. Also press coverage, mass mailing, point of purchase messages, presentations at council and community group meetings. Stores not selling to minors publicised in ads. Stores selling to minors given further education. Active involvement of youth coalition.
Outcomes	Illegal sales: Test purchase by 13-17-yr olds on multiple occasions over a period of 34m. Truthful responses. Smoking behaviour: Initial survey of 7th, 9th, 11th graders further surveys so grade cohorts surveyed at 4 timepoints. Both cross-sectional and longitudinal analyses done. Saliva samples from a 30% random sample were tested for cotinine. Cut-off level of 20 ng/ml used; since there were few individuals with levels over this no adjustments to self report made.
Notes	No prosecutions because of lack of support from District Attorney Analysis of longitudinal data on smoking behaviour used generalized estimating equations. Baseline differences in 11th grade.

New South Wales 1994

Methods	Controlled trial with random assignment of stores using computer-generated random numbers Site: New South Wales, Australia.
Participants	Retailers within 50 km of research centre identified from telephone listings. 300 retail outlets randomized, 272 checked for compliance, 217 completed both surveys.
Interventions	Education vs education + threat of enforcement. Retailers in all groups surveyed pre- and post-intervention, by telephone or in person. Minimal intervention (education): letter from public health unit, informing of new law, need for age check and signage. Maximal intervention (education and threat of enforcement); same as minimal, but letter warned of possible enforcement, and followed by visit from a public health officer. Control: survey only
Outcomes	Illegal sales: Single test purchase using 18-yr olds assessed as looking younger (to avoid illegal acts) who wore school uniform at baseline and 2m post-intervention. Each assessor did approx 50 checks. Compliance was requiring proof of age. Knowledge & attitudes of retailers assessed by survey. Smoking behaviour: not assessed
Notes	

Ontario 1992

Methods	Pre/post study, no control group. Site: 2 neighbouring health units. 2 interventions implemented sequentially in 1 (KFL&A) with assessment over 21m and 1 in the other (H&PE) with assessment over 2 wks
Participants	Stores in the health unit areas. Different numbers assessed at each timepoint. No further details.
Interventions	Retailer Education Interventions in KFL&A: 1. (between baseline and 6m assessment) General education - media events, public flyers, results of purchase attempts. 2. (between 6m and 21m assessment) Targeted intervention sending information kits and letters to retailers advising them whether or not they had complied with the law, also federal intervention. Intervention in H&PE: Federal intervention - kits sent to retailers by Health Canada with a letter saying an inspector might call. Assessment was 1 wk later (2 wks after baseline)
Outcomes	Illegal sales: Single test purchase at baseline, 6m & 21m by pairs of 13-14 yr olds. One watched while other requested cigs.
Notes	

Oregon 1995

Methods	Time series design Setting: 8 rural communities, Oregon, USA (Project SixTeen community program)
Participants	Retailers in 8 communities. Programme first used in 2 communities whilst baseline assessment continued in 2 others, then replicated in 4 more.
Interventions	Community intervention and education, positive reinforcement Components: Mobilising community support; Education of merchants; changing consequences to clerks for selling (reminder) or not selling (gift token reward) to those under 18 yrs; publicity; feedback. Implemented by a community co-ordinator.
Outcomes	Illegal sales: Test purchase attempts (underage possession illegal) by 16-17 yrs at 2 wk intervals over approx 6m.
Notes	Results for first 2 pairs of communities reported in Biglan 1995. Replication in 4 further communities and combined results reported in Biglan 1996.

Perth 1994

Methods	Pre/post study, no control group Setting: areas near schools in urban areas of Perth, Western Australia
Participants	Tobacco merchants within 2km of 12 secondary schools surveyed at baseline in 1992 (230 outlets) and again in 1994 (284 outlets, as petrol stations included)

Perth 1994 (Continued)

Interventions	Comprehensive approach including education, enforcement and community action. State-wide activities. Materials sent to retailers. Prosecutions, or warning letters if prosecution impossible. Responsible merchants given display sticker. Action guide with practical suggestions for community. Media coverage sought.
Outcomes	Illegal sales: Single attempted purchase by pairs of 15-16 yr olds (same pair used for most areas at follow up). At baseline but not follow up children could say cigs were for parents if initially refused.
Notes	

Philadelphia 1998

Methods	Time series Setting: 14 areas of Philadelphia Tobacco-free Education and Action Coalition for Health (TEACH)
Participants	1655 stores in Philadelphia. Some selected at random, some had been reported as making sales to minors, some located in same area. Proportion in each category varied from yr to yr. Checks conducted 1994-1998
Interventions	Enforcement, education and community action. Passage of an ordinance and compliance checks with \$100 fines. Ordinance banned self service and required vending machine lock.
Outcomes	Illegal sales: Single purchase by 14-17 yr old, 15 youths used over period, mix of ages varied over the period. ID shown if prompted
Notes	No data on the proportion of attempts made at stores already suspected of illegal sales.

San Diego 1991

Methods	Controlled study. Cluster allocation of stores by location Setting: 6 communities in San Diego, California USA Project TRUST
Participants	Retailers in 6 low income, ethnically diverse communities. Data from 260 stores at pre- and post-test and 236 at 6m follow up
Interventions	Education and community awareness. Face-to-face education of retailers combined with community education and media strategies to encourage retailer compliance and to promote community awareness. Included video for training sales assistants. Managers of stores which sold at baseline also received 10 min discussion from Environmental Health Field inspectors. Duration of intervention 1 yr. Control: no intervention
Outcomes	Illegal sales: Single purchase or purchase attempt (in 2 communities ringing up of the cigs constituted a 'sale') by 70 teens aged 12-17 yrs. Assessment at baseline and 1 yr (1m after conclusion of intervention), and 6m later (Willey 1995)

San Diego 1991 (Continued)

Notes	
-------	--

Santa Clara 1988

Methods	Controlled study with random allocation of stores Setting: county in California, USA
Participants	412 stores selling cigs over the counter and 30 with vending machines. At 6m post test n=408, at 1 yr n=97 from a stratified random sample.
Interventions	Retailer education (as supplement to community intervention) The intervention included 3 key components 1: Community education through mass media and presentations to community groups 2: Direct education with merchants who sold tobacco - stores were randomly allocated to one of 3 variants of this component: i) no personal contact, ii) mailed information, iii) visits from project staff with education kit. 3: Contact with chief executives of companies that owned major chain and franchise operations.
Outcomes	Illegal sales: Single test purchases by 14-16-yr olds (18 assessors) who gave truthful answers. Attempt to use same assessor for pre- and 6m post-test.
Notes	

Solana County 1990

Methods	Pre/post design, no control group. Setting: 4 communities in Solana county, California The initial intervention was modelled on that used in the Santa Clara study
Participants	Random 50% sample of stores in 3 cities and all in a 4th city surveyed at pretest (n=169). 104 revisited at post-test 2, and a further 41 visited for the 1st time.
Interventions	Education only, followed by enforcement. Intervention organised by the County Cancer Prevention Program directed at merchants, law enforcement agencies and the community at large. Education packages mailed to retailers. Pre-test results widely publicised. 2nd phase (because of lack of effect of 1st) local police depts were requested to carry out 'stings' in which underage police cadets attempted purchases and citations issued. Results (34% sales) were publicised in local media.
Outcomes	Illegal sales. Test purchases by 14-16-yr olds. Single attempt at pre-test and 2 post-tests.
Notes	No differences found in results for stores visited at 1 or 2 post-tests. Local judges not always willing to sentence or fine those issued with citations.

St Paul 1990

Methods	Pre/post study, no control group Setting: St Paul, Minnesota
Participants	Random sample of businesses with vending machines. Baseline data for 95 of a possible 237 machines, complete data for 77.
Interventions	Vending Machine Locks St Paul adopted an ordinance which required that locking devices be installed on all cig vending machines in the city.
Outcomes	Illegal sales: Single attempt by female age 15 yrs conducted before implementation and at 3m & 12m post-implementation. Compliance in installing a locking device.
Notes	

Stirling 1997

Methods	Pre/post study, no control Setting: town in Scotland, UK
Participants	Convenience sample of 41 outlets surveyed at baseline. Intervention delivered to those selling. Resurvey of these and a further 26 outlets not initially visited 7m later.
Interventions	Warning: Immediately after a successful purchase at baseline, verbal warning given by Trading Standards Officer. Followed up by letter.
Outcomes	Illegal sales: Single test purchase by 11-15-yr olds.
Notes	

Sydney 1992

Methods	Controlled trial with randomization of outlets to warning letter. Setting: Sydney, Australia Pre-intervention (T1) 'stings' were carried out in a sample of retail outlets (n=255). Post-intervention (T2) 'stings' were carried out at 2m (n=244). Retailers found selling cigs at T1 were randomly allocated to receive or not receive a warning letter (Intervention grp n=50, control n=49).
Participants	Pairs of children aged 12-13, truthful about their age if challenged. Same children used for each outlet at both timepoints.
Interventions	Threat of enforcement Letter warning of another 'sting' and threatening prosecution sent to 50% of retailers selling at T1 Also media publicity about an undercover buying operation.
Outcomes	Illegal sales: Single test purchase at T1 and at T2 approx 2m after warning letter

Sydney 1992 (Continued)

Notes	
-------	--

Sydney 1995a

Methods	Controlled study Site: Two distinct geographic areas in Northern Sydney, Australia
Participants	All retailers targeted, 357 education kits distributed. Public and schools also targeted. Students at 13 public secondary schools used to evaluate effect on smoking prevalence.
Interventions	Retailer education and community awareness Intervention area: 'Beat police' delivering education kits about law to retailers. Local media articles, information in school newsletters. 'Informers' line to identify non-compliant retailers. Control area: no intervention
Outcomes	Illegal sales: not assessed Smoking behaviour: Baseline survey of students in yrs 7-11. Follow up 6m later. Smoking prevalence (daily plus occasional vs non and past smokers, or daily vs occasional, non and past). Ease of purchase (rated by students), knowledge of legal age.
Notes	

Sydney 1995b

Methods	Pre/post study with randomization of stores where sales occurred at baseline to intervention variants Site: Ethnically mixed area, Sydney Australia
Participants	143 shops selling tobacco on 15 major commercial streets
Interventions	Warning letters to retailers and media publicity Shops selling at baseline were randomized to receive the warning letters by post or delivered by an Environmental Health Officer
Outcomes	Illegal sales: Assessment by 2 16-yr old girls, up to 3 visits per shop Baseline survey July 1995, follow up 2.5m later
Notes	

Sydney 2000

Methods	Pre/post study Site: Northern Sydney Health region, Australia
Participants	No pre/post assessment of compliance. Regular compliance checks as part of intervention; 545 first time and 93 follow-up checks conducted over 5 yr period. Approx 1000 retailers in region

Sydney 2000 (Continued)

Interventions	Enforcement of laws with follow-up checks for non-compliant retailers and possible prosecution/fines
Outcomes	Illegal sales: not assessed Smoking behaviour: School surveys in 1995 & 2000; 11/13 schools resurveyed. Paired yr group data sets used. Ease of purchase assessed by type of outlet.
Notes	

TPOP 1996

Methods	Controlled trial with random assignment of communities after stratification by population and baseline smoking rate Setting: Minnesota, 14 communities with at least 90 students in each of grades 8,9,10, outside ASSIST area and with no recent ordinance changes regarding tobacco.
Participants	All retail outlets, and students in grades 8-10 in all communities (3200 to 13,100 residents)
Interventions	Comprehensive community intervention including the introduction of new ordinances, community awareness, media campaigns and compliance checks. All Intervention communities introduced new ordinances, with a variety of provisions. 3 control communities introduced new ordinances but these were weaker and less comprehensive.
Outcomes	Illegal sales: Test purchases, 2 attempts on successive days by 15-yr old females. Smoking behaviour: In school survey of grades 8-10 in 1993 and 1996. Smoking index used to classify as never/ monthly/ weekly/daily smokers. Perceived access: Ease of purchase (difficulty rated on 7 point scale for a variety of sources); Usual Source (commercial or social); Number of purchase attempts (in 30 days).
Notes	'Tobacco Policy Options for Prevention (TPOP)' Analysis took into account clustering of data, using mixed-model regression procedures. Results of long-term follow up of smoking prevalence in 1998 % 2000 reported in Chen & Forster 2006

Wisconsin 1993

Methods	Pre/post study, no control Setting: Dane County (urban and suburban and rural areas) Wisconsin, USA
Participants	153 retailers were surveyed at baseline and 137 at 1 yr follow up but only the outcome for the 60 surveyed at both points are considered for this review. No information on how samples chosen.
Interventions	Retailer education and feedback. Retailers notified by letter of results of compliance test, given signage and offered training.
Outcomes	Illegal sales: (from a clerk, from a self-service display, and from vending machine after request for change), single test purchase by 12-15-yr olds in groups of 2-3 who reported age honestly, at baseline and 12m

Wisconsin 1993 (Continued)

Notes	
-------	--

Woodridge 1991

Methods	Pre/post study with long-term follow up (no control -see notes) Setting: Single community, Woodridge USA
Participants	All stores in Woodridge (19-20 at baseline, 22-30 at follow-up assessments) Local students (680 at pre-test, 639 at post-test)
Interventions	Legislation and enforcement Introduction of local legislation modelled on liquor control laws, including licensing, enforcement, possession of cigs an offence. Education and media coverage. Community awareness maintained by letters from police to merchants and parents. Legislation introduced May 1989. Quarterly compliance checking carried out, congratulatory letters sent to compliers
Outcomes	Illegal sales: Test purchases by 12-17-yr olds (age range changed over period). Assessments at 6m intervals from August 1988 to December 1994. Smoking behaviour: Surveys of local 7th & 8th graders in March 1989 and April 1991. In 1991 they were asked about perceived availability. Further survey of high school students in 1996. 557 junior high school students surveyed in June 1997
Notes	In 1996 Woodridge students were compared with students from a community not conducting regular enforcement attending the same school (Jason 1999)

Illegal sales: if assessment procedure stated that purchase not completed, described as purchase attempt.

Characteristics of excluded studies [ordered by study ID]

Aguirre-Molina 1995	No compliance data reported after passage of the local ordinance intended to restrict youth access.
Bidell 2000	Not a clearly defined intervention. Case study of 3 communities considering introduction of ordinances limiting self-service tobacco displays. Only 2 communities were able to introduce bans, and a tobacco industry lobby warning of test purchasing 'stings' affected retailer behaviour whilst an ordinance was being debated.
Bryant 2002	Not a test of a retailer-directed intervention; investigated ease of underage purchase over the internet, and the possible effect of using an internet filter to block access.
Cowling 2000	No intervention. Study compared rates of illegal sales by type of tobacco sign (tobacco industry 'Its The Law' or 'We Card', or government warning sign). Sales rates were as high in stores displaying only tobacco industry signs as in stores displaying no sign.

(Continued)

Dent 2004	No specific intervention. Seventy-five community survey showing a small positive relationship between community rate of sales to minors and 11th grade smoking prevalence.
Glanz 2007	No specific intervention. Reports a decrease in test purchase success over 8 yrs in Hawaii.
Hagquist 2007	Not an experimental study. Brings together smoking prevalence data and test purchase for 3 regions of Sweden over a period when legislation introduced, but when other changes also occurred.
Its The Law 1	Survey, undertaken in Massachusetts in 1991. This is a survey of tobacco retailers to evaluate the efficacy of the Tobacco Institute's 'Its the Law' programme. It is post-intervention only, comparing retailers participating with those not. Of the retailers surveyed only 4.5% (7) were participating in the programme. Most of these retailers were found to be willing to sell cigs to minors. Most of the retailers not participating in the programme (131/149) were also willing to sell cigs to minors.
Its The Law 2	Survey, undertaken in Massachusetts in 1994 Survey of tobacco retailers to evaluate the efficacy of the Tobacco Institute's 'Its the Law' programme. Of 480 purchase attempts, 240 were made from participating retailers. Participation did not lead to a significantly lower rate of illegal sales.
Jason 2007	Trial of a 'Possession, use & purchase' (PUP) Law.
Krevor 2003	Not an intervention to prevent illegal sales; evaluated use of devices to improve the rate of age verification by store personnel.
Lovato 2007	Observational study of point-of-sale marketing, not an intervention.
MMWR 2002	No formal intervention. Comparisons made between data on illegal sales and smoking prevalence and source of cigs in middle school students.
New Zealand 1997	Data from a variety of sources are available but not clearly an intervention study. National surveys in 1992 and 1997 of smoking prevalence and reported source and ease of cig purchase for 14-15-yr old students. There was an increase in the minimum purchase age from 16 to 18 in early 1997 and test purchasing for enforcement purposes was initiated in September 1996. Survey data suggest that purchasing of cigs fell, more students were refused a sale and more students had difficulty purchasing. Data on smoking prevalence was reported separately, and showed increases over the period on all measures of smoking. No assessment of baseline sales rates prior to enforcement testing.
Project SCAN	This study did not include any pre-programme measurement Project Scan (Stop Children's addiction to Nicotine) included 3 broad activities 1) a public information campaign utilizing the media, newsletters, and a speaker's bureau; 2) distribution of sale to minor cards to all citizens to report on stores that illegally sell cigs to minors 3) work with community leaders, voluntary organisations, businesses, and law enforcement officials to support and implement activities. Police officers delivered the package to merchants.
Siegel 1999	No planned intervention. Longitudinal study compares prevalence of smoking onset over 4 yrs for youths in communities with and without ordinances at baseline. Local laws were associated with lower initiation rates but perceived access was no lower.

(Continued)

Siegel 2006	Not a direct assessment of a retailer intervention. Evaluated changes in public opinion associated with a media campaign to prevent youth access.
Teall 2001	No intervention evaluated; baseline assessment of youth access.
Thomson 2004	Not a direct assessment of a retailer intervention. Telephone survey used to evaluate whether adolescents' perceived ease of access, purchase attempts and tobacco use was associated with level of access regulations in their community.
Thomson 2007	Not a direct assessment of a retailer intervention. Follow up of cohort from Thomson 2004 used to evaluate associations with progression to smoking.
Wichita 1996	Intervention was citation or commendation of clerks by citizens in a community coalition. Both alcohol and tobacco sales targeted. No data on number of stores selling tobacco, or number in which intervention was delivered.
Woodruff 1995	Intervention to reduce sales of single cigs, with no control group. Test purchasers were 19 to 32, not adolescents.
Woodruff 2003	No intervention. Longitudinal study of access-related predictors of trial smoking
Zubow 1994	Identified from a secondary source (Levy 2002), original report not obtained. Pre/post study, moderate effect of compliance checks consistent with other studies.

DATA AND ANALYSES

Comparison 1. Effects of retailer interventions

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 All Outcomes			Other data	No numeric data
1.1 Controlled studies			Other data	No numeric data
1.2 Uncontrolled studies			Other data	No numeric data

Analysis 1.1. Comparison 1 Effects of retailer interventions, Outcome 1 All Outcomes.

All Outcomes

Controlled studies					
Central Coast 1996	Active enforcement with publicity (7 prosecutions)	No control for sales rates. Compliance amongst retailers near high schools increased from 69% in Dec 1994 to 92% in May 1996. Equates to a drop in potential retailers from 41 to 10. In additional random checks over a wider area, compliance between 96-100%	(Tutt 2004) In 1993 83% of smokers reported purchase attempts in past month, falling to approx. 44% in 2002. This equates to 21.6% of all 12-17 year olds making attempts in 1994 falling to 5.7% in 2002 as a result of reduced smoking rates and fewer smokers making attempts.	Monthly smoking rates fell sharply in Central Coast between 1993-1999 (>25% to 17%), and to 13% in 2002 (Tutt 2004). Monthly smoking rates in New South Wales remained stable at approx 25% between 1993 & 1996, and fell to just over 20% in 1999. Greatest impact was reported for the youngest (12-13y) and lighter (<5/day) smokers.	
Chicago 1993	Active enforcement (with different scheduled frequency)	Baseline sales rates were high and similar across all interventions and communities - 86-89% over 5 months. Sales decreased in all conditions following warning. For last 6 months of intervention, average sales rates were 19% in 2 month, 34% in	Not assessed	Not assessed	Sales were higher to girls during baseline. Publicity about the project caused a decrease in sale in all conditions in months 11/12, and this contributes somewhat to the low average rate in 2-month condition, but rates

All Outcomes (Continued)

		4 month and 42% in 6 month condition.			were =<20% at 5 of the monthly assessments
Erie County 1987	Mailed educational package	There were no significant differences in illegal sales between intervention and control groups (77% vs 86%).	Not assessed	Not assessed	40% of intervention stores posted the warning signs provided, no control stores had warning signs.
Erie County 1995	Enforcement (with different numbers of checks) compared to warning only	There were 44 violations/385 checks. Only one store fined twice. The baseline compliance rates were similar in enforcement (36%) and nonenforcement (35%) communities. Rates at follow-up were 74% and 72% (difference NS). Rates were similar in stores that had and had not been fined. Signif change in asking for ID from baseline. Additional data from Cummings 2003: 6/12 achieved compliance rates over 80% (average 89% vs 71% in remainder).	Data from Cummings 2003: No average change in perceived access, >=80% classified as easy at both times. Ease of access was unrelated to intervention condition or retailer compliance.	Change in smoking behaviour was unrelated to intervention condition. In a secondary analysis prevalence of past 30-day smoking remained stable in 6 communities achieving over 80% compliance and increased by 18% in the remaining communities (p=.06) Frequent smoking decreased by 16% in over threshold communities and increased 28% in others (p=.04)	Schedule for number of checks not adhered to. Lack of differential effect for enforcement may be due to the prior warning and widespread publicity about the sting operations in all communities. Also coincided with FDA's proposed regulations, and tobacco industry mailings.
Gateshead 1996	Enforcement (intended)	Only assessed as part of intervention. No checks in control area.	Few children reported being refused sales and there was no change over time. Over half of regular smokers bought cigarettes every day.	There were no significant changes in smoking prevalence. Regular smoking was more prevalent in the intervention school before and after.	No illegal sales were made during the intervention compliance checks.

All Outcomes (Continued)

Harlem 1993	Enforcement or education	Baseline sales were high; 70% sold loose and 98% sold loose or packet. No significant group differences at baseline. Control group showed no significant change over time. Both education and enforcement group sales declined from baseline to 6 and 12 months but there was a clear benefit of the enforcement strategy (From 100% to 47% for any sale at 1 year.)	Not assessed	Not assessed	Provides evidence for superiority of enforcement over education although compliance rates still only 53%. Enforcement intervention was delivered twice, with assessment 6m later. Effect could have lapsed over time.
Massachusetts 1994	Enforcement compared to information alone	There were no significant differences in baseline intervention and control compliance rates (35% and 28%). Compliance increased among the merchants in all communities but more rapidly in intervention than control according to a mixed-effects model with adjustment for time point, type of store and type of sale. Most effects in first 6 months, with rise to >70% compliance in intervention areas. Final compliance rates 82% in intervention and 45% in control areas.	Young people's self reported difficulty in buying cigarettes increased over time but there were no differences between the intervention and control groups. There were similar shifts in the sources of tobacco in the two groups with a reduction in the proportion buying their own in their community.	There were significant differences between intervention and control communities at baseline and both follow-ups even after adjustment for age, sex and ethnic group. The rate of current tobacco use rose slightly in the intervention communities but remained stable in controls, with borderline significance. No other measures of use changed differentially.	Compliance never reached the target 90% rate although it was >70% for 18m.

All Outcomes (Continued)

Monterey 1994	Community intervention with retailer education	Proportion of successful purchases fell from 75% to 0% in intervention and from 64% to 39% in comparison communities. The difference was statistically significant towards the end of the assessment period. Sales rate in intervention communities <20% at final 4 assessments. Proportion of clerks asking for ID rose more in intervention communities.	Intervention community 7th graders were less likely to report tobacco purchases at survey points 2 and 3, and 9th graders less likely to do so time 4	Cross sectional analyses of smoking behaviour (30 day tobacco use) found an effect on 7th graders which was not sustained to the end of study, but no significant effect in other grades. A longitudinal analysis of grade cohorts using generalized estimating equations found a significant effect favouring intervention communities only for the 7th grade. Females in intervention communities less likely to use tobacco post intervention than in comparison communities.	Baseline tobacco use was significantly higher in intervention community 11th graders (survey method different). There was some evidence that in the intervention community more youths perceived that others relied on social sources for tobacco and also perceived the use of fake IDs or stealing to be more commonplace. Authors suggest that 30 day smoking prevalence, may not be a sensitive enough outcome to pick up possible reductions in use.
New South Wales 1994	Education, or education and threat of enforcement	Baseline differences not significant. There were no intervention effects on compliance (requiring proof of age); there was a pre to post-test increase across all groups in the number of retailers requiring proof of age (17% to 43%) but no differences between intervention and control.	Not assessed	Not assessed	There were no effects on retailers' knowledge of law, which was already high. There were small changes in attitude. The overall improvement in compliance may have been due to the survey of retailers, contamination between groups, or media reporting of another compliance study.
San Diego 1991	Retailer education with community awareness	Baseline sales rates were 70% intervention/65% control. Intervention stores showed a significant	Not assessed	Not assessed	Some differential effects were noted for retailer type. Supermarkets maintained a high sales rate not

All Outcomes (Continued)

		decrease to 32% after intervention (X2 =35.11, p<0.001). Control stores showed a non significant reduction to 59%. This may reflect a limited impact from the media element of the campaign. Results were similar 6m later (Willey 1995)			significantly lower than their pretest rate (but only 16 in study). Results were similar in all areas except one which was predominantly African- American.
Santa Clara 1988	Retailer education (with/without personal contact) compared to community education alone	There was no differential effect on sales as a function of the type of contact project staff had with merchants. Baseline purchase rate was 74%. At 6 months 39%. Not sustained at 1 year success fell 18% to 56% (95% CI -4, -31). There was no change in vending machine sales.	Not assessed	Not assessed	Stores that received an education kit in the mail or a personal visit from project staff increased the posting of warning signs significantly more than did stores exposed to community education alone.
Sydney 1992	Threat of enforcement	The combined effects of publicity about undercover buying operations and warning letters threatening prosecution reduced sales of cigarettes to minors by 29% (95% CI 8% to 50%). 31% of retailers receiving warning letter sold at T2 compared to 60% of those not sent letter. However amongst the 146 retailers who	Not assessed	Not assessed	

All Outcomes (Continued)

		had not sold at T1 and were resurveyed, 24% did sell at T2.			
Sydney 1995a	Retailer education and community awareness	Not assessed	Ease of purchase was rated as being greatest from vending machines (93% rated as easy or very easy) and lowest in s'markets (60%). The proportion of males in the intervention area who rated purchasing from petrol stations as easy or very easy was significantly lower post intervention but no other significant changes were noted.	In some school year/ gender sub-groups there were significant changes in prevalence from baseline, In the intervention group, 2 were decreases and 3 increases. In the control group there were 2 increases. When logistic models were used there was only an indication of the effect of the intervention in year 7, the youngest students.	Estimated survey response rates were lower in control than intervention area at baseline. At follow-up response rates similar; lower than at base in intervention and higher than base in control area
TPOP 1996	Comprehensive community intervention	There was a decline in over the counter purchase success in all communities, from 36.7% to 3.1% in intervention, 41% to 8.8% for control. The net difference did not reach statistical significance.	Perceived availability from commercial sources was high in all communities but there was a small decline in intervention areas (79.8% to 77.2% rating as high). There was also a decline in proportions citing a commercial source for most recent cigarette and making a purchase attempt in last month in intervention vs an increase in control areas.	Baseline prevalence was marginally lower in intervention than control communities. Prevalence of all levels of smoking climbed sharply in control communities over the early course of the study, the increase in the intervention communities was less pronounced. The difference in prevalence was only significant for daily smoking (-4.9%, 95% CI -9.0, -0.7). Effects were homogenous across gen-	Other findings: No differential in increases in requests for ID. Cigarettes became more likely to be stored behind the counter (Signif), and signs posted (NS) in the intervention counties. By 2000 by difference in prevalence was no longer significant, and the communities had very similar ordinance scores.

All Outcomes (Continued)

					der and grade. For daily smokers there was a non significant trend towards greater effectiveness among younger students.
Uncontrolled studies					
Alberta 1991	Legislation and education	There was some reduction in willingness to sell in all three communities. Community A pre 62.5% post 41.9% (NS), Community B: pre 40.5% post 37.5%(NS): Community C pre 57.1% post 14.3% (p<.02)	Not assessed	Not assessed	Knowledge: Pre-programme knowledge of the act was high in the two large communities (96% and 91%). In the smallest community pre-pro-gramme knowledge of the programme was 42.8%. This improved to 85.7% post-programme.
Bristol 1983	Retailer education and publicity	91% (N=100) sold at baseline, 44% (N=50) sold at 1 year. 75% displayed signs stating the law.	Not assessed	Not assessed	New guidelines and publicity materials were issued nationally between baseline and follow-up
California 1995	Implementation of legislation	Purchase rate declined over period. Time 1-41.2%, time 2-32.3%, time 3-34.7%, time 4-12.7%, time 5-15.2% Trend was significant	Not assessed	Not assessed	
Cook County 1996	Education and warning	120/129 non compliant stores revisited. Purchase success rate fell to 51%	Not assessed	Not assessed	
Everett 1990	Legislation	Not assessed	More students reported retailers ask-	Tobacco use fell from 25.3%	

All Outcomes (Continued)

			ing for proof of age after the intervention (P=0.008)	to 19.7% (not stat. sign.), but reduction amongst girls was significant (26.4% to 11.5%). Stores as a source of tobacco products did not change significantly, but some reduction was noted post intervention. Friends increased as a source of tobacco products post ordinance (P=0.04).	
Fort Morgan 2007	Enforcement	495 purchase attempts over 9 months. Purchase success rate fell from 48% in week 1 to 0% between weeks 29 and 35	Bought cigarettes decreased as source (active smokers, ever bought fell from 40.8% in 2004 to 25.7% in 2005 p<0.05). Stolen cigs fell as source. Small increase in reported frequency of being asked for proof of age, but 45.9% of those who had attempted purchase in past 30 days still said they were never asked and 50.4% said they were never refused post intervention.	Prevalence of current smoking in students aged 14-15 fell from 22% in 2004 to 16% in 2005 (p<0.01). Changes in other age groups not significant.	Cigarette supplies decreased as measured by frequency and number of cigarettes typically carried by smokers. Proxy buyers remained commonest source.
Illinois 1999	Enforcement	In 4 towns only enforcing sales laws, compliance increased from 69% to 83%. In 4 towns also enforcing possession laws, retailer compliance increased from 79% to 96%. The changes over time were significant.	Not assessed	Not relevant to review: Grade cohort followed, so rates increased, not possible to assess impact of enforcement alone.	No information as to why baseline compliance rates might have differed at baseline between intervention groups

All Outcomes (Continued)

Larimer County 1999	Legislation	Compliance increased from 66% average over 5 years prior to ordinance introduction to 86% shortly after passage, and 94.2% after 1 year	Not assessed	Not assessed	
Leominster 1991	Education and enforcement	Sales were refused in 81%, 84% and 35% of tests at each follow-up. No baseline assessment of sales rates and different ages used for test purchasing.	Not assessed	Smoking prevalence fell significantly in 12-13 and 16-17 age groups.	
Manly 1995	Community intervention and retailer education	Purchase success fell. At baseline 52% of outlets sold (85% if up to 3 attempts), fell to 26% (55% if 3 attempts) at 3 months and 14% at 10 months	Not assessed	Not assessed	
Ontario 1992	Retailer education	In KFL&A willingness to sell fell from 46% at baseline to 43% after general education and to 6% after receiving kit. There was also a marked effect in H&PE, 47% to 2%, but this was measured just one week after the intervention. There were national events which could have contributed to the change in KFL&A in 1993, but no effect was apparent in	Not assessed	Not assessed	Different numbers of stores were tested at each assessment and there is no information about stability in behaviour over time.

All Outcomes (Continued)

		H&PE where baseline rates in 1994 were similar to those over 2 years previously in KFL&A.			
Oregon 1995	Community intervention, retailer education and positive reinforcement	When the results of multiple assessments pre- and post intervention in eight communities were combined, there was a significant reduction in the mean level of sales, from 57% to 22%.	Not assessed	Not assessed	Changes in individual communities were not all significant. The community with the least change had low baseline sales rates.
Perth 1994	Comprehensive including community awareness, education and enforcement	At baseline 89% of outlets prepared to sell. At follow-up overall rate fell to 28%.	Not assessed	Not assessed	Substantial variation by area - from 9% to 67% at f-up. One pair of assessors had much higher rates than other. Success less likely if another customer in store.
Philadelphia 1998	Legislation, Enforcement, community education	1994 (n=102) 85% sold 1995 (n=131) 70% 1996 (n=136) 84% 1997 (n=781) 61% 1998 (n=499) 52%	Not assessed	Not assessed	
Solana County 1990	Retailer education followed by enforcement	73% (n=169) sold at pretest, 68% sold at posttest 1 (n=83) (after education), 31% sold at posttest 2 (n=145) (after enforcement).	Not assessed	Not assessed	The reduction in over the counter sales was very significant, 71% to 24%, P<.0001) whilst vending machine sales remained high.
St Paul 1990	Vending machine locks	1 year after the law 47% of businesses had installed devices and 30% were still not in compli-	Not assessed	Not assessed	

All Outcomes (Continued)

		ance. Overall purchase success rate was 86% before law, 30% at 3 months and 48% at 1 year. Where a locking device had been installed purchase success was 19% (6/32) at 3 months and 39% (14/36) at one year.			
Stirling 1997	Warning of enforcement	At baseline 37% sold. Of 13 revisited, only 1 sold at follow-up. Amongst outlets visited for first time at follow-up survey, sales rate 35%, similar to baseline.	Not assessed	Not assessed	
Sydney 1995b	Education (warning letters) and publicity)	At baseline 84% of shops prepared to make sales, 74% of them at first attempt. At follow-up sales rate fell to 55% (31% at first attempt). For shops which sold at baseline, rates fell to 61.5%. There was no significant difference between rates for hand delivered (65.5%) or mailed (57.6%) warning letters.	Not assessed	Not assessed	
Sydney 2000	Enforcement	No pre- post compliance testing. During checks 66% compliance at initial test, 72% when offenders rechecked. 9 prosecutions and 8 fines resulted	Rated ease of purchase fell for most categories of shop but still remained high. No reduction in small general stores where 80% rated easy or	Little change in any measure of smoking, except significant increase in female never smokers: 1995: 9.0% daily smokers, 10.5% oc-	

All Outcomes (Continued)

			very easy. This category had been the focus for checks in the enforcement programme.	casual-ly, 21.8% past but not previous month, 58.7% never smokers 2000: 9.2%, 10.9%, 17.3%, 62.7%.	
Wisconsin 1993	Education and feedback	Of 60 surveyed twice, 40% permitted purchase at baseline and 18% at follow-up. Of those who permitted purchase at baseline 25% permitted at f-up. Those surveyed twice were more likely to have been non compliant at baseline than the entire sample, of which only 27% permitted a purchase.	Not assessed	Not assessed	
Woodridge 1991	Legislation	Sales were reduced to a minimal level for the first 2 years after passage of legislation, as measured by quarterly compliance checks. In later periods youths were older and sales rates also rose. When a 17 year old was used 25% sold illegally.	In 1991 69% of students felt the law would either prevent their procurement of cigarettes or make them harder to obtain. In 1996 more Woodridge smokers felt it was difficult or moderately difficult to get cigs than smokers from another community (20 vs 14.3%, NS). In 1997 45% of junior high students thought it was difficult or moderately difficult to get cigarettes. Smokers	Between 1989 and 1991 the proportion of 7th-8th graders describing themselves as regular smokers fell from 16% to 5% and experimenters from 46% to 23%. In 1996 there were significantly fewer smokers amongst a sample of Woodridge students compared to students at the same school from a non enforcement community (42.2 vs 54.7%, P<.05). The	50 minors were ticketed for possessing cigarettes in the 18 months after legislation.

All Outcomes (Continued)

			estimated that they were successful in 3.4/10 attempts to purchase cigarettes.	difference in regular smoking was 8.3 vs 13.4% (NS). In 1997 5.3% of junior high students were regular smokers and 13.7% social smokers	
--	--	--	--	---	--

WHAT'S NEW

Last assessed as up-to-date: 30 April 2008.

1 May 2008	New search has been performed	Updated with one new study (Fort Morgan 2007), Small changes to Background and Discussion sections to cite recent reviews and related research, no change to conclusions
1 April 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 2, 1999

Review first published: Issue 4, 1999

9 November 2004	New citation required and minor changes	Four new studies and additional data on two others. Discussion expanded with additional references, no change to conclusions.
-----------------	---	---

CONTRIBUTIONS OF AUTHORS

TL and LS have both extracted data and written the first version of the review and all updates.

DECLARATIONS OF INTEREST

None

SOURCES OF SUPPORT

Internal sources

- Imperial Cancer Research Fund General Practice Research Group, UK.

External sources

- NHS Research & Development Programme, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Adolescent; Adolescent Behavior; Age Factors; Commerce [*legislation & jurisprudence]; Smoking [*legislation & jurisprudence; *prevention & control; psychology]; Social Control, Formal; Tobacco Industry [*legislation & jurisprudence]

MeSH check words

Child; Humans