Alcohol Availability Trends in Australia: A Review

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# Glossary of Terms

**Alcohol availability** The ease or convenience for consumers to obtain alcohol

**Hotel licence** A longstanding licence category, originally requiring also that overnight accommodation be supplied, which typically allows off-premise as well as on-premise sales

**Licensing system** A method for controlling the sale and distribution of alcohol by way of licenses granted by the state or local government to appropriately qualified persons

**Off-premise outlets** Places licensed to sell alcohol for consumption off the premise (e.g., packaged liquor outlets, ‘take-away’, bottle shops, ‘drive-throughs’ and supermarkets)

**On-premise outlets** Places licensed to permit the sale of alcohol for consumption on the premise (e.g., hotels, bars, clubs, restaurants). There are often separate categories of on-premise licences

**Outlet density** The number of places where alcohol may be sold for consumption (whether on- or off- the premises, or both) in a particular area

**Restricting alcohol availability** Making alcohol harder to obtain

**Trading hours/Hours of sale** Hours of the day in which it is legal to sell alcohol beverages for consumption; hours are often different for on- and off-premises

# Abbreviations

**COAG** Council of Australian Governments

**IPV** Intimate Partner Violence

**LRB** Licence Reduction Board

**NCC** National Competition Council

**NCP** National Competition Policy

# Executive Summary

Alcohol is associated with a wide range of health and social problems in Australia and regulating alcohol’s availability is a key component of a public health-oriented alcohol policy. There is strong international evidence that demonstrates links between the physical availability of alcohol (in terms of outlet numbers and hours of sale), alcohol consumption and alcohol-related harm.

We conducted a systematic search of peer-reviewed articles published from 2005 to 2015, which investigated associations between alcohol availability and alcohol consumption and alcohol-related harms. The review identified 191 relevant publications which assessed impacts of alcohol availability either in terms of the number and density of outlets or their hours of operation. A supplementary literature search was conducted for research examining changes to alcohol availability in remote Aboriginal and/or Torres Strait Islander communities.

Our findings are summarised below in sections reflecting the different types of restrictions reviewed in the main body of the report.

*Restrictions on trading hours*

* There is strong and consistent evidence from Australia showing reducing trading hours for bars, hotels and clubs late-at-night can substantially reduce violence. A growing body of international research supports this finding, although some studies on a relaxation of trading hours from England and Wales find inconsistent evidence on an effect on alcohol-related harms.
* Despite this slight inconsistency, the body of evidence is strong enough to consider restrictions on late trading hours for on-premise outlets as a key approach to reducing late-night violence in Australia.
* There is insufficient evidence on the impact of restricting trading hours for packaged liquor outlets, although the overseas studies that do exist point strongly towards effectiveness in reducing harms for young people.

*Outlet density*

* In general, there is high-quality, locally relevant research that alcohol outlet density is associated with violence. This is found for both on-premise and packaged liquor outlets, however, the effects from packaged liquor outlet density may be affected by the volume of alcohol sold (i.e. two small outlets may contribute less to violence compared to one larger outlet).
* There is good evidence that alcohol outlet density is associated with morbidity and mortality.
* There is some evidence which suggests that outlet density is related to both risky drinking among adults and intimate partner violence, although more work is needed in both areas to resolve uncertainties. It is helpful that there is one longitudinal study from Australia on the relationship of outlet density and intimate partner violence; however, there were limited control variables used in that study, so the findings need to be interpreted cautiously.
* Studies from overseas suggest outlet density is positively associated with child maltreatment, sexually transmitted infections, and suicide, although studies of these outcomes remain limited to settings not necessarily reflecting Australian conditions.
* The evidence on impacts of outlet density on traffic accidents and drunk-driving, as well as on underage drinking, is mixed.
* There remain substantial weaknesses in the outlet density literature, and improvements in data and analytical approaches are needed to ensure the best quality evidence is available to inform policy. This includes refining the categorizations of alcohol outlets and taking into account potential variation of the effect of outlet density on outcomes across neighbourhoods.
* Inconsistent approaches to operationalizing both a measure of availability, and a measure of availability in a geographic area (i.e. density, proximity etc.) remains a major stumbling block to developing a clear picture of the actual relationship between alcohol availability and various outcomes, and future research is necessary to explain why different measures produce different results.
* The use of sales data in research has been constrained by their lack of availability. However, research that does incorporate sales data, suggest the amount of alcohol sold significantly predicts local problems. There is a need for detailed alcohol sales data to be collected in each state and territory and made available to researchers.

*Restrictions on off-premise alcohol sales in remote communities*

* Restricting the availability of particular alcoholic beverage containers or forms, even those used by the most problematic drinkers, in the absence of limits on other containers or forms, is unlikely to have more than a limited effect.
* In contrast, a substantial restriction or ban on off-premise sales is likely to have more substantial effects in remote communities or other circumstances where access to alternative sources is limited.

## Implications for policy and regulations

* There is sufficient evidence to conclude that decreasing hours of sale at on-premise outlets reduces alcohol-related harms.
* There is some evidence that decreasing hours of sale at packaged liquor outlets reduces harms among adolescents and young adults, although this evidence comes from Europe and the results may not be generalizable to Australia.
* Despite the limitations mentioned above, the body of research on alcohol outlet density suggests that the regulation of outlets would be a useful public health tool for the reduction of risky drinking and alcohol-related harm.
* There are very few evaluated studies of licensing policy changes to limit growth in licensed premises. There is some evidence that ‘Cumulative Impact Zones’ which introduce the presumption that applications for new licences will not be granted in specified areas, have reduced alcohol-related harms in the UK.

# Introduction

In terms of both health and social harms, alcohol is one of the most harmful substances regularly consumed by humans (1, 2). On a global basis alcohol is among the ten most harmful “risk factors” to health (3), and is a potent source of such harms in Australia (4). Alcohol is also a harmful risk factor in social harms, both to those around the drinker and more broadly in the society (5). Given the harm caused by alcohol, governments impose regulations on alcohol’s availability to mitigate the adverse effects of alcohol while not prohibiting its availability.

The focus of the current report is on the impact of changes in alcohol’s availability on alcohol consumption and alcohol-related harms. Specifically, this report aims to systematically review the recent research evidence on the association between alcohol availability, alcohol consumption and harms as well as provide a contemporary account of the way alcohol is currently available in Australia.

This introductory chapter provides a definition of ‘alcohol availability’ and a description of how this is regulated in Australia. The chapter concludes with an overview of the structure and scope of the systematic review.

## What is meant by ‘Alcohol Availability’?

Alcohol availability refers to the physical availability of alcohol as well as the convenience of access (6: 127). Physical availability contrasts other ways alcohol is available that effects its use, such as affordability. Alcohol availability is frequently regulated by laws on the number and type of licensed premises, as well as the hours and days in which outlets are permitted to trade. Liquor licensing laws in each Australian State and Territory have key control over these factors, although local governments are given some powers to regulate these characteristics, primarily through land use planning laws (7). Beyond the permissible number and type of licences and the hours and days in which they may trade, other ways in which the retail availability of alcohol is regulated is through setting minimum purchase ages. Though it is not focused on here, the price of alcohol beverages, which can be influenced by taxes and other government market interventions, can be regarded as yet another dimension of availability. The retail availability of alcohol may also be influenced by approaches beyond liquor licensing. For example, land use and planning policies, administered by local governments, can influence the conditions under which building permits for liquor licences are issued and the size of parking lots approved for new bottle-shops limit, in some way, the capacity of customers to access and easily purchase quantities of alcohol.

This report focuses on trends in the number of licensed premises and the hours in which they are open. We also conducted a supplementary search for research examining restrictions and bans of alcohol sales in Aboriginal and/or Torres Strait Islander communities.

A range of different liquor licenses are available under state and territory liquor acts. The most relevant categories to us are:

* On-premise licences (i.e. bars, clubs, restaurants), which authorise the sale of liquor for consumption on-premises, and
* Packaged Liquor licences (i.e. bottle-shops), allowing for the supply of liquor for consumption off-premises.

Hotel licences (pubs), allow for the supply of liquor for consumption both on- and off- premises, but are generally counted as on-premise outlets in Australian research.

## Regulatory frameworks governing alcohol availability

Government controls over the availability of alcohol are very common. In some countries, alcohol availability is controlled through monopolies on retail sales – a measure used only in local circumstances in Australia (8). More commonly, liquor licensing systems regulate the availability of alcohol (over 130 countries have some form of licensing system for selling alcohol (9)). Licensing regulates who can sell and purchase alcohol, and places conditions on where (the density of outlets), when (trading hours) and how (license conditions) alcohol can be sold.

In Australia, licensing is a state and territory function – retained as a state function when Australia federated in 1901. While some licence conditions are consistent across borders, such as mandatory ‘responsible service of alcohol’ training and a minimum legal purchase age of 18 years, there is variation in the categories of licences available (e.g., NSW has seven licence types the Northern Territory has five), the conditions attached to each type of licence as well as to the permissible trading hours and process for granting new licences.

## Report overview

### Scope

This report draws primarily on a systematic review of the peer-review literature on the association of alcohol availability, alcohol consumption and harms. The report focuses on two main areas: the density of alcohol outlets and the permissible trading hours. The report concentrates on research conducted over the past 10 years (2005-2015), although studies of significance to Australia published since 2015 are noted. A supplementary search was conducted for research examining restrictions and bans of alcohol sales in Aboriginal and/or Torres Strait Islander communities.

### Structure

Alcohol has become more available in Australia in terms of access through off-premise sales, web-based purchasing and growth of big-box package liquor with heavily discounted alcohol. The next chapter summarizes how alcohol availability has changed in Australia overtime. It provides a review of the major policy changes in alcohol’s availability in Australia from the turn of the nineteenth century on, as well as a summary of the studies of policy impacts prior to 2005.

The review in the remainder of the report consists of three major chapters pertaining to different aspects to regulating the availability of alcohol in Australia. The first is regulating the hours during which alcohol can legally be sold. The second is studies on the number and density of alcohol outlets; there is a substantial body of research in this area. Lastly, studies on the effect of bans or restrictions on off-premise outlets in Aboriginal and/or Torres Strait Islander communities are reviewed. The structure of these chapters vary depending on the extent and nature of the body of research. The chapter structure is described at the beginning of each chapter. The methods are described in the Appendices.

# Trends in alcohol availability in Australia, 1900 to the present

***Chapter Summary***

* From 1900 up to about 1930 the implementation of restrictive alcohol policies was driven by the influence of a politically engaged and popular temperance movement. This led to a sharp decline in the number of hotels and, with 6pm closing enforced in most states, to reduced trading hours.
* From the 1950s, Australia began to relax its licensing controls: trading hours were extended, the kinds of outlets permitted to sell alcohol were expanded, and the number of outlets (especially non-hotels) began to rise.
* Legislative reforms during the 1980s and 1990s greatly liberalised licensing: available licence types were streamlined, and greater options for extended trading hours were introduced, along with the removal of a range of restrictions for obtaining a licence. Indices of alcohol-related harms increased alongside increases in availability.
* Competition reforms in the early 2000s greatly increased the influence of Woolworths/Coles in the packaged liquor market and there was a sharp rise in ‘big-box’ stores as a proportion of all packaged liquor outlets. Flexible licensing laws meant one could sell alcohol without providing food facilitating leading to a rise in small bars in many capital cities.
* Trading hours continued to be extended in the first decade of the 2000s but some restrictions have since been implemented around Australia aiming to reduce the late-night availability of alcohol to prevent violence and acute injury late at night.

## Introduction

The empirical work of this review focuses entirely on research on changes in alcohol availability, alcohol consumption and alcohol-related harm published over the decade 2005-2015. This period captures sharp increases in alcohol availability in Australia associated with legislative liberalisation in the late-1980s, 1990s and the 2000s, which will be described in detail below. This chapter provides a historical overview of licensing policy in Australia. It seeks to put contemporary policy developments into historical context.

While it obviously represents a simplification, for the sake of clarity this history is summarized in four stages:

1. Turn of the century until World War II
2. World War II until the 1980s
3. Liberalisation in the 1980s and 1990s
4. The new millennium (from 2000 until the present day)

In addition to reviewing policy change, the chapter also includes summaries of the research on the impact of these changes. Impacts of recent policy changes will be included in the results of the systematic literature review that follows.

It is worth noting that up until the 1970s, hotels (which were, and still are, able to sell alcohol for both on- and off-premise consumption) were the predominant source of alcohol sold in Australia. For example, Merrett (10) reports that hotels accounted for around 80% of all alcohol purchases between 1917 and 1968. Thus, the regulation of alcohol availability in Australia has historically been largely the regulation of hotels.

## Turn of the century until World War II

The late 1800s saw the growth of a strong temperance movement across Australia (and indeed internationally) (11), leading to increasingly contested regulation of the alcohol industry. Alcohol consumption peaked in the 1880s (12) and, under pressure from organised temperance groups, and a shift in public attitudes towards drinking, the state governments began to implement more restrictive alcohol policies (13). This began with a shift to local control after a period of relatively unrestrictive state licensing laws for most of the 1800s. In most states new laws provided that a poll of local ratepayers (‘local option polls’) was required before any new hotel licence was granted in the local area. Restrictions were tightened further a decade later when statutory limits on the number of hotels in a municipality were introduced. In Victoria, for example, the 1885 Licensing Act introduced a cap of four hotels for the first 1,000 residents and one more for each subsequent 500 residents (14). In areas where the existing number of hotels exceeded these limits, the government began to slowly close down and compensate ‘excess‘ hotels, resulting in the closure of more than 200 hotels between 1886 and 1902 (13).

This trend to reduce licence numbers continued with the establishment of the Victorian Licence Reduction Board (LRB) in 1906. The LRB was introduced as a more efficient and effective method for closing hotels than local option polls. There was a similar body in Britain which reduced licences by a buy-back scheme, but in general, most temperance counties at in the very early century were toying with state prohibition rather than continued alcohol availability albeit under strict control. The LRB closed (and compensated) problematic or unprofitable ‘excess’ hotels. In the decade following its introduction, more than 1,000 hotels were closed (15). In NSW, after similar dissatisfaction with the slow rate of reduction in licences resulting from local option polls, an LRB was created in 1919.

Under pressure from temperance movements, many states extended their local option polls to state-wide polls (a trend again found internationally in countries with strong temperance movements). However, prohibition never passed at the state level in Australia – although alcohol was prohibited in the new National Capital Territory, Canberra, from 1911 to 1928. For example, in Western Australia, prohibition referendums were held in 1911, 1921, 1925 and 1950, none of which succeeded (13). In general, the support for prohibition had largely petered out by the 1920s and 1930s, by which time licence numbers had been reduced by almost two-thirds in all states (see Figure 1).

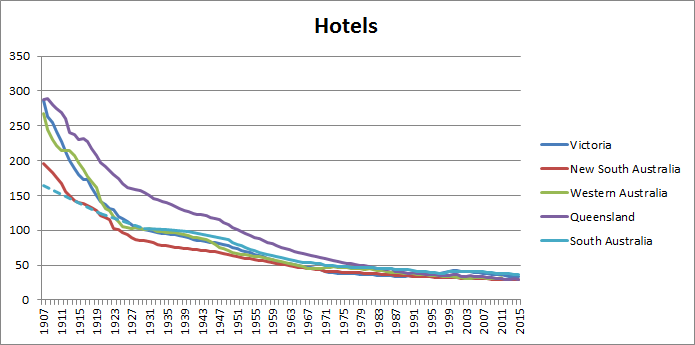


Figure 1 – Hotel liquor licences per head of population, 1900s- 2015, in five Australian states (sourced from annual liquor licensing reports)

In addition to restrictions on the number of outlets, the heavy regulation of the alcohol industry included restrictions on their permissible trading hours. During World War I, “6 o’clock closing” for all hotels was introduced by popular vote in four states, with Queensland following a few years later (13) (Table 1). However, with the influence of the temperance movement waning in the 1920s, the regulation of liquor entered a kind of stasis. LRBs greatly reduced their efforts in closing down hotels, instead focussing on improving the amenity of existing venues (i.e. carpets, accommodation and bathroom facilities). Overall, there was a focus on regulating the character of hotels, not just their number (10). The combination of the depression in the 1930s and the impacts of World War II in the 1940s meant that there was little regulatory change over these two decades (although the reduction in hotel numbers continued due to the depression (10)) – again see Figure 1.

Table 1 Restricted trading hours - ‘Six o'clock closing’.

|  |  |  |
| --- | --- | --- |
| **State** | **Adopted** | **Abolished** |
| [Tas](https://en.wikipedia.org/wiki/Tasmania)mania | 1916 | 1937 |
| [New](https://en.wikipedia.org/wiki/New_South_Wales) South Wales | 1916 | 1955 |
| [Vic](https://en.wikipedia.org/wiki/Victoria_%28Australia%29)toria | 1916 | 1966 |
| [South](https://en.wikipedia.org/wiki/South_Australia) Australia | 1916 | 1967 |
| [Queensland](https://en.wikipedia.org/wiki/Queensland) | 1923 | 1966 |

## World War II until the 1980s

In the decades immediately after World War II popular opinion turned decisively against the “wowser” tradition, as temperance sentiments in Australia had been dubbed. In line with this generational shift, restrictions on alcohol were considerably loosened, notably with the end of “6 o’clock closing” (Table 1) and the loosening of Sunday opening restrictions beginning in 1970. The limited early research on the effects of these changes, not generally methodologically strong, reflects a general scepticism about alcohol regulation, tending to cast doubt on their effectiveness, and a view that problems associated with alcohol availability rested more with the individual (16, 17).

A “restaurant licence”, that is, a permit for a restaurant to serve alcoholic beverages, was created in the post-World War II period and take-up of this licence accelerated from the 1970s (see Figure 2).

Figure 2 – Restaurant and bar liquor licences per head of population, 1900s- 2015, in five Australian jurisdictions (sourced from annual liquor licensing reports)[[1]](#footnote-1)

An exception to the general relaxation of Australian concerns about alcohol in the 1950s and 1960s was the increasing concern about drink-driving. The loss of young lives as drink-driving casualties was not something Australians could accept as inevitable. The result was that Australian legislators, police and researchers led the way internationally in this period in enacting, enforcing and evaluating drink-driving countermeasures, in particular in the institution of intensive programs of random breath testing as a general deterrence measure (18).

By the late 1970s, in the wake of a substantial rise in alcohol consumption levels and problem rates in all the countries with strong temperance traditions (19, 20), there began to be renewed attention in a number of countries to social and health problems related to alcohol. In connection with this, there was a revival of interest in alcohol controls (21), and in measuring their effects. The publication in 1975 of an international collaborative report on *Alcohol Control Policies in Public Health Perspective* (22) signalled the need for the development of an international literature measuring the effectiveness of different policy options.

Australia lagged somewhat in this trend, in the absence of established institutions for alcohol research. However, one researcher in a state alcohol and drug authority, D. Ian Smith, did take up the issue of studying alcohol policy changes in Australia, and in the period 1978-1990 contributed over half the studies on alcohol policy impacts then completed in Australia (see 23).

From the 1950s up until quite recently, the direction of development of Australian alcohol policies has been primarily towards greater availability. As a result, as in the Nordic countries (24: 7), Australian studies of general alcohol controls have measured the results of change primarily in one direction: changes which increase the availability of alcohol. Here the results of the main Australian alcohol policy impact studies in this period are summarized.

### Removing restrictions on Sunday opening

A series of studies by Smith examined the effects of introducing Sunday opening of hotels (pubs) in different Australian cities or states in the course of the 1970s and 1980s. The introduction of Sunday opening in Perth in 1970 was associated with a significant increase in the proportion of traffic casualty accidents and deaths occurring on Sundays, compared with the rest of the state (25). The introduction of Sunday afternoon and evening opening in New South Wales in 1976 was associated with increases of more than 20% in fatalities, admissions to hospitals, and other injuries from traffic accidents between Sunday noon and midnight, and a 14% increase in casualty accidents compared to Queensland specifically in the 6pm-midnight Sunday period, in comparison with no excess in other periods (26).

The introduction of two 2-hour Sunday drinking sessions in Brisbane in 1970 resulted in a more than doubled rate of casualty accidents in the two hours after the second session, compared to no significant change in other time periods or in the same period in a control site (27). On the other hand, the introduction of two 2-hour sessions of alcohol sales in Victoria in 1983 did not produce a special increase in casualty accidents on Sunday, probably because relatively few hotels and clubs implemented the sessions. But extension of Sunday opening to a noon-8 p.m. session in late 1984 was associated with a 45% increase in accidents in the four hours after the end of the session (28).

In general, these studies demonstrate an increase in traffic casualties in association with the inception of Sunday on-premise sales. It should be noted that many of these studies leave open the possibility that Sunday opening redistributed drinking and alcohol problems from other times of the week. However, this was addressed in the New South Wales analysis which found an overall increase in alcohol-related problems. Extensions of opening hours

The alcohol control change most studied in Australia is the extension or reduction of opening hours, primarily for on-premises consumption. The earliest modern study in this tradition, by Raymond (16), argued that the result of the change from 6 pm to 10 pm closing in Victoria in 1966 had been a change in the timing of alcohol-related traffic casualties, but not in the rate of such casualties. In a reanalysis, Smith (29) showed that there had indeed been a net increase in the number of traffic casualties – the increase in casualties seen after 10pm was over three times the size of the decrease seen after 6pm (the old closing time).

Another study by Smith (27) inaugurated a new tradition of studies on the more recent further extensions of licensing hours. In 1977, hotels in Tasmania, the earliest state to repeal 6 pm closing, were allowed to extend their open hours until a time of their own choosing, other than on Sunday morning and evening. The main net effect was to allow opening after 10 pm on six days of the week. Smith found a 10.8% increase in the number of traffic casualty accidents in the period from 10 pm to 6 am.

Two other studies have examined the effects of temporary extensions in opening hours during this period: in connection with the Commonwealth Games in Brisbane in 1982 and the America’s Cup in Fremantle in 1986. Smith (30) found that the Brisbane extension was not associated with additional casualty or property damage accidents. He hypothesized that an intensive traffic law enforcement campaign during the Games may have offset any effects of the extensions in hours. McLaughlin & Harrison-Stewart (31) used a before-after survey of males aged 18-28 in Fremantle and a control site to study the effects of the 1986 extension. They found that heavier drinkers were more likely than others to make use of the extended hours of sales. But there was no net increase in consumption reported by the Fremantle residents after the increase in hours.

### Lowering the minimum drinking age

A series of studies in the late 1980s by Smith examined the effects of the lowering of minimum alcohol purchase ages in the early 1970s from 20 to 18 (South Australia and Tasmania) or 21 to 18 (Queensland and Western Australia), using trends in another state and in older age groups at the same time as controls. In general, the studies found substantial increases in crime rates, both for the ages directly affected and for those younger than the new age limit (28). Effects on rates of traffic deaths and injuries were also found in three of the four states, though primarily confined to males (28, 32). A study of hospital injury admissions among young females in Queensland found a significant and substantial increase for 15-17 year olds after the lowering of the minimum drinking age (33).

The findings of significant increases for both genders on juvenile crime rates suggest that drinking and indeed intoxication increased among both genders, both for the legally affected ages and for the next age-grade below.

### Restrictions on off-premise alcohol sales of particular beverage types and large containers, particularly in remote communities

While the response of earlier Australian governments to the temperance movement concerning the population in general had been harm reductionist (e.g. early closing and licence caps), the response for Indigenous Australians was prohibitionist. In the 1960s the prohibitions on Indigenous Australians access to alcohol were removed. This change reflected the general mood of problem deflation concerning alcohol at the time but was framed in more general terms as part of according full citizenship rights to Aboriginal and/or Torres Strait Islander peoples. Though the effects of the change must have been obvious to bystanders at the time, it was only considerably later that the adverse health and social effects on Indigenous Australian drinkers and their communities began to find their way into the academic literature (34, 35).

There is one big exception to this direction of development, and it is an exception which has left a special mark on alcohol policy research. The exception is for Aboriginal and/or Torres Strait Islander communities in remote areas and small country towns. The adverse effects of alcohol on many of these communities and their inhabitants have become well recognized over time, not least by the communities themselves (35, 36). This has resulted in new restrictions, with a primary emphasis on off-premise sales, and particularly sales of the cheapest forms of alcoholic beverages (see Chapter 7). This constitutes a break with the historical emphasis of Australian licensing policy, which long placed primary emphasis on drinking in the hotel/pub, perceived a century ago as the main rival of the home and family for the leisure time of the male drinker (20).

## Liberalisation of licensing laws in the 1980s and 1990s

The process of liberalisation continued in Australian states and territories in the 1980s with only occasional and minor push back from temperance groups. In general, the view was held that the hours of trading and the number of outlets did not significantly affect consumption. As such, trading hours continued to be extended (including on Sundays) and new licence categories allowed alcohol to be sold at a wider variety of settings associated with increasing tourism and new leisure activities (e.g. al fresco dining, cabarets and motels). Increasing fines for drunk-driving and sales to underage consumers, the introduction of low-strength alcohol beer as well as investment in treatment systems were seen as positive measures to address alcohol-related harms.

Victoria led the way with removing restrictions on new and existing liquor licences. The Niewenhuysen review of Victoria’s Liquor Act in the mid-1980s, ushered in a new Act that removed many of the provisions that protected those already with licences from new entrants. In particular, hotels were no longer required to provide accommodation and smaller scale drinking venues were encouraged (13) – for the rise in ‘bar’ licences in Victoria (and then other states) see Figure 2. The other major states have followed suit, and this 1987 Act is often cited as ushering in ‘European style drinking’ and providing for Melbourne’s lane-way bars. Queensland committed itself in 1988 to liberalisation in the Niewenhuysen style (13: 94) and NSW introduced similar legislation in 2007 (37).

### National Competition Policy

The next major step in the process of licensing liberalisation came in the late 1990s, driven by the newly enacted National Competition Policy (NCP) and the competition principles agreed to by all states via the Council of Australian Governments (COAG) in 1995 (38). Under the NCP, states were required to review all legislation that restricted competition and to ensure that the public benefits of these restrictions outweighed the costs. Liquor licensing was a key area reviewed by the National Competition Commission (NCC). Under this pressure, there were a number of liberalisations of state licensing laws but not enough to satisfy the Commission; a number of states were eventually fined for maintaining provisions in liquor acts deemed by the NCC to be anti-competitive (39).

Studies on the effects of the changes in alcohol outlet density resulting from these changes are captured in our systematic review of the research evidence (Chapter 6).

## Alcohol availability in the new millennium

### Packaged liquor

The effects of the NCP were felt across most Australian jurisdictions, with amendments to liquor acts introduced in most states, almost entirely focussed on packaged liquor availability. Most notably, many jurisdictions had included some form of ‘needs test’ within their regulatory systems, which allowed for the refusal of a new licence on the basis that there were already sufficient outlets in a particular area (40). In Victoria, the 8% cap on the proportion of packaged liquor outlets that could be owned by a single entity was lifted, while in Queensland the number of packaged outlets that could be operated in conjunction with a hotel licence increased from one to three. As Jones has argued (41), these regulatory shifts had the effect of greatly increasing the influence of the two major grocery chains (Woolworths and Coles/Wesfarmers) on the Australian liquor market, who have a combined market share of over 60% of the packaged liquor market (42).

In most jurisdictions, the number of packaged liquor outlets has increased roughly in line with population growth since the competition-related reforms in the early 2000s. However, there has been a marked shift in the type of alcohol outlets, with a sharp growth in big-box liquor stores like Dan Murphy’s and First Choice. These stores, which typically sell alcohol more cheaply than other packaged outlets (43), have grown from just a handful in 2000 to more than 300 stores across Australia in 2017. Research has shown that this growth in big-box stores is likely to have contributed to increasing rates of alcohol-related harms, with a Western Australian study finding that the amount of alcohol sold was an important predictor of local level harms (44), while a Victorian study suggested that packaged liquor outlets run by the major chains were associated with higher rates of harm than independent outlets (45).

In recent years there has been a steady growth in online sales of alcohol as the major chains compete aggressively for market share (46). But online sales still represent a very small piece of the liquor market, with recent research estimating that just 2.5% of Australians who purchased takeaway alcohol over a four week period had used an online store (47). The regulatory mechanisms for online alcohol sales are still being refined and there are concerns about online retailers who provide short turn-around late-night deliveries of alcohol (48).

### The night-time economy

Throughout the first decade of the 2000s, most Australian cities saw a steady expansion of their night-time economies, with restrictions on late-night trading weakened or removed (49). However, since the late 2000s, public opinion has shifted towards greater concern about drinking-related problems (50) and towards more restrictive availability policies (51). In this context, some limited restrictions have been implemented around Australia aiming to reduce the late-night availability of alcohol. These include primarily lock-outs (whereby new patrons are not permitted to enter premises after a certain time), last drinks restrictions (whereby venues cannot sell alcohol after a certain time) or freezes on the granting of new late night licences.

The most well-known interventions have been the combined lock-out and trading hours restrictions implemented in two cities in New South Wales (Newcastle and Sydney), both of which have been shown to have reduced violence in rigorous evaluations (see Chapter 5 for more details). Similar restrictions on last drinks were recently implemented in Queensland, although the lockouts that were originally proposed as part of the intervention were recently scrapped under significant political pressure (52). Other jurisdictions have taken more gradual approaches to reducing the late-night availability of alcohol via freezes on new licences in particular areas. Freezes of late-night licences have been implemented in Melbourne, Brisbane and Sydney over the past decade, although there have no rigorous evaluations of this approach.

In spite of these restrictions, there has been a sharp growth overall in the number of on-premise liquor outlets across Australian jurisdictions (see Figure 2) which, alongside the previously discussed shifts in the packaged liquor market, means that the last fifteen years have seen a variety of important shifts in Australian alcohol availability. The following chapter will examine the Australian and international evidence assessing the relationship of alcohol availability to alcohol-related harms, summarising the likely effects of changing alcohol availability in Australia.

# Limits on Trading Hours

***Chapter Summary***

* Twenty-one studies examined the impacts of changes in outlet trading hours:
  + Thirteen studies reported on policies that extended permissible trading hours;
  + Seven studies reported on policies that reduced trading hours, and
  + One study reported on municipal policies that both extended and restricted trading hours.
* Only two of the 21 studies examine changing off-premise outlet trading hours, the remainder examine changing on-premise outlet trading hours.
* There was suffıcient evidence to conclude that decreasing hours of sale at on-premise outlets reduces alcohol-related harms.
* There is some evidence that reducing hours of packaged liquor outlets reduces harms among adolescents and young adults, although this evidence comes from a context where alcohol was much more widely available making the generalizability of such findings to Australia unclear.

## Sample

The 21 studies were of five events of increasing trading hours, four of reductions in trading hours and one of both increases and decreases in trading hours (Table 3). Studies were conducted in Australia (7 studies), UK (6 studies), Canada (3 studies), and one each from Germany, The Netherlands, Norway, Switzerland and the USA. Two studies examine impacts of changing off-premise trading hours, the remainder examine changing on-premise trading hours.

## Increasing hours of sale, particularly for on-premise outlets (e.g. bars, clubs and pubs)

Several studies have examined the impact of policies that have permitted the extension of on-premise trading hours by one hour. In 1993 Perth granted ‘extended-trading permits’ to some inner-city hotels, extending trading from 12am to 1am. Findings of two studies were inconclusive: there was some evidence of increases in traffic crashes (53) although the effects on the blood-alcohol level of drivers who’d been drinking at late-trading hotels were mixed (54). Three studies (55-57) examine the effect of a 1-hr extension of trading hours for on-premise outlets in Ontario in 1996 from 1am to 2am. One study found (55) no impact on assault rates, although this study did not include a control site. A further two studies found no significant impacts on motor vehicle crashes and drink driving (56, 57). Lastly, one study assessed the impact of a one-hour extension to closing times for licensed ‘eating and social establishments’ in the state of Minnesota in 2003 (58). The study found significant increases in motor vehicle crashes and drink driving incidents.

In 2005, a new Licensing Act came into effect in England and Wales (Licensing Act 2003), which repealed 11pm closing and permitted 24-hour trading. Six studies examined the effect of this policy (59-64); however, findings are somewhat inconsistent. One study found increases in hospitalisations for the relaxation (64). Four studies (59-62) examined the impact of these changes on violence, with the most sophisticated explicitly measuring the degree extensions to trading hours were taken up (60). None found any relationship between extensions in hours of sale and violence rates. A sixth study found that the extension to trading hours reduced rates of traffic accidents (63). Actual extensions to trading hours were modest (that is not all venues and only for an hour or two) (60). Furthermore, there had already been the potential for pubs to trade beyond 11pm through special entertainment permits (65 pp.39-60, 215-258). The trading hours at baseline and the limited and varying degree of change may be important factors for explaining the otherwise unexpected findings from this policy change.

## Decreasing hours of sale for on-premise settings (e.g. bars, pubs, clubs)

Five studies (66)assess two events of reductions in trading hours. All five studies come from recent policy changes in NSW, Australia. In 2008, a range of restrictions on hotels trading in the central business district of Newcastle were introduced in what is now colloquially called the ‘Newcastle solution’. The restrictions included closing hotels at 3:30am (initially 3am) and a lock-out from 1:30am (initially 1am). Three studies assessed the impact of this decrease in hours of sale. The first study (67), using a neighbouring suburb (Hamilton) as a control site, found a 37% reduction in assaults. Importantly, the control site implemented the same restrictions as Newcastle except for the lock-out and trading hours changes, meaning any differential effects could reasonably be attributed to these interventions. The second study found that the reductions in assault rates had been sustained five years after the intervention (68). Most of the reduction came after 3am, with little impact between 1am and 3am, suggesting that the trading hour restrictions and not the lock-out was the key policy. The third study (69) contrasted Newcastle with Geelong – a similar regional city centre in Victoria – to provide further evidence that trading hours restrictions are more effective than various policing and safety measures implemented in Geelong (e.g. safe taxi ranks, night watch radio program, ID scanners, high visibility policing).

In 2014, a similar set of interventions were implemented in central Sydney. Two studies have since examined effects of this event (66, 70). The first examined the impact of these restrictions on assault rates, with appropriate controls and tests for whether harms were simply displaced from the restricted areas to other parts of Sydney. The study found assaults dropped by between 26% and 32%. There was little evidence of displacement to other areas (see also (71)). This finding is supported by a less robust study of presentations to an inner-Sydney emergency department that found reductions in alcohol-related presentations following the intervention, particularly late at night (66).

## Decreasing hours of sale for off-premise outlets (e.g. bottle-shops, convenience stores)

Two studies focus on the impact of restricting trading hours of off-premise liquor licences (72, 73). A study based in Switzerland (72) examined the impact of two changes to the availability of take-away alcohol in the experimental area of Geneva compared to the rest of Switzerland between 2002 and 2007. In 2005 the Canton of Geneva banned the off-premise sale of alcoholic beverages between 9pm and 7am and banned their sale in gas stations and video stores. The authors found a reduction of 25%-40% in hospital admission rates for alcoholic intoxication among youth. The second study is based in Germany. It examined the impact of a 2010 ban on the off-premise sale of alcoholic beverages between 10pm and 5am in the German state of Baden-Württemberg on hospitalisations between 2007 and 2011. The authors found alcohol-related hospitalizations among adolescents and young adults dropped by approximately 7% (73).

## Increasing and decreasing hours of sale in on-premise outlets

One study (74) examined the impact of small changes (<2 hours) in late-night trading for bars in 18 Norwegian municipalities[[2]](#footnote-2). The study found each 1-hour change in allowable hours was associated with a 16% change in recorded assaults. This is the only study to include both extensions and restrictions on trading hours and the findings were similar for changes in both directions, adding more evidence that effects were causally related to the policy changes.

## Research gaps

The few studies of changes to off-premise trading hours have been conducted in Europe. In general, compared to Australia, alcohol is widely available for off-premise purchasing in Europe through gas stations, convenience stores and supermarkets. It would be useful to have studies of changes in off-premise outlets in Australian settings to confirm results from other settings. Policy changes in 2016 requiring 10pm closing for off-premise outlets in NSW, (since the Callinan Review rolled back to 11pm) provide an opportunity to examine this relationship in the Australian context.

## Summary

There are many studies that find reducing trading hours of alcohol-outlets is an effective means of reducing alcohol-related harms, particularly violence. Some of the most compelling studies come from recent restrictions introduced in different parts of New South Wales. The findings from the UK are not particularly consistent with the findings in other jurisdictions but may be explained because of the modest and gradual nature of the policy change. There is some evidence that reducing hours of packaged liquor outlets reduces harms among adolescents and young adults.

# Density of alcohol outlets

***Chapter Summary***

* One hundred and sixty-five studies examined the relationship between the density of alcohol outlets and alcohol consumption or alcohol-related harms.
* All but a handful examined the impact of *increasing* alcohol outlet density on alcohol-related outcomes – whether immediate from a policy change, or gradual increases in availability over time.
* Forty-four studies included measurement over time and are the strongest form of evidence.
* There is high-quality, locally-relevant evidence that alcohol outlet density is associated with violence and good evidence that outlets are associated with alcohol-related mortality and morbidity.
* There is some evidence that outlets are associated with risky drinking and intimate partner violence, and evidence from overseas suggests outlets are positively associated with child maltreatment, sexually transmitted infections and suicide.
* There is mixed evidence about associations of outlets to traffic accidents and drunk-driving as well as underage drinking.
* There remain substantial weaknesses in the outlet density literature, and improvements in data and analytical approaches are needed to ensure the best quality evidence is available to inform policy.
* Alcohol sales data are rarely available for outlets in an area, however, research that is able to include sales data, suggest the amount of alcohol sold significantly predicts local problems rather than the density of outlets. There is a need for detailed alcohol sales data to be collected in each state and territory and made available to researchers.

## Sample

Studies which examined associations with the density of alcohol outlets are summarised in Tables 6-8 (see Appendices). Here we focus on summarizing the best-quality studies – predominantly longitudinal (Table 6) – as well as studies undertaken in Australia (or in a couple of instances New Zealand). Most of the studies (Tables 7-8) were cross-sectional studies, which allow only a weak inference of causality.

In contrast to the studies reviewed in Chapter 4 on the effects of extensions and restrictions in alcohol trading hours on alcohol-related harms, the density studies are a mix of studies assessing the effects of policies that resulted in changes in outlet density, as well as studies assessing the consequences of changes in outlet density in which the cause of density change is unknown (i.e. changes over time). For this reason, studies are summarised according to their key outcome, rather than the policy change.

The chapter ends by summarizing four studies of note conducted since our systematic review.

## Problem drinking and consumption among adults

Seven studies examined the effects of changes in outlet density on alcohol consumption; however, none of these are from Australia.

One study assessed the effects of partial privatization of the off-premise alcohol monopoly in British Columbia, Canada. The study found that, all else being equal, the number of private off-premise outlets in a neighbourhood was significantly and positively associated with alcohol sales (75) even after adjustment for the number of government-run stores, restaurants and bars.

Three studies used data from the Finnish Public Sector Study, which is an ongoing prospective epidemiological cohort study of public sector employees. The studies examine to what degree changes in drinking patterns correspond to changes in the number of alcohol outlets in the respondents’ neighbourhood, amongst a sample of respondents who move residential address over the study period (76-78). After respondents move closer to alcohol outlets their drinking increases, particularly for women. The applicability of the Finnish studies to Australian circumstances is questionable. Like parts of Canada, Finland has an alcohol retail monopoly for off-premise sales. Furthermore, the study cohort has particular characteristics - 80% women, socio-economically advantaged – which limit generalisations to a more diverse sample. A study from WA (79) found a strong association between local alcohol availability and alcohol consumption and a small association of local availability with hospital contacts for anxiety, stress, and depression. However, the study was cross-sectional and authors cannot infer causality.

Three papers from the USA provide reasonable evidence that increasing the availability of alcohol is associated with higher rates of heavy drinking. However, each study has key weaknesses (e.g. 80 focuses only on bars, and does not control for off-premise outlets) or is conducted in a very specific context (e.g. 81 examined drinking in relocated public housing tenants in Atlanta in the US), which makes it difficult to generalise their results to the Australian context.

Research from cross-sectional studies provides a more mixed picture, with some studies finding little association between availability and consumption (82-85), while others find different effects for different outlet types, definitions of density or drinking measures (86-89).

The cross-sectional studies from Australia and New Zealand provide the most relevant evidence. Two studies of the general population in New Zealand produced inconsistent findings. In the first, Connor et al. (90) found no association between any measures of outlet density and drinking volume, but a significant link between off-premise density and binge drinking. In the second, Ayuka et al. (91) found no overarching outlet density effects, but when the sample was stratified by sub-population there was evidence to suggest availability may influence the consumption of some population sub-groups (younger Māori and Pacific peoples males; younger European females; middle-aged European men; and older men). Studies of young adults in New Zealand and Australia both find evidence that higher densities of off-premise outlets are associated with heavier drinking (92, 93).

These studies all have significant limitations, including low survey response rates, potential biases in self-reported measures of consumption and the likelihood that some of the variation in drinking patterns is due to individual or community factors, which are not controlled for in these cross-sectional models.

## Underage drinking

As with most of the studies assessing impacts on adult alcohol consumption, studies on underage drinking are nearly all constrained by their reliance on self-reported alcohol consumption (rather than sales data, for instance) in surveys with relatively low response rates. We found three longitudinal studies, all from the US, that asses the effect on underage alcohol consumption of changes in local alcohol availability. All three found that increased local alcohol availability was associated with earlier onset of drinking (94-96). However, differences in drinking behaviour evened out over time as the young people approached adulthood.

For relevance to an Australian setting, there is one Australian and one New Zealand study, although both use a cross-sectional research study design. In New Zealand, a combined measure of outlet density (on- and off-premise outlets together) was associated with teenage drinking (97). The Australian study found that densities of outlets of all types were associated with risky drinking among young teenagers (12-14 year olds) but not older teenagers (15-17 year olds) (98). A number of studies have examined the mechanisms by which outlet density may be associated with underage drinking – whether through parental supply or underage purchasing; however, they show inconclusive results (99-101).

## General Violence

There is a large body of evidence indicating a significance relationship between alcohol availability and violence (see Tables 6-8). Studies use a diverse array of outcomes (police data, health system records, self-reported victimisation and perpetration) and methods and come from a variety of settings (predominantly the USA, Australia and Canada). Nearly all studies find significant associations between violence and alcohol outlet density, although the specifics of the relationship vary. For example, some studies find that the density of off-premise liquor outlets is more important for violence than density of on-premise outlets (102, 103), while others find the reverse (104). The substantial variation in the cross-sectional findings is likely to stem from the differing study contexts as well as variation in measurement and analytical approach.

Thus, while the overarching message of this body of research is that there is a link between alcohol’s availability and violence, it is important to focus on the longitudinal studies and those from Australia to inform Australian policy.

Nine longitudinal studies examine the impact of changes in the density of outlets in a community on changes in rates of violence, including one from Australia. Seven of these find changes in the density of alcohol outlets within communities is associated with changes in rates of violence. Two studies from the US found increases in the densities of bars and off-premise outlets were associated with changes in rates of violence (105, 106). A sophisticated US study found bar densities were particularly associated with assaults in areas with low mean incomes and high population densities (104). An innovative study, using sophisticated spatial clustering, explored the effect of opening new bars in Buffalo, New York. The study found that violent crime clustered around many new outlets, providing the clearest evidence that increasing the density of alcohol outlets in an area can lead to increased violence (107). Two longitudinal studies of the after-effects of the civil unrest in Los Angeles in 1992 find evidence that the closure of off-premise outlets in neighbourhoods affected by the riots led to reductions in assaults (108, 109).

The one study from Australia found changes in the densities of pubs, restaurants and off-premise outlets in Melbourne were all significantly associated with changes in police-recorded assaults (110). Specifically, densities of pubs were associated with violence, particularly in entertainment precincts, while off-premise outlets were associated with violence in suburban areas only.

In contrast to these studies that find an effect on violence, two longitudinal studies find no effect associated with density changes. A study of the impact of permitting off-premise outlets to trade after a long period of prohibition found no statistically significant increase in violence, using policy records (111). Similarly, a study on the effects of increases in densities of private liquor stores on crime outcomes in British Columbia, Canada, during a partial privatization of off-premise liquor sales found no association (112), although again the relevance of this study to the Australian context is questionable given that it was testing the effects of a change in the universality of the government alcohol monopoly.

An important cross-sectional study from Western Australia incorporated measures of both alcohol outlet density and alcohol sales (44), finding that it was the amount of alcohol sold via packaged liquor outlets that predicted violence rates, rather than just the density of outlets. This finding has been replicated (for injury outcomes) in a recent high-quality longitudinal study (113) and using a case-crossover approach (114), suggesting that policy should not focus only on the density of packaged liquor outlets without considering how much alcohol they sell.

## Intimate partner violence[[3]](#footnote-3)

Three longitudinal studies were identified that measured the effect of changes in outlet density on intimate partner violence (IPV). IPV was measured using police data (e.g. IPV-related police calls) and IPV-related crime reports or data from emergency room departments (e.g. cause-of-injury event codes) which indicate that injuries are sustained through alleged abuse by a domestic partner. Two studies were conducted in the US and one was conducted in Australia.

The two US studies produced somewhat conflicting results. When IPV was measured using police data there was a significant positive association with off-premise outlet density (but not bar density) (115), while when IPV was measured using data from emergency department presentations the reverse was true (116).

The Australian study (also using police data) found similar results to the first US study, with packaged liquor outlet density significantly associated with IPV rates over time (117).The cross-sectional literature provides a similarly mixed view, with some studies identifying off-premise outlets as the most important licence type (118, 119), while others find that bar density is more important (120, 121).

## Morbidity and mortality

Several longitudinal studies examine impacts on alcohol–related mortality and alcohol–related morbidity. Outcome measures come from hospital and death records. Alcohol-related mortality as measured by diagnoses either wholly or partially-attributable to alcohol consumption -- for example, alcoholic liver cirrhosis and hypertensive diseases, respectively. Alcohol-related morbidity has generally been based either on similar diagnoses categories (e.g. alcohol poisoning) or on a proxy measure of alcohol involvement (e.g. late-night injury rates).

Three longitudinal studies from British Columbia, Canada have studied different impacts of the privatisation of the retail monopoly. As the number of private stores increased, so did rates of alcohol-related morbidity (122)and mortality (123, 124).

One study from Switzerland examined the association of neighbourhood density of on-premise alcohol outlets with alcohol-related mortality. Using data from the entire Swiss adult population, the authors found exposure to on-premise outlets in 2000 was associated with mortality in 2008. Significantly, the effects were not found when non-alcohol-related causes of death were examined, providing stronger evidence that the relationships were alcohol-specific and therefore more likely to be causal.

There are two longitudinal studies from Australia that find somewhat contradictory findings. The first examines impacts on alcohol-specific chronic diseases while the second examines impacts on alcohol-related injuries. In the former, Livingston found that the density of packaged liquor outlets in a neighbourhood predicted alcohol-specific diseases. In the second, Hobday et al. (113) combined data on outlet density with measures of alcohol sales and venue trading hours. The authors found that injury rates are significantly associated with the density of on-premise outlets, and particularly those trading late at night. In contrast, the density of off-premise outlets was not significantly associated with injury, but the amount of alcohol sold at these venues was. By including sales data, this study makes an important improvement on the existing literature. It demonstrates the need for detailed alcohol sales data to be collected in each state and territory and made available to researchers (125).

## Child maltreatment

Twelve studies were identified that examined the relationship of density of alcohol outlets with child maltreatment. Ten of these come from one research group in California (Freisthler and colleagues).

Two studies examined the relationship over time. In the first, the authors found a significant and consistent relationship between off-premise alcohol outlets and rates of child maltreatment in 576 local zip (postal) zones over a six-year period. The density of bars was associated with the rate children were moved into foster care, but not with the maltreatment measure. In the second longitudinal study, a combined measure of alcohol outlet density (on- and off-premise outlets together) was associated with referral rates in the child protection system at the county level.

Freisthler and colleagues have used a combination of survey and licensing data in cross-sectional analyses to try to further unpack the links between alcohol availability and child maltreatment, finding no relationship between density and self-reported child physical abuse (126) and mixed evidence for a link between alcohol availability and child neglect (127). The validity of self-reported data on child abuse and neglect is not clear, and these studies have less robust designs than the longitudinal work. The only two studies outside of California come from one county in New Jersey and are limited by their cross-sectional designs (128, 129).

## Traffic accidents and drink driving

Traffic accidents are one type of alcohol-related harm that theoretically have a potentially negative relationship with outlet density. As the number of alcohol outlets increases the distance that a person has to travel to reach an outlet decreases, potentially reducing traffic accidents. However, and in contrast, increases in outlets may lead to more drinking, and therefore more drink-driving and associated accidents. Four longitudinal studies were retrieved; however, reflecting the complexity of the relationship, they find mixed results.

In a compelling natural experiment from Lubbock, New Mexico, a policy change in 2009 ended the prohibition of the sale of alcohol from off-sale premises. Within a year the city had 141 off-premise outlets. Times-series analysis of total crashes and single-vehicle night-time crashes were used to compare the periods before and after the policy change in Lubbock and in a comparison area. The study found no significant increases in crashes (130).

Three studies using panel data of gradual increases in alcohol’s availability over time have contrasting results. In one, off-premise outlet density increases the risk of crashes while the density of restaurants decreases the risk (131). In another, the opposite is the case - off-premise outlet density is protective from car accident risk, while restaurant density increases risk (132). The most sophisticated panel study highlights the interaction between outlet density and traffic flows, suggesting that it is too simplistic to think of a single overarching relationship between outlet density and car-related outcomes (133).

## Other outcomes

There are three longitudinal studies that examine the effect of changes in outlet density on other alcohol-related outcomes. One study found that the rate of suicide increased as the density of bars and off-premise outlets in a neighbourhood increased, but the rate decreased as the density of restaurants increased (134). Two studies of the 1992 Los Angeles civil unrest found reductions in the rate of gonorrhoea associated with the closing of off-premise outlets in affected neighbourhoods (135, 136).

## Summary

Research assessing the relationship of alcohol outlet density to alcohol consumption and related harm is large and growing rapidly. We found 191 articles published internationally in the last ten years. We summarised all studies in accompanying tables but limited our written summary to studies using longitudinal research designs and those conducted in Australia or New Zealand. Even considering just this subset of research, there is a diverse set of studies examining a range of outcomes.

Generally speaking, there is good evidence that alcohol outlet density is associated with violence. This seems to hold for both on- and off-premise outlets, although the effects of the latter may be entirely a product of the volume of alcohol sold. Similarly, most studies that examine impacts on health outcomes, including two from Australia, find that changes in outlet density are associated with changes in health outcomes.

There is some evidence which suggests that outlet density is related to both risky drinking among adults and intimate partner violence, although more work is needed in both areas to resolve uncertainties. It is helpful that there is one longitudinal study from Australia on the relationship of outlet density and intimate partner violence; however, there were limited control variables used in that study, so the findings need to be interpreted cautiously.

Studies from overseas suggest outlet density is positively associated with child maltreatment, sexually transmitted infections, and suicide, although studies of these outcomes remain limited to settings not necessarily reflecting Australian conditions.

The evidence on impacts of outlet density on traffic accidents and drunk-driving, as well as on underage drinking, is mixed.

## Limitations in the research literature

Despite the large body of research outlined above, there remain critical concerns about the applicability of the research findings to policy (e.g. 137). In this section we briefly outline three key limitations of the research literature: 1) Measuring alcohol availability, 2) geographical units used, and 3) varying effects across locations.

### Measuring alcohol availability

A key limitation of the evidence base linking alcohol outlet density to alcohol consumption and harms is the relatively simplistic approach to measuring alcohol availability. The majority of studies use broad classification of outlets (e.g. on-premise vs off-premise; pubs vs restaurants vs bottle shops), which fundamentally assume that each outlet in a particular category is equivalent to every other outlet in that category. For example, studies from Melbourne that measure the density of packaged liquor outlets (e.g. 110) do not differentiate between small wine cellars and warehouse-size outlets (e.g. Dan Murphy’s). Similarly, studies that group different types of on-premise licences into a single category are treating small bars that close at 11pm as equivalent to larger nightspots that are open until 5am. Using such broad classifications of outlets means one cannot identify what type of outlet within the broad classification contribute more substantially to harms and problems.

Researchers have pointed out the problems that this simplistic approach to measurement raises for policy makers trying to apply existing research to policy (see 137). Increasingly studies are attempting to develop more nuanced measures. For example, Liang & Chikritzhs (44) incorporated a measure of alcohol sales into their models of the link between outlet density and violence, finding that the density of packaged liquor outlets was not significantly associated with violence after controlling for the volume of alcohol sales. These findings imply that the effect of two small liquor stores on violence in a community would be less than that of one large outlet that sold more alcohol. These findings have been replicated using longitudinal data (with injury rates as the outcome) (113), and have been further supported by a very recent study from Victoria (published after our literature search period) that identified substantially stronger associations between chain packaged liquor outlets and injury than were found for independent packaged liquor outlets (45). Chain outlets were larger and seemed to sell alcohol at cheaper prices than at independent package liquor outlets, supporting the theory that densities of chain outlets are particularly associated with rates of local alcohol-related problems because they increase the financial availability of alcohol. Beyond the relatively simplistic approach to measuring alcohol availability, there are also inconsistent approaches to operationalizing the measure of alcohol availability in a geographic area. In our review the range of measures included:

* number of alcohol outlets per capita in a community,
* number of alcohol outlets per kilometre of roadway in a community,
* number of alcohol outlets per square kilometre in a community,
* number of outlets within buffer zones of varying sizes (e.g. outlets within a 500m, 1km or 3km radius of a community or residential address), and
* distance to the closest alcohol outlet.

The most common measures used are number of outlets, based on either a per capita or per kilometre of roadway denominator, but there remains no consensus in the field as to the best approach to measuring community-level alcohol availability. Some early studies compared multiple measures and found consistent patterns of association (138), but more recent studies provide less consistent evidence. For example, Young et al. (139) found that the distance to the nearest off-premise outlet was significantly associated with weekly drinking among adolescents, while the density of off-premise outlets within 1200m of their residence was not. On the other hand, Kavanagh et al. (140) found that density of alcohol outlets within a 1km distance of a respondent’s residence was associated with heavy drinking, while the distance to the nearest outlet was not.

This inconsistency in approach remains a major stumbling block to developing a clear picture of the actual relationship between alcohol availability and various outcomes, and future research is necessary to explain why different measures produce different results.

### Geographic units

Related to the question of how alcohol’s availability is measured is the question of the choice of geographic unit. In the studies reviewed here measures included:

* cities (up to ~500,000 residents),
* postcodes (up to ~50,000 residents),
* census tracts (up to ~10,000 residents), and
* street segments (up to ~120 metres long).

There is little critical discussion on selecting the most appropriate unit despite the varying geographical relationships of outlet to harm. For example, assaults are more likely to occur in close proximity to on-premise outlets, while traffic accidents or IPV are likely to be more dispersed. The choice of geographic unit is often a product of study setting and the administratively defined spatial units.

Researchers are developing new methodological approaches that limit the reliance on pre-defined geographic units via more sophisticated spatial modelling, but at this stage there are few such studies (e.g., 107, 141).

### Varying effects spatially and cumulatively

Researchers using advanced modelling approaches have shown that even within a single study, the effect of outlet density on outcomes can vary between locations within the study setting (e.g. St Kilda versus Dandenong within the Melbourne Metropolitan area) (142, 143). This variation has important implications for policy, as it suggests regulation of outlet density may need to take into account variation across neighbourhoods. More research is needed to pin down these variable effects – only one Australian study has attempted to assess the relationship of availability and harm across different neighbourhood types (144).

Similarly, more evidence is needed to examine whether a new outlet opening in an area with relatively few existing outlets has a larger or smaller impact on outcomes than a new outlet in an area with an existing high outlet density.

## 5.12 Recent developments in the field

Regarding evidence on outlet density and harm in Australia, there are four recent studies of note. Very recent publications on outlet density have boosted the Australian-specific evidence assessing the relationship of alcohol availability to adolescent and young adult alcohol consumption overtime. Using two waves of an annual survey of adolescents Rowland et al. (145) examined how changes in outlet density over two years was associated adolescent alcohol use. They found living in neighbourhoods with higher outlet density was associated with a statistically significant increase in alcohol use one year later.

Two recent Australian studies have attempted to differentiate effects by licence type’s over time. Foster et al. (146) examined associations between different liquor licences and alcohol consumption amongst young adults at two time points (participants aged 20 and 22yrs). The authors found that increases in the number of off-premise and club licences in a participant’s neighbourhood was associated with increased consumption. Club licences included sport clubs and RSL clubs. Every additional off-premise outlet was associated with an 8% increase in alcohol consumption and every additional club licence was associated with a 6% increase in consumption. In the second study, Azar et al. (147) examined the association of the density of four types of outlets and self-reported alcohol consumption using repeated cross-sectional surveys with a large sample of adolescents (aged 12-17yrs). The authors found higher densities of general, on- and off-premise outlets in an adolescent’s neighbourhood were associated with increased likelihood of consumption. Club licences were only associated with consumption in urban areas.

As mentioned, a study published in 2016 found that chain off-premise outlets are more strongly associated with alcohol-related harms than non-chain outlets. In addition, they found that chain outlets are generally larger, and larger outlets tended to sell cheaper products (45).

A very recent study from Perth has demonstrated that convenience is an important factor in purchasing decisions (148). After price, ‘closeness to home’ was the second most important factor influencing where drinkers choose to purchase alcohol. Other factors, including opening hours of the outlet, proximity of the outlet to work and the variety of drinks available, were of lesser importance.

# ****Restrictions or bans on off-premise alcoholic sales in remote communities****

***Chapter Summary***

* Restricting the availability of particular alcoholic beverage containers or forms, even those used by the most problematic drinkers, in the absence of limits on other containers or forms, is unlikely to have more than a limited effect.
* Bans on off-premise sales is likely to have more substantial effects in remote communities or other circumstances where access to alternative sources is limited.

## Introduction

As described in Chapter 3, from the 1970s restrictions **or bans on off-premise alcoholic sales were introduced in a number of relatively remote communities with high** Aboriginal and/or Torres Strait Islander **populations.** Limiting or banning sales of forms of alcoholic beverages seen as having an especially high risk has been an approach used in a number of places to reduce problematic alcohol consumption. In the current Australian context, this has usually been defined in terms of cheap cask wines, although in other times and places it has often been spirits drinks. That wine is the cheapest available form of alcohol in Australia is an artefact of the tax system, since the cheapest form to produce, per unit of alcohol, is spirits. However, there has been no response at the policy level to calls from public health interests for “volumetric” taxes that would be tied to the alcohol content of a beverage.

Public policies targeting drinkers have been introduced in the Northern Territory (such as mandatory alcohol treatment). A recent evaluation of the Alcohol Mandatory Treatment (AMT) program highlighted a number of positive outcomes but found that people who received mandatory treatment did not see significantly fewer problems (e.g. emergency department presentations, interactions with the police) than those who did not (149). Importantly, the evaluation highlighted many problems with the implementation of AMT, largely related to the short timeframe provided for setting it up and made a comprehensive range of recommendations to improve its operation. More broadly, commentators have emphasized that alcohol policies relying on police enforcement and punitive measures often target Indigenous Australians and local community support is a key factor in whether an intervention is successful or not (150).

## Restrictions on particular drink types and large containers

A set of voluntary restrictions in Port Hedland, Western Australia initiated in 1996 and confirmed as mandatory in January 2004 included restrictions on the size of containers of spirits and wine available for sale, as well as the hours of off-premise outlet trading. Midford (151) found that the level of alcohol consumption remained stable in Port Hedland, while it rose by 20% in a control area.

A series of restrictions adopted in Alice Springs in 2002 included, along with restrictions on off-premise outlet opening hours and restrictions on morning on-premise sales, a ban on sales of alcohol containers (essentially, wine casks) larger than 2 litres. Crundall (152) found that the decline in cask wine sales was offset by increased sales of fortified wine, premixed spirit drinks, spirits and mid-strength beer. Even when the limits on container size were lifted, a market which had not existed before remained for fortified wine.

The much-evaluated Tennant Creek sales restrictions included a ban on sales of 4- and 5-litre wine casks and a limit (to one per person per day) on sales of 2-litre casks (Gray et al., 1998 cited in 153), along with limits on hours of sales, considered below. As might be expected, cask wine sales dropped substantially – by more than half (154). There were increases in sales of fortified wine and premixed spirit drinks, and also sales increased at nearby roadhouse inns (154). But the overall level of sales of alcoholic beverages decreased, as did most indicators of alcohol-related harm. However, the effects of the partial sales ban and of the restrictions on hours of sale in Tennant Creek cannot be fully disentangled. The effects seem to have been on both Indigenous and non-indigenous drinkers, and on both males and females. However, there is some evidence of a greater effect on indigenous drinkers (Gray et al., 1998 cited in 153), and there was a particular decline in female indigenous victims of assault (154, 155).

Most recently, restrictions on the sale of take-away alcohol with greater than 2.7 per cent alcohol in Halls Creek, WA, found a substantial reduction in crime and health outcomes (156). Similarly, there are two studies of Alcohol Management Plans (AMPs) in four communities in Cape York in Northern Queensland which restricted takeaway sales of spirits and stronger beer. They found a reduction in serious injury (157, 158). However, evidence from AMPs more broadly are mixed (150, 159). A 12-month trial of restricting the sale of 4- and 5-litre casks of wine and reductions in off-premise trading hours resulted in a reduction in harms and a shift in purchasing to the next cheapest form of alcohol still available for sale (160).

## ****Bans on off-premise alcohol sales****

There are evaluations of bans on alcohol sales in Aboriginal and/or Torres Strait Islander communities in several areas. One evaluation found that a 5½-month ban on sales from Curtin Springs Roadhouse, potentially serving drinkers from 29 communities which had declared themselves “dry”, resulted in a 79% drop in sales at the Roadhouse, and there was still a 59% drop when it was succeeded by a daily ration on take-away sales of a six-pack of beer (154). No evidence was found of a displacement of sales to other outlets. The number of automobile crashes in the district involving indigenous Australians fell by 60%.

In the Indigenous community of Jabiru, in the Arnhem region of the Northern Territory, a total ban on off-premise sales of alcohol from the community sports and social club took effect in April, 1997. The club’s alcohol sales fell by 73%, but this was partly offset by increased sales elsewhere; on a net basis, consumption in Jabiru decreased by 22%. There were substantial decreases in assaults and public drunkenness complaints, but increases in stealing and motor vehicle offenses, so that there was no net change in the total number of complaints to the police (161).

In 2007 the Director of Liquor Licensing prohibited the sale of full strength packaged liquor at the only licensed premises in Fitzroy Crossing. The effect of this ban has been to significantly reduce the consumption of full-strength alcohol in that community (162). An evaluation of the restriction two years later found health and social benefits to the community. This includes a reduction in alcohol-related presentations to the Fitzroy Crossing Emergency department and number of drink driving charges. However, the two-year evaluation noted that substantial declines in harms seen in the first year had started to weaken. This was attributed to an increase in community members travelling outside of Fitzroy Crossing to obtain full-strength take-away alcohol.

## Summary

An overall conclusion would be that restricting the availability of particular alcoholic beverage containers or forms, even those used by the most problematic drinkers, in the absence of limits on other containers or forms, is unlikely to have more than a limited effect. The main effects presumably would be from the price differential involved in purchasing the least expensive form still available, and perhaps from the mild discouragement of switching to an unaccustomed beverage. In contrast, a substantial restriction or ban on off-premise sales is likely to have more substantial effects in remote communities or other circumstances where access to alternative sources is limited.

# Discussion

## Implications for policy and regulations

### Limits on trading hours

The Australian and international examples provide encouragement for policy action around late-night licensing regulation, and the strength of the evidence base reviewed in this report suggests it would be a fruitful approach for jurisdictions looking to reduce violence. Issues of displacement are still being evaluated but do not negate the conclusion of an overall reduction in violence.

### Density of alcohol outlets

Despite limitations, this body of research in general suggests that the regulation of alcohol outlets would be a useful public health tool for the reduction of risky drinking and alcohol-related harm. However, this evidence has had limited impact on policy in most high-income countries in recent decades, as current economic orthodoxies around competition and deregulation have held sway.

There are few examples of successful interventions related to outlet density, with most policy movement towards more liberal rather than more restrictive approaches (163). The most likely policies around density relate to restrictions on the granting of new licences, rather than explicit quotas for particular licence categories – although quotas do still exist in parts of the US. One example of a new and potentially density-limiting policy is the UK model of Cumulative Impact Zones (CIZs). CIZ are advocated and declared by local governments as a tool to limit the growth of licensed premises in areas where a significant number are concentrated. Recent evidence suggests that these policies have been effective at reducing alcohol-related harms (164, 165). However, it is not clear if this effect is achieved by limiting the growth in licensed premises, as originally intentioned, or rather by influencing the type and operating conditions of new licenced premises (166). Other examples of shifts towards more restrictive licensing policies are licensing assessment tools for use in assessing the risk of adverse social outcomes that might follow from granting a new liquor licence. An evaluation of one such Australian tool - the Environment and Venue Assessment Tool (EVAT) – suggested the tool was positively received by decision-makers and use of the tool was associated with a greater proportion of granted licences having trading conditions imposed (167). The impact of the tool on alcohol-related harms was not be evaluated. The lack of successful policy action reflects both the challenging political environment and the shortfalls in the evidence base outlined earlier. Tools purporting to assist authorities limit outlet density often require location-specific evidence, including assessments of the relationship between a new alcohol outlets and harms, which are resource-intensive to generate. The effectiveness of the dramatic reduction in off-premise outlets in parts of Los Angeles following the civil unrest there in 1992 provides a counter-example, with community action resulting in reduced alcohol availability and subsequent reduction in harms (109, 168). However, given the very specific context of this intervention, it is hard to use it as a more general policy approach. Ongoing policy experiments are required to provide definitive evidence of the effectiveness of policies regulating outlet density – the largely observational evidence base reviewed here provides encouragement that such policies could be effective.

## Scientific evidence and policymaking about alcohol availability

The growth in Australian studies on effects of alcohol availability, particularly late at night, reflects that this has become a contested area in Australian politics. On the one hand, the availability of alcohol has grown tremendously in Australian communities in the last half-century. This trend has certainly been pushed along by commercial interests but was also enabled by a neoliberal consensus on more open markets and “competition policies” on both sides of the central ground of Australian politics. On the other hand, concerns about adverse consequences of drinking have also grown, initially focused particularly on drink-driving, but now concerning a wide spectrum of social and health harms. As noted on p. 20 (the section on “The night-time economy”), public discourse on alcohol and public opinion on alcohol policies have shifted toward more attention to the harmful side of drinking and more support for restrictive policies (50, 51). So far, the policy results of this shift have been meagre, though hotly contested. Shifting the closing hour to 3:30am is a comparatively minor change, affecting small parts of the population, compared with the dramatic changes in both directions in alcohol policy in the first 60 years of the 20th century.

In the highly contested policy arena of limits on alcohol availability, research results have certainly played an important role. It is unlikely that the pullbacks of closing hours in Sydney and in Queensland, for instance, would have occurred or persisted without the well-done studies of the effects of such measures.

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# Appendices

# Methods

***Chapter Summary***

* We conducted a systematic literature review of peer-reviewed publications on the relationship of alcohol availability on alcohol consumption and alcohol-related harms over the ten year period 2005-2015.
* 191 articles were retrieved, the majority assessing how changes in outlet numbers relate to drinking patterns and alcohol-related harm.
* Supplementary searchers were conducted to examine studies relevant to Aboriginal and/or Torres Strait Islander peoples – what interventions to reduce the availability of alcohol through restricted sale have been evaluated.

**Databases**

We conducted a systematic review of the published literature on the impact of changes in alcohol availability on alcohol consumption and alcohol-related harms (search criteria outlined below). Databases searched were MEDLINE, EMBASE, PsychINFO and Core Collection (see Table 4). Core Collection captures studies in the humanity disciplines, such as criminology, which may not be included in the other three databases, which are focused on medical and behavioural science research. Medline and Core Collection were accessed through the Web of Science interface and PsychINFO and Embase through the OVID interface both via La Trobe University.

**Search Strategy**

The search strategy is comprised of two parts – availability in terms of number and density of outlets, and availability in terms of hours of operation. The searches combined alcohol terms (‘alcohol’ OR ‘liquor’) and availability-specific terms. Search terms were informed by existing systematic reviews of the literature (including Popova, Giesbrecht, Bekmuradov & Patra, 2009 and Stockwell & Chikritzhs, 2009). Searches were further refined by limiting searches to the ten years (until December 14th 2015 when the search was conducted). Table 2 and 3 show the search terms used.

Table 2 Search terms used for number and density of alcohol outlets

|  |  |  |
| --- | --- | --- |
| Step | Search Terms | Sections of articles searched |
| 1 | alcohol OR liquor | Title, abstract, keywords |
| 2 | outlet\* OR premise\* OR store\* | Title, abstract, keywords |
| 3 | densit\* OR availability OR proximit\* OR access OR spatial OR neighbour$hood[[4]](#footnote-4) | Title, abstract, keywords |
| 4 | Combination of 1 AND 2 AND 3 |  |
| 6 | Limit to articles published between January 2005- December 14th 2015 |  |

Table 3 Search terms used restrictions on trading hours

|  |  |  |
| --- | --- | --- |
| Step | Search Terms | Sections of articles searched |
| 1 | alcohol OR liquor | Title, abstract, keywords |
| 2 | closing hour\* OR opening hour\* OR trading hour\* OR operating hour\* OR drinking hour\* OR closing time\* OR hours of alcohol sale\* OR serving-hour\* | Title, abstract, keywords |
| 3 | Combination of 1 AND 2 |  |
| 6 | Limit to articles published between January 2005- December 14th 2015 |  |

These two searches were performed in each of the four databases and results imported into Endnote (a standard software tool for publishing and managing bibliographies, citations and references). These searches produced a comprehensive list of 1,276 potentially relevant original articles (Table 3).

Table 4 Electronic database search summary

|  |  |  |
| --- | --- | --- |
| **Database**  **(Citation Indexing Service)** | **Discipline Range** | **Number of Records Returned** |
| MEDLINE (Web of Science) | Medicine, biomedicine, life sciences, public health, clinical care and more | 391 |
| Core Collection (Web of Science) | Multidisciplinary – A collection of indexes including arts and humanities and social science indexes | 705 |
| PsychINFO (OVID) | Psychology and related disciplines | 131 |
| EMBASE (OVID) | Biomedical & pharmaceutical | 49 |
| **Total** |  | **1,276** |

**Review of Identified Citations**

Returned results were imported into Endnote and duplicates removed. From the 1276 results, 459 duplicates were removed.

The list of articles then underwent two phases of assessment of their suitability based on defined exclusion criteria. The first phase was a review of the abstract of each article only and the second phase involved a review of the full article. Figure 2 presents a flow chart of search and exclusion phases.

Exclusion criteria used were:

* Article was not in English
* Article was a conference Abstract only and NOT a journal article
* Article was a review article (i.e. systematic review or commentary)
* Studies without relevant outcomes (e.g. studies of the distribution of outlets in general)
* Countries with non-comparable alcohol availability/consumption patterns (Studies from eastern and southern Europe, Asia, Africa, South America)
* Study Participants, persons aged 18 year or younger

*Exclusion Phase 1: Abstract Review*

Abstract review was undertaken independently by two researchers (ML and CW) using Endnote. Where there was disagreement between the two researchers’ decisions to include or exclude a paper (n=100 articles), the abstract was reviewed by both researchers and discussed and a final decision was made to either reject or include the article. In some cases it was necessary to access the full paper to make this decision. A final 261 articles were selected for assessment (556 were rejected) at phase two.

*Exclusion Phase 2: Review of Full Paper*

The full papers were obtained for those abstracts that were not excluded in Phase 1. Two researchers (ML and CW) read half of the 261 articles each to determine their relevance for inclusion. The same criteria used to make decisions on abstracts were used for the papers. Of 261 studies, 73 were excluded. Key reasons for exclusion were: review articles and commentary articles with no original data, or the research was conducted in a country with non-comparable alcohol availability (e.g. Romania and Brazil).

In a further step to ensure a comprehensive list of articles, our sample was cross referenced with the results of two existing systematic reviews of changes in trading hours (for papers published since 2005) Three articles were added in this way. A total of 191 studies are reviewed for this report.

Records identified through database searching (n = 1276)

Records identified through other sources (n = 3)

Records after duplicates removed

(n = 817)

Records screened

(n = 817)

Records excluded

(n = 556)

Full-text articles assessed for eligibility (n = 261)

Full-text articles excluded

(n = 73)

Studies included in the review (n = 191)

Figure 3 Process for identifying publications to be included in the review

**Review of Articles**

The final 191 articles were summarized using Microsoft Excel. The following categories were used to summarize the articles: author and year of study; place of the study (city and country); main outcome variable (described below); description (study design or policy change); findings and limitations. Key outcome variables were - crime, problem drinking & consumption, general violence and crime/theft and violent crime; underage use of, exposure to and/or access to alcohol; sexual health; intimate partner violence; motor vehicle crashes and drink driving; child maltreatment & neglect; violence, injury; mental health; morbidity and mortality. The most common outcome measures were violence, crime, motor vehicle accidents and drink driving.

Of the 191 articles, the clear majority of studies measured associations and impacts of changes in the density of alcohol outlets (n = 165). A further 26 studies examined the effect of changes in trading hours (hours of sale: n = 26). The findings of this study are organised into these two main categories: density of alcohol outlets, and hours of sale.

The 165 ‘*Density of alcohol outlet’* studies were classified according to three categories in broadly descending levels of strength of study design:

1. Longitudinal studies, which explore how changes over time in availability are associated with changes over time in consumption or harms (Table 4)
2. Cross-sectional individual-level studies, which examine how individual-level outcomes are affected by objectively measured alcohol availability via multi-level models (Table 5)
3. Cross-sectional aggregate studies, which examine how aggregate-level measures of availability are related to aggregate-level measures of consumption at harm at a single point in time (Table 6)

The quality and applicability of studies to the Australian context varies substantially within each of these categories so, while the tables provide the detailed results of our review, the following section will provide a focused synthesis of the results emphasising the key strengths and weaknesses relevant to the Australian policy environment. We focus largely on studies that use longitudinal data for both exposure (alcohol availability) and outcomes (e.g. violence rates), as these studies provide the most robust evidence. To assist with interpretability, we present our summary of the literature broken down into sub-categories based on the outcomes under consideration.

The 26 trading hour studies were further reviewed with the following exclusion criteria:

* Studies of the effect of ‘lockout’[[5]](#footnote-5) policies alone with no change in trading hours (2 studies, Australia (169, 170))[[6]](#footnote-6)
* Studies on limits on the days of sale (1 study, Sweden (171))
* Studies reporting on other licensing policies that indirectly affected hours in which alcohol could be purchased (e.g. a six-hour no-service period for any 24-hour trading premise). (1 study, Australia (172)).

**Supplementary searches**

Supplementary searchers were conducted to examine studies relevant to Aboriginal and/or Torres Strait Islander peoples.

## Table 5 Studies on changes in alcohol outlet trading hours (n=21) (2005-2015)

| Study | Setting | Outcome | Policy | Design | Findings | Limitations |
| --- | --- | --- | --- | --- | --- | --- |
| Bouffard et al 2007 (58) | Minnesota, USA | motor vehicle crashes & drink driving | Extended trading (1am to 2am): eating and social establishments | Interrupted time-series with no control series | Significant increases in DUI. Greater number of DUI stops occurring after 2am, more proactive policing, and more use of Breathalyzer tests at stops, no evidence of changes in driver characteristics | Police data under-report DUI. Changes in police enforcement practices could be driving effect. Respondents could have been drinking at other locations other than bars and restaurants |
| Chikritzhs & Stockwell 2006 (53) | Perth, Australia | motor vehicle crashes & drink driving | Extended trading (12am to 1am): hotels | Time-series analysis with controls sites | Increase in crashes, no association with BAC | Self-selection of hotels seeking later trading. ‘Last drink method’– the last venue is not always the premise where the majority of alcohol consumed. Differences between the hotels that got an Extended-trading-permit. Extended trading hotels were inner-city, purchased greater quantities of high-alcohol content beverages, and had younger clientele. Validity of 'last-drink' method |
| Chikritzhs & Stockwell 2007(54) | Perth, Australia | Motor vehicle crashes & drink driving | Extended trading (12am to 1am): hotels | Pre/post comparison with control sites | Influenced average BACs among some patrons, and outcome varies by time of day, age and gender. Among women some evidence of reduced BACs associated with extended-trading hotels, while among men late at night, higher BACs were recorded | Error associated with 'last place of drinking' data. Self-selection of hotels seeking later trading. Unmeasured variables - management practices, service staff, proportion of underage drinkers |
| de Goeji et al 2015(173) | Amsterdam, Netherlands | alcohol-related morbidity & violence | Extended trading (by 1hr): two-types on-premise outlets: two city municipalities | Pre/post comparison with control sites | Increase in alcohol-related injuries - effect significant between 2-6am, during the weekend, for men, and for those aged 25-34 yrs | No information on similarity of control sites - could attract different clientele and bias results (although controlled for age and sex).Difference between ambulance pickup and site of alcohol consumption. Policy introduced in small geographic areas (easy for patrons to move between policy affected and non-policy affected areas). Ambulance data may not report alcohol, and text description detail may change across the course of the night (i.e. less detail at busier times) |
| Durnford et al 2008(62) | Birmingham, UK | alcohol-related morbidity & violence | Extended trading (24 hr trading): on-premise | Pre/post comparison with no control site | The Act may have shifted presentations into the early hours of the morning. No difference in attendances or hospitalisations. No differences between the comparative days of the week of presentations between 2005 and 2006. Significant variations in the time of presentations: significant increase between 3-6am on weekends and smaller proportion in the early evening | Limited post-policy period. Unclear how many licences were trading at extended hours, even if they had applied for a longer opening licence |
| Fulde et al 2015(66) | Kings Cross & Sydney CBD, Australia | alcohol-related morbidity & General violence | Restricted trading (lockout 1.30am-3.30am: on-premise) | Pre/post comparison with no control site | Significant decrease in alcohol-related serious injury and trauma presentations in the 12 months following the intervention, especially on weekends | One hospital/site of data collection only. Broader trends not well controlled |
| Green et al 2014(63) | UK | motor vehicle crashes & drink driving | Extended trading (up to 24 hr trading (from 11pm)): on-premise | Difference in differences with control site | Decline in traffic accidents in intervention site, larger decline on Friday, Saturday nights, concentrated in younger drivers | Limited post-policy period. Not all licences extended their licence conditions |
| Hough & Hunter 2008(59) | UK | Multiple outcomes | Extended trading (up to 24 hrs (from 11pm)): on-premise | Descriptive pre/post comparison with no control sites | The changes to the Act did not lead to major changes in actual trading hours. Effects on crime statistics were small or non-existent | Relatively short post-policy change = only- short-term evaluation. No control site. No controls of exogenous factors |
| Humphreys et al 2013(61) | Manchester, England | Violence | Extended trading hours (up to 24 hrs (from 11pm)): on-premise | Interrupted time-series with no control series | Violence level unchanged, some evidence violence shifted to later in night | No control site |
| Humphreys & Eisner 2014(60) | Manchester, England | Violence | Extended trading (up to 24 hr trading (from 11pm)): on-premise. Data on actual trading hours were incorporated. | Dose-response differences in differences analysis (with geographic areas as the unit of analysis) | No effect | No control site |
| Kypri et al 2011(67) | Newcastle, Australia | Violence | Restricted trading (3.30 a.m. closing with a 1.30 a.m. lockout): 14 inner-city hotels | Pre/post comparison with control site and control for overall trend | Assaults fell sharply following the intervention | Control setting is not the most appropriate (but does allow for testing of diffusion effects) |
| Kypri et al 2014(68) | Newcastle, Australia | Violence | Restricted trading (3.30 a.m. closing with a 1.30 a.m. lockout): 14 inner-city hotels | Pre/post comparison with control site and control for overall trend | The original drop in assaults was maintained for ~ 5 years |  |
| Marcus & Seidler 2015(73) | Baden-Wurttemberg, Germany | Alcohol-related morbidity & assault | Restricted trading (between 10pm - 5am): off-premise outlets | Difference in differences with control sites | Reduced hospital admissions for 15-19 and 20-24 yr olds, but not for 25-29 and 30+ |  |
| Miller et al 2014(69) | Geelong & Newcastle, Australia | General injury | Restricted trading (3.30 a.m. closing with a 1.30 a.m. lockout): 14 inner-city hotels in Newcastle, compared to variety of voluntary interventions in Geelong | Interrupted time-series with no control sites | Reductions in injuries in Newcastle. No significant effects in Geelong | Evaluating many policies in the same study, making specificity of effects difficult |
| Newton et al 2007(64) | London,  UK | General injury & Violence | Extended trading (up to 24 hrs (from 11pm)): on-premise | Pre/post comparison with no controls | Increases in admissions coded as alcohol-related, increases in alcohol-related assaults and injuries, increases in alcohol-related admissions | Changes to coding, no analysis of how the changed policy affected actual hours |
| Rossow & Norstrom 2012(74) | 18 municipalities, Norway | Violence | Extended and Restricted trading (≤2hrs): on-premise | Quasi-experimental design, using cross-sectional time-series models with city fixed effects | Increases in trading associated with increases in assault and decreases associated with decreases in assault |  |
| Vingilis et al 2005(56) | Ontario, Canada | Fatal motor vehicle crashes | Extended trading (1am to 2am): on-premise | Interrupted time-series with non-equivalent control site | No significant effects identified | Relatively simple study design and analytical approach, broad trends not considered |
| Vingilis et al 2007(57) | Ontario, Canada | Motor vehicle and non-motor vehicle injuries | Extended trading (1am to 2am): on-premise | Interrupted time-series with no control site | No significant effects for traffic, but significant increases in late night non-traffic injuries | Relatively simple study design and analytical approach, broad trends not considered |
| Vingilis et al 2008(55) | Ontario, Canada | Drink-driving and assault | Extended trading (1am to 2am): on-premise | Interrupted time-series with no control site | No significant effects identified overall, some increases at particular times of the night | No control site |
| Wicki & Gmel 2011(72) | Geneva Canton, Switzerland | Alcohol-related morbidity | Restricted trading (no sale from 9pm to 7am): off-premise outlets | Interrupted time-series with control sites | Significant reductions in hospitalisations for under 30s | Unable to determine which policy measure drove the effect – other policy change: banned off-premise sales in some venues - gas stations and video stores |

Acronyms: BAC – Blood Alcohol Content: DUI – Driving under the influence: IPV – Intimate partner violence

## Table 6 Studies with measures over time (time series, cohort, pre-post and panel study designs) (n=44)

| Study | Setting | Outcome | Description | Findings | Limitations |
| --- | --- | --- | --- | --- | --- |
| Anderson et al 2013 (174) | Los Angeles, USA | Crime | Examined the association of zoning on crime by assessing the effect of rezoning neighbourhoods on changes in crime rates. Four years of crime data prior to the rezoning used to control for historical differences between the neighbourhoods in crime trajectories. Regressions and propensity score model. | Rezoning neighbourhoods to include portions of residential zoning land experienced significant declines in crime - driven by reductions in automobile and stolen cars. | Very specific policy context. Analyses only tangentially focus on alcohol. |
| Brenner et al 2015 (175) | Six sites, USA | Problem drinking & consumption | Cohort study examining the association of neighbourhood socioeconomic status and alcohol outlet density with three alcohol use outcomes over 5-waves (~9.5 years) across census-tracks. Hybrid effect models. | Increase in off-premise density associated with increase in weekly consumption (men specific to beer: women specific to wine). | Sample of adults aged 45-84 years, free of clinical cardiovascular disease, therefore healthier than general population sample. Sample attrition may introduce bias. |
| Ceccato & Dolmen 2011 (176) | Rural municipalities, Sweden | Theft and violence crime | Longitudinal ecological study examining the levels and spatial patterns of crime in rural Sweden over a ten year period and comparison to urban areas. Ordinary Least Square regressions. | Alcohol outlet measures were associated with both theft and violence rates in nearly all models. | Combined measure of alcohol outlets. Analyses did not truly model change over time, but compared effects at different time points. Rural Sweden is a very particular context. |
| Chen et al 2009 (95) | California, USA | underage use of, exposure to and/or access to alcohol | Panel study examining how community alcohol outlet density associated with alcohol access among adolescents, controlling for parent and peer drinking at each wave. | Outlet density significantly related likelihood and frequency of alcohol access. | Sample attrition likely to introduce some bias. Very little change in outlet densities over the study period. |
| Chen et al 2010 (94) | California, USA | underage use of, exposure to and/or access to alcohol | Panel study examining the association of outlet density with youth drinking across 3 waves (approx. 3 years). | Growth in drinking and excessive drinking was, on average, more rapid in zip codes with lower alcohol outlet densities. The relation of zip code alcohol outlet density with drinking appeared to be mitigated by having friends with access to a car. | Sample attrition likely to introduce some bias. Very little change in outlet densities over the study period. |
| Cohen et al 2006 (135) | Los Angeles, USA | Sexual health | Controlled natural experiment examining the effects of changes in alcohol outlets and damaged buildings on rates of gonorrhoea at the census tract level, following the 1992 Civil Unrest. Four years of data prior to and post the unrest used non-damaged census tracks as a control. | census tracts with more surrendered licences had a steeper decline in gonorrhoea rates than in tracts with fewer surrendered licences: off-premise outlets had a positive association with gonorrhoea rates | Very specific situation being studied. Likelihood that the 1992 Civil Unrest was related to other, unmeasured, community-level factors. |
| Conrow et al 2015 (107) | Buffalo, USA | General crime & Violence | Panel study examining the association of newly licensed on-premise outlets with clusters of crime. Using global and local bivariate space-time k-function analyse. | The opening of new on-premise licences led to significant new clusters of crime nearby in more than 60% of cases. | Off-premise outlets were not included in the study. |
| Cooper et al 2013 (81) | Atlanta, USA | Problem drinking and consumption | Uncontrolled natural experiment examining then association of local socioeconomic conditions on substance misuse by assessing the effects of a policy change which saw individuals relocated from public housing complexes. Generalized linear mixed model. | A reduction in tract-level alcohol outlet density (by at least three outlets) predicted a reduction in binge drinking. | The intervention involved moving people between neighbourhoods, rather than changing the licensing environment per se. The population has limited generalisability to NSW. |
| Cunradi et al 2011 (115) | Sacramento, USA | Intimate partner violence | Panel study examining the association between outlet density and intimate partner violence. Bayesian space–time models. | Off-premise outlet density, but not bar or restaurant density, was significantly linked to both IPV-related police calls and IPV-related crime reports. | Police records of IPV may vary over both space and time in ways unrelated to incidence. |
| Cunradi et al 2012 (116) | California, USA | Intimate partner violence | Panel study examining alcohol outlet density and IPV-related emergency department visits over a 3.5 year period. Controlling for % Hispanic, % Black, % below poverty line, unemployment rate averaged to zip code level. Baysian spatial models with hierarchical regression. Poisson regression modelling. | An increase in one bar per square mile was associated with a 3% increased likelihood of IPV-related ED visits: an off-premise outlet associated with a 1% reduction, and restaurant density was not associated with IPV-ED visits. | Hospital data may not adequately capture incidence of IPV. |
| Desapriya et al 2012 (177) | Japan | motor vehicle crashes and drink driving | Pre- post study design examining the effect of increased alcohol availability on fatal motor vehicle accidents. By comparing motor vehicle fatalities and crashes before (1986-1993) and after (1994-2001) a policy that increased availability and decreased price. Poisson regression. Controlled for confounders of per capita alcohol consumption, unemployment and vehicle miles travelled. | Night-time crashes significantly decreased, nonfatal crashes decreased. Daytime fatality rate has no statistically significant ratio. Alcohol consumption did not significantly increase. | Relatively crude design, not controlling for broader trends. Nation-wide policy made a control site infeasible. |
| Freisthler et al 2007 (178) | California, USA | Child maltreatment & neglect | Panel study examining changes in number of alcohol outlets affect changes in rates of child maltreatment in 579 zip codes over 6 years. Spatial random effects panel models. | Higher off-premise outlets related to all three outcomes. Bar density, including lags were related to foster care entries, restaurants were related to decreases in maltreatment. | Potential bias in the measurement of incidence based on system data, which may reflect enforcement/surveillance as well as actual rates of mistreatment. |
| Freisthler et al 2008b (179) | 58 California counties, USA | Child maltreatment & neglect | Panel study examining three measures of the substance use environment and referrals to Child Protection Services in 58 counties over 4 years. Conditionally autoregressive Bayesian models. | Number of alcohol outlets increase risk of referral. | Potential bias in the measurement of incidence based on system data, which may reflect enforcement/surveillance as well as actual rates of mistreatment. |
| Gruenwald et al 2006 (105) | California, USA | Violence | Panel study examining the association of alcohol outlets to violence across 6 years in 581 zip codes (and adjacent areas). Random effects model. | Increases in bars and off-premise outlets related to increases in violence across local and lagged areas, these effects increased with larger male populations | Potential bias in the measurement of incidence based on system data, which may reflect enforcement/surveillance as well as actual rates of crime. |
| Gruenwald et al 2010 (180) | six communities, California, USA | motor vehicle crashes and drink driving | Cross-sectional and time-series spatial analyses were performed using data collected from 144 geographic units over 4 years. Survey measure of the estimated size of the local drinking-and-driving population. Generalized least squares. | The effect of on-premise venues on traffic accidents is moderated by traffic flow, with areas of higher on-premise density and highway traffic flow having higher rates of single-vehicle traffic accidents. | Proxy measure for alcohol-related crashes. Limited number of communities. Licence data does not distinguish between some types of on-premise outlets with different characteristics. |
| Halonen et al 2013 (77) | Finland | Problem drinking and consumption | Cohort study examining whether changes in proximity to off-premise outlets is associated with changes in heavy alcohol consumption. Binomial logistic regression with generalized estimating equations. Within individual modelling - quasi-experimental fixed-effects approach with conditional logistic regression. | Living in proximity to off-premise, particularly beer, increases risk of heavy drinking: changes in the distance to the nearest beer outlet is associated with change in heavy alcohol use status. There were weaker effects for liquor store outlets. | Sample is Finnish Public Sector Cohort, of which 80% women, therefore not generalizable to males. |
| Halonen et al 2013b (78) | Finland | Problem drinking & consumption | Cohort study examining proximity to on-premise outlets and heavy drinking. Binomial logistic regressions and longitudinal mixed effects conditional logistic regression. | A decrease in distance was weakly associated with both outcomes. | Sample is Finnish Public Sector Cohort, of which 80% women, therefore not generalizable to males. |
| Halonen et al 2014 (76) | Finland | Problem drinking & consumption | Cohort study examining changes in beverage-specific licensing is related to change in beverage-specific consumption. Data collected at 2 time points over eight years. Two-level cumulative logistic regression. | Increases in wine outlets associated with increased wine consumption for women. Decreases in outlets, not associated with changes in consumption. | Discrepancy between year of licence data and survey time points – 2004 licence data used for 2000 baseline. Sample is Finnish Public Sector Cohort, of which 80% women, therefore not generalizable to males. |
| Han & Gorman 2013 (111) | Lubbock, USA | Violence | Uncontrolled natural experiment examining policy change which saw the introduction of off-premise outlets in a city, on violent crime and assault. | No significant association between off-site outlets and either violent crime or total assault was found. | Lack of obvious control site. |
| Han et al 2015 (130) | Lubbock, USA | Motor vehicle crashes & drink driving | Controlled natural experiment examining effect of introduction of off-premise outlets on motor vehicle crashes in a relatively isolated city, compared to control city with not such policy change. Controlled ARIMA time series. | A weak stat sig effect in trend in crashes no statistically significant effects for single vehicle crashes. | Lack of obvious control site. |
| Hobday et al 2015 (113) | Perth, Australia | Injury | Panel study examining the independent effects of three different availability measures on ED alcohol-related presentations in 117 postcodes over 8 years. Negative binomial regression with random effects. | On-premise outlet density positively associated with assaults, those with extended trading hours had greater effect. Off-premise outlets negatively associated with injuries. Sales at on-premise outlets were not associated with injuries. Sales at off-premise outlets positively associated with injuries. | Relies on proxy-measurement of alcohol involvement in ED presentations. |
| Johnson et al 2009 (134) | 581 California zip codes, USA | Mental health (including suicide) | Panel study examining the relationship between neighbourhood densities and the two outcome variables. Spatial longitudinal random effects models. | Bars in particular associated with both attempts and completed suicides. Restaurants protective. Off-premise associated with completed suicides. | Potential biases in measurement of suicide and suicide attempts. |
| Livingston 2008 (110) | Melbourne, Australia | Violence | A longitudinal analysis of alcohol outlet density and assault. Fixed effects spatial-panel models with controls for socio-economic disadvantage and trends. | Assault rates significantly associated with density of all three outlet types (pubs, bottle shops, restaurants/bars). Pubs most significant in entertainment precincts and fringe, off-premise in suburban areas, on-premise in suburban and inner-urban. | Limited control variables. Uncertainty over alcohol involvement in assaults. |
| Livingston 2011 (181) | Melbourne, Australia | alcohol-related morbidity & Violence | A longitudinal spatial panel model examining the relationship over time at the postcode level, between density and hospital admissions. | Packaged liquor density was the only density measure associated with domestic violence rates. | Police records of IPV may vary over both space and time in ways unrelated to incidence. Limited control variables. |
| Livingston 2011 (117) | Melbourne, Australia | Intimate Partner Violence | A longitudinal analysis of alcohol outlet density and domestic violence. | General and packaged outlets predicted assault admissions, restaurant and packaged outlets predicted disease admissions. | Limited control variables available longitudinally. No incorporation of lagged effects for chronic disease. |
| Mair et al 2013 (104) | California, USA | Violence | Panel study examining association of outlet density on hospitalisation rates. Bayesian space-time conditional autoregressive models. | Significant effects for bars particularly - lagged effects also significant. Off-premise outlet density negatively associated with assault hospitalisations. | Hard to explain protective effects of off-premise outlets. |
| Parker et al 2011 (182) | USA | Violence | Panel study examining the association of alcohol availability and youth homicide from 91 US cities, based on data from the US Census of business activity (for density) and US homicide reports. Fixed effects modelling. | Significant relationship between density and homicide rates over time. | Very broad spatial units. |
| Paschall et al 2014 (96) | 50 Californian cities, USA | underage use of, exposure to and/or access to alcohol | Longitudinal multi-level regression models examining association of density with underage drinking, controlling for standard variables plus perceived availability, enforcement and acceptability of alcohol use. | Bar density was significantly associated with underage drinking at baseline, but not with increases in underage drinking over time. Not associated at all with heavy drinking. | Broad spatial units. City-level variables captured at one point in time only. |
| Picone et al 2010 (80) | USA | Problem drinking & consumption | Panel models assessing the links between proximity to bars and five measures of drinking over 17 years. Off-premise outlets were assessed and were non-significant so were not modelled. | Close proximities to bars were associated with amount of alcohol consumed per week. | Potential biases due to attrition. |
| Ponicki et al 2013 (132) | California, USA | Motor vehicle crashes & drink driving | Panel study examining the relationship between alcohol outlet density and road traffic crashes and the proportion of crashes involving alcohol at the zip code level. | Significant associations between restaurant density and crashes; bar density and proportion alcohol involved. Off-premise density was negatively associated with risk of crashes and alcohol involvement. Lagged effects were also found. | Does not incorporate traffic flows into crash rate denominators, which may bias findings. |
| Shamblen et al 2011 (183) | USA | underage use of, exposure to and/or access to alcohol | Multi-level models were used to examine the associations between density and adolescent drinking over time. | Students in high off-premise density areas had lower initial prevalence of drinking but were more likely to initiate in the waves following baseline. | Neighbourhood level variables captured at one point in time only. Some bias due to attrition likely. |
| Stockwell et al 2009 (75) | British Columbia, Canada | Sales | Panel study examining the effects of effects of changes in outlet density on consumption, specifically in changes in the proportion of off-premise outlets in private rather than government ownership over four years across 89 local health areas. Multi-level regression. | Private stores significantly associated with increased sales (all beverages). Government stores significantly associated with decreased sales. | Broad geographic areas. Very specific policy context of privatisation that is less relevant in Australia. |
| Stockwell et al 2011 (123) | British Columbia, Canada | Alcohol-related deaths | Panel study examining the association of density of annual liquor outlets and alcohol-related deaths over 6 years for 89 local areas. | Off-premise outlets and bars have a positive association with population rates of alcohol-related deaths. Government stores have an inverse relationship with mortality. | Broad geographic areas. Very specific policy context of privatisation that is less relevant in Australia. |
| Stockwell et al 2015 (112) | British Columbia, Canada | Crime & Motor vehicle crashes and drink driving | Longitudinal ecological study examining the independent effects of density and minimum pricing on crime across 89 local areas between 2002 and 2010, controlling for confounding variables. Mixed models. | Private stores significantly associated with increased sales (all beverages). Government stores significantly associated with decreased sales. | Broad geographic areas. Very specific policy context of privatisation that is less relevant in Australia. |
| Stockwell et al 2013 (122) | British Columbia, Canada | Alcohol-related morbidity | Panel study assessing the association between density (and price) and hospital admission rates. Mixed models across 89 local health regions. | Private off-premise outlet density positively associated with hospital admission rates over time. | Broad geographic areas. Very specific policy context of privatisation that is less relevant in Australia. |
| Tang 2013 (184) | Texas, USA | Motor vehicle crashes & drink driving | Panel study examining the association of alcohol outlet density on highway safety, controlling for local trends and alcohol sales. | Outlets are negatively correlated with alcohol-related traffic accidents and arrests for driving under the influence (DUI). | No data on traffic flows included. |
| Theall et al 2009b (136) | part of Los Angeles affected by 1992 riots, USA | Sexual health | Panel study examining the association between social capital (% voting) and gonorrhoea rates and their mediating role on the impact of off-premise alcohol outlet surrenders on gonorrhoea rates over 6 years by 445 census tracks. Multi-level growth models. | Outlets were association with gonorrhoea rates (pre- and post-). Overtime, surrendering of outlets was associated with decreased gonorrhoea rates, tracks with increasing outlets experienced increased gonorrhoea rates. Adding social capital mediated the association. | Very specific situation being studied. Likelihood that the 1992 Civil Unrest was related to other, unmeasured, community-level factors. Voting is an imprecise measure of social capital. Causality may operate in the opposite direction than proposed here. |
| Treno et al 2007 (131) | California, USA | Motor vehicle crashes & drink driving | Panel study examining the association of outlet density and motor vehicle accidents over six years across 581 zip codes (and adjacent zip codes modelled for spatial lag). Random effects models. | Bars and off-premise related to both outcomes: restaurants protective effect for the hospital data. | No data on traffic flows included. |
| White et al 2015 (106) | Norfolk, Virginia, USA | General crime | Panel study examining the relationship between density and street crimes. Spatial panel models, focussing particularly on newly opened outlets. | Significant relationship between change in outlet numbers and street assaults. | Potential biases in police data as a measure of assault. |
| Xu et al 2012 (185) | New Orleans, USA | Violence | To assess the effects of changes in licensing policy at a city-level examined the association between rates of assaultive violence at the census tract level (n=170) over a ten year period. | The implementation of the new city level policy was associated with a decrease in the positive association between rates of assaultive violence and off-premise outlet density. | Policy effects likely to be related to more than just outlet density. |
| Yu et al 2008 (109) | USA | Violence | Natural experiment study of the effect of the closure of off-premise alcohol outlets in LA after the civil unrest, modelled using Bayesian models that account for spatial and temporal autocorrelation. Tracts with surrendered outlets were the intervention, tracts without the controls. | A significant drop in assault occurred in the intervention tracts in the year following the unrest and was maintained for 5 years. | Very specific situation being studied. Likelihood that the 1992 Civil Unrest was related to other, unmeasured, community-level factors. Voting is an imprecise measure of social capital. |
| Yu et al 2009 (108) | Los Angeles, USA | Violence | Longitudinal spatial non-parametric CAR models were used to assess the link between density and assault over time. | Significant association between density and violence. | Very specific situation being studied. Likelihood that the 1992 Civil Unrest was related to other, unmeasured, community-level factors. Voting is an imprecise measure of social capital. |
| Zhao et al 2013 (124) | British Columbia, Canada | Alcohol-related morbidity | Panel study of 16 areas over 8 years, assessing the longitudinal relationship between density and deaths. | Significant associations between the density of private liquor stores and mortality were identified | Broad geographic areas. Very specific policy context of privatisation that is less relevant in Australia. |

## Table 7 Studies of association using individual-level measures (n=66)

| Study | Setting | Outcome | Relevant Population | Description | Findings | Limitations |
| --- | --- | --- | --- | --- | --- | --- |
| Ahern et al 2013 (186) | British Columbia, USA | Problem drinking & consumption |  | Examined association of alcohol outlet density with binge drinking, allowing for non-linear models. | Non-linear relationship: stronger relationship to binge drinking in neighbourhoods with more than 80 outlets | No control for on-premise outlets. Not clear what year of licence data obtained. |
| Ahern et al 2015 (187) | British Columbia, USA | Problem drinking & consumption |  | Examined association of neighbourhood alcohol outlet density and norms around drunkenness with alcohol use disorders. | higher density statistically significant association relations with alcohol use disorders | No control for on-premise outlets. Alcohol use disorder measure derived from health system and may differ from clinical assessment. |
| Astudillo et al 2014 (86) | Switzerland | Drinking level, Problem drinking & consumption | college-student men (18+) | Examined association between outlet density, drinking practices and consequences among men. | On-premise outlets positively associated with drinking level and heavy drinking. No significant association found with off-premise outlets. | Sample - college student sample only. Self-report measures of alcohol consumption and harms. |
| Ayuka et al 2014 (91) | New Zealand | Problem drinking and consumption |  | Examined association of proximity and density of outlets on hazardous drinking, Binary logistic regressions. | At national level no association of proximity or density measure. However, there was evidence of associations with neighbourhood retailing for sub-populations: younger Māori and Pacific people’s males; younger European females; middle-aged European men; and older men. Strong social gradient in the distribution of outlets. | Measures of access may not be where population purchases. Measures are not broken into on- and off-premises. No control for length of residence. |
| Branas et al 2011 (188) | Philadelphia, USA | Mental health (including suicide) |  | Case–control study examining association between acute alcohol consumption, alcohol outlets, and intentionally self-inflicted gun injury. Conditional logistic regression adjusting for confounding. Used risk-set sampling to match controls to cases on the date and time of each shooting. Control matched according to age, gender and race. | Gun suicide risk in areas of high availability was less than the risk incurred from acute alcohol consumption. Proximity to alcohol outlets overall was largely unrelated to the risk of intentionally self-inflicted gun wound, although elevated but Non-statistically significant for proximity to off-premise outlets. Subjects in areas of high-on-premise outlets were also at lower risk of gun suicide of borderline significance. | On-premise measure included unknown number of restaurants that do not sell alcohol. Unmeasured confounders include depression and other mental health issues. Low response rate for sampling controls. |
| Brenner et al 2015 (88) | multi-site, USA | Problem drinking and consumption | Adults aged 45-84 years, free of clinical cardiovascular disease | Examines association of alcohol outlet density and neighbourhood disadvantage with alcohol consumption. SES - composite measure from US Census. Covariates were age, gender, race/ethnicity, study site, marital status, education, current job status and income. Gender stratified negative binomial models. Models accounted for clustering at the census tract level. | Alcohol outlet density not associated with current alcohol use. Among drinkers, men increased consumption in high density neighbourhoods. Women in moderate outlet density areas had lower weekly liquor consumption than women in low or high density areas. Outlet density not associated with number of drinks consumed on heaviest drinking days. | No control for length of time residing in neighbourhood. Sample typically healthier than general population. Heavier drinkers more likely for attrition. Cross-sectional data, categorical measures of outlet density used |
| Cederbaum et al 2015 (189) | Philadelphia, USA | Problem drinking & consumption | mother-adolescent son dyads, sampled from housing estates across City | Examined association between individual, familial, and environmental factors and adolescent alcohol use. Multivariate logistic regression analyses predicting mother’s recent alcohol use and son's lifetime alcohol use. | Outlets associated with mothers recent alcohol use. Alcohol outlet density increased odds of sons lifetime use. | Discrepancy between timeframes of survey and licence data. No peer use. Did not model for effects of same housing commission block. Low R-square values for all models. Self-report susceptible to social desirability bias. |
| Chilenski et al 2010 (190) | Iowa and Pennsylvania, USA | Underage use of, exposure to/and or access to alcohol | Eighth grade high school class | Examined association between community substance use environment and adolescent substance use. Ordinary Least Squares multivariate regression. | No association between composite measure and adolescent alcohol use. No association between outlet density and adolescent alcohol use. | Exposure is a composite measure including total alcohol outlet density and perceived availability. |
| Connor et al 2011 (90) | New Zealand | alcohol consumption & problem drinking & consumption |  | Examined association between outlet density and harms. logistic regression and zero-inflated Poisson models | Binge drinking remained significantly associated with off-premise outlet density, the strongest associations between clubs, and off-licences, although the other density types were also associated with harms. | Self-report measures may underestimate consumption and harms. Small sample size limit power of analysis |
| Davis & Grier 2015 (191) | California, USA | underage use of, exposure to and or access to alcohol | Middle and high school children | Examined the influence of urbanicity on alcohol and cigarette consumption among middle and high school children, and mediating effects of density of convenience stores (off-premise sales). | High convenience store density may explain why living in an urban area is associated with problem consumption in high but not low poverty areas. | Self-report for adolescent use may result in recall or desirability bias. |
| Farley et al 2006 (192) | Louisiana, USA | Child maltreatment & neglect |  | Examined how mother’s neighbourhood conditions relate to birth outcomes. Hierarchical linear modelling. | Neither outcome was associated with density of outlets (neighbourhood physical deterioration was). | No control for length of residency in current neighbourhood. Women deliver in different neighbourhoods to where they reside. |
| Forsyth 2010 (193) | Scotland, UK | Amenity problems |  | Examined the association of off-premise outlets with litter across eight neighbourhoods of public housing. | no association with off-premise outlets, suggesting the alcohol purchased at these locations is not necessary consumed locally | Address location determined manually not using GIS. Possible limited generalizability given very specific setting. Study didn’t account for fluctuations in local authority cleaning activity. |
| Freisthler et al 2009 (194) | California, USA | Child-deviance | adolescents aged 14-16 years | Examined whether density interacts with levels of parental monitoring to affect levels of deviance hierarchical linear modelling. Controlling for other correlates of deviance. | Density of bars was associated with low parental monitoring, this interaction was related to higher reports of deviance among adolescents (off-premise and restaurants not significance). | Survey - self-reported. 1) neighbourhood crime levels no included 2) social desirability bias in social deviance and parental monitoring measures 3) parental monitoring has low reliability |
| Freisthler et al 2014 (137) | 50 (of 123) Californian cities, USA | Child maltreatment & neglect | Parents | Examined how parental drinking level, location, density of outlets and types of is associated with child abuse. Telephone surveys with stratified random sample of parents across 50 randomly selected cities (n= 3,023). Multilevel Poisson models. | On-premise outlet density positively associated, and off-premise outlet density significantly negatively associated with child physical abuse. Social companionship moderated density harm relationship. | Low survey response rate (47.4%). Physical abuse self-reported by parents causing possible desirability response bias, although used voice automated interviewing for gather information on abuse. Sampled more high income parents (thus possibly underestimating child abuse) that state averages. Low reliability for some of the measures used. |
| Freisthler et al 2014 (127) | 50 (of 123) Californian cities, USA | Child maltreatment & neglect | Parents | Examined how parental drinking and outlet density effect child neglect controlling for caregiver and child characteristics. Same dataset as Freisthler et al 2014 [99]. | On-premise outlet density positively associated with leaving children home alone Off-premise outlet density was negatively associated with leaving children home alone or in a car. | Same as those listed for Freisthler et al 2014 [99] |
| Freisthler et al 2015 (126) | 50 (of 123) Californian cities, USA | Child maltreatment & neglect | Parents | Examined association of outlet density with child abuse, considering social neighbourhood disorder and interactions between residents. Same dataset as Freisthler et al 2014 [99]. | On- or off-premise outlet densities were associated with child abuse once neighbourhood and social processes were accounted for. | Same as those listed for Freisthler et al 2014 [99] |
| Goldstick et al 2015 (195) | Flint, USA | Violence | 14-24 yr olds | Examined the relationship of substance use and weapon aggression is influenced by community-level variables. | No simple relationships between outlet measures and weapon aggression. Off-premise density mediated the relationship between cannabis use and aggression - more packaged outlets reduced the size of this relationship | Self-report. Single city may limit generalizability. A non-general population sample. |
| Gruenwald et al 2014 (196) | 50 cities, California, USA | Problem drinking & consumption |  | Examined association of demographics and personality characteristics of individuals, city-level environmental characteristics (incl. outlet density, collective efficacy, residential stability and disorganization) on drinking patterns and use of drinking contexts. | On-premise outlet densities related to drinking frequencies and volumes; greater proportions of bars among on-premise establishments were related to greater drinking frequencies, quantities, heavy drinking and volumes used. No significant association for off-premise outlets. | Large geographical unit of analysis (city-level). Low survey response rate (48%). Assume participants pass by alcohol outlets within 500m of homes. |
| Huckle et al 2008 (97) | Auckland, New Zealand | underage use of, exposure to and or access to alcohol | teenagers | Examined the association between self-reported consumption and outlet density and willingness to sell to underage measure. | Density predicted typical quantity significantly, but not frequency or frequency of drunkenness (although p=0.06) | Non-drinkers excluded. |
| Iritani et al 2014 (118) | USA | IPV (female to male) | 18 to 26 year olds (Wave III participants) females who reported a romantic relationship | Examined the association between outlet density, and self-reported IPV controlling for self-reported drinking, demographics and other neighbourhood factors. | Off-premise outlet density associated with self-reported physical IPV, although relationship was not mediated by consumption. | Exposure measure from 2006, harm measure from 2001. Self-report IPV likely to suffer from desirability bias. |
| Kavanagh et al 2011 (140) | Melbourne, Australia | Problem drinking & consumption |  | Examined the associations between self-reported consumption and measures of density and proximity. Multi-level models. | No effect for proximity on any consumption measure, significant effects for density on weekly and monthly episodic drinking, but not long-term drinking or overall drinking frequency | Measure of consumption is self-report. |
| Kuntsche et al 2005 (197) | Switzerland | Underage use of, exposure to and/or access to alcohol | Adolescents | Examined whether perceived alcohol availability is related social environment and outlet density and whether these things are associated with adolescent alcohol use. Including interactions between density and public drinking. Multi-level modelling. | Density associated with both measures of drinking | Unclear whether non-drinkers are included in the sample. |
| Kuntsche & Kuendig 2008 (198) | Switzerland | underage use of, exposure to and/or access to alcohol |  | Examined link between density and perceptions of availability and their respective effects on consumption. Structural equation models. | On-premise density was linked to perceived availability and volume of drinking | Density measure is based on a categorical question answered by school staff. |
| Kypri et al 2008 (92) | New Zealand | Problem drinking & consumption | University students | Examined association between outlet density and measures of student drinking, clustered by university campus. Generalised estimating equations. | All measures of consumption and self-reported harm were associated with density, particularly off-premise density | Cross-sectional analyses, relying on self-report consumption and harm data. |
| Livingston et al 2008 (93) | Victoria, Australia | underage use of, exposure to and or access to alcohol | 16-24 year olds | Examined the association between individual and community-level factors and self-reported very heavy episodic drinking. Multi-level modelling. | Packaged liquor density was significantly associated with self-reported heavy drinking | Cross-sectional analyses, relying on self-report consumption data. Survey response rate relatively low. |
| Lo et al 2013 (199) | Alabama, USA | underage use of, exposure to/and or access to alcohol | school students in grades 6–12 | Examined whether and how student binge drinking at the individual level was influenced by population disadvantages, community instability, alcohol-outlet density, and protective factors generated by community and school. Multi-level modelling. | No effect for outlet density | Cross-sectional analyses, relying on self-report consumption data. Outlet measure not disaggregated by type. |
| Lo et al 2013 (200) | Alabama, USA | underage use of, exposure to/and or access to alcohol | school students grades 6–12 | Examined the individual and community factors associated with 30 day alcohol use. Spatial regression models | No effect for outlet density | Cross-sectional analyses, relying on self-report consumption data. Outlet measure not disaggregated by type. |
| Maimon et al 2012 (201) | Chicago, USA | underage use of, exposure to/and or access to alcohol |  | Hierarchical linear models of alcohol use in survey wave 2, controlling for use in wave 1 and for a comprehensive array of individual and community variables | Significant relationship between density and alcohol use | Density estimated by observers rather than official statistics |
| Major et al 2014 (202) | 6 US states + 2 cities, USA | alcohol-related morbidity |  | Assessed contribution of alcohol outlet density on incidence of liver disease death and cancer using a large cohort. Multi-level cox proportional hazards models. | Significant effects for deaths, but not cancer incidence. | Density measured at baseline only based on national database with limited detail. |
| McKinney et al 2009 (121) | USA | IPV | couples who were current drinkers | Logistic regression models on survey data, linked to availability measures based on respondent's residence, adjusting for a range of individual and community variables | Male-on-female partner violence was higher in areas with higher on-premise outlet density, but not off-premise -and no result for Female-to-Male | Self-reported IPV data. Cross-sectional analyses. |
| McKinney et al 2012 (82) | USA | Problem drinking and consumption | couples who were current drinkers | Logistic regression models on survey data, linked to availability measures based on respondent's residence, adjusting for a range of individual and community variables | No effect on either drinking or problems | Self-reported IPV data. Cross-sectional analyses. |
| Mennis & Mason 2011 (203) | Philidelphia, USA | Underage use of, exposure to and or access to alcohol | 13-20 yrs adolescents recruited at  health care clinics | Examined association between distance to nearest alcohol outlet and substance use. | Little association of ecological characteristics with substance abuse. Significant association for older girls, but not for younger girls or younger/urban boys | Described as an exploratory study. Small sample (n=301). Cross-sectional. |
| Milam et al 2014 (204) | Baltimore, USA | Underage use of, exposure to and or access to alcohol | elementary school children aged 8-12yrs | Examined association between counts of off-premise alcohol outlets on children’s route to school and perceived safety and exposure to alcohol, tobacco and other drugs. Controlling for neighbourhood disorder. | Counts of outlets was not associated with the outcome measures when controlling for neighbourhood disorder. | Route-to-school based on GIS modelling rather than actual route. Survey measure not identify location. Relatively homogeneous sample of children may limit generalizability. |
| Milam et al 2013 (205) | Baltimore, USA | Underage use of, exposure to and or access to alcohol | elementary school children aged 8-12yrs | Examined association between off-premise outlet density and pre-adolescents' opportunity for alcohol, tobacco or other drug use, adjusting for neighbourhood physical disorder. Used buffer zones. | Outlet count not associated with exposure to alcohol, tobacco or other drug use, nor perceived neighbourhood safety. | No context on where the adolescents exposure to alcohol, tobacco or other drug use. Could have occurred outside the alcohol outlet buffer zones. Not a representative sample. No measure of exposure length (ie. Residency length). Didn't include other importance confounders such as parental/peer substance-use |
| Milam et al 2014 (206) | Baltimore, USA | underage use of, exposure to and or access to alcohol | Young adults, predominantly African American | Examined the association between off-premise alcohol outlet density and exposure to alcohol, tobacco and marijuana. GEE logistic regression accounting for neighbourhood clustering. | No association between any outlet measure and alcohol use, significant association between distance to nearest outlet and cannabis use. | Limited control variables. Adolescent self-reported exposure to alcohol, tobacco and marijuana could have occurred in a different neighbourhood to where subject resided. |
| Pasch et al 2009 (207) | Minneapolis, USA | underage use of, exposure to and or access to alcohol |  | Cross-sectional regression models of self-reported drinking behaviour and alcohol availability measures | No significant relationship | Cross-sectional analyses, relying on self-report consumption data. |
| Paschall et al 2012 (208) | 50 Californian cities, USA | underage use of, exposure to and or access to alcohol |  | Cross-sectional multi-level regression models, controlling for standard variables plus perceived availability, enforcement and acceptability of alcohol use | Outlet density was significant in early models, but the effect was attenuated when controlling for perceived availability, enforcement and acceptability. | Large unit of analysis. Cross-sectional analyses, relying on self-report consumption data. |
| Pereira et al 2013 (79) | Perth, Australia | Mental health (including suicide) |  | Examined association of off-premise outlet density and harmful alcohol consumption and mental health disorders. Controlled for consumption. Negative binomial regression models. | Some associations between particular measures of alcohol availability and mental health disorders; significant effects for consumption across all measures. | No information on location of alcohol consumption. |
| Pollack et al 2005 (83) | USA | Problem drinking and consumption |  | Multi-level logistic models of the association between self-reported heavy drinking and five measures of density, controlling for individual and neighbourhood SES. | No significant relationship | Cross-sectional analyses, relying on self-report consumption data. |
| Ray et al 2008 (114) | Ontario, Canada | General injury and morbidity |  | Case-crossover study examining the association of alcohol sales (no availability measure) and assault hospitalizations. Compared sales 1 day prior to assault injury with sales 7 days earlier. | 13% higher risk of hospitalization for assault for each additional 1,000 lts of alcohol sold per day. ~1/3 assaults related to alcohol. | No measure of patients alcohol use or BAC - perpetrator could have been the one consuming alcohol. Associations with beer may not be detected given 80% sold in non-state owned stores. |
| Reboussin et al 2011 (100) | 5 US States, USA | underage use of, exposure to and or access to alcohol |  | Cross-sectional alternating logistic regression, controlling for individual factors and some neighbourhood-level factors | Frequent drinking was associated with on-premise outlet density, purchase attempts and successful purchases associated with off-premise density | Cross-sectional analyses, relying on self-report consumption data. |
| Resko et al 2010 (209) | 1 Michigan county, USA | Violence | (14-18 year olds) | Cross-sectional multi-level model of the association between self-reported violence perpetration and outlet density, controlling for individual and community characteristics (including self-reported drinking) | Association between overall density and violence perpetration was non-significant when disadvantage was controlled | Cross-sectional analyses, relying on self-report data on violence perpetration. Data just from one county in Michigan. |
| Rowland et al 2014 (101) | Victoria, Australia | underage use of, exposure to and or access to alcohol | Student survey | Examined the association between alcohol outlet density and self-reported parental supply of alcohol. Examined interactions by parental cultural background. | No main effect for density, although some interactions with parental cultural background | Self-report measure of parental supply of alcohol. Relatively large unit of analysis. Cross-sectional analyses, relying on self-report consumption data. |
| Rowland et al 2014 (98) | Victoria, Australia | underage use of, exposure to and or access to alcohol |  | Examined the association between outlet density and self-reported alcohol consumption. | Outlet density was protective overall, although was associated with increased consumption for drinkers aged 12 to 14 years. | Relatively large unit of analysis. Cross-sectional analyses, relying on self-report consumption data. |
| Rowland et al 2015 (99) | Victoria, Australia | Underage use of, exposure to and or access to alcohol | Secondary school students | Examined the association between alcohol outlet density and underage purchasing. A representative student survey identified adolescent reports of purchasing alcohol, including outlet type. | Density of all outlet types were positively associated with adolescent purchasing, particularly density of clubs and off-premise outlets. | Possible biases from using self-report on alcohol purchasing among adolescents. Cross-sectional data. |
| Schonlau et al 2008 (87) | LA and Louisiana, USA | Problem drinking & consumption |  | Multi-level model examined the link between self-reported alcohol consumption and off-premise outlet density/proximity. | Significant relationship in Louisiana but not Los Angeles | Cross-sectional analyses, relying on self-report consumption data. |
| Schootman et al 2013 (210) | British Columbia, USA | Problem drinking & consumption | Cancer Registry - sample of breast cancer survivors | Examined association of proximity to alcohol outlets and consumption. Multilevel regression. | Women living within 3 miles (4.8 km) of nearest outlet more likely reporting excessive alcohol consumption than women > 3 miles. No significant association between excessive alcohol use and two other density outlet measures | Consumption threshold low, specific recommendation for breast cancer survivors. Discrepancy between outlet measures, although authors argue proximity roadmiles is optimal measure. Low response rate. Outlets included all gas stations etc which legally can but may not be selling alcohol |
| Scribner et al 2008 (211) | USA | Problem drinking & consumption | university students | Multi-level models were used to test the association between various measures of student drinking and alcohol outlet density, controlling for various student and campus factors | On-premise outlet density (within 3 miles of the campus) was associated with all measures of drinking. | Cross-sectional analyses, relying on self-report consumption data. |
| Shimotsu et al 2013 (84) | Minnesota, USA | Problem drinking & consumption |  | Multi-level cross-sectional Poisson regression models of the association between self-report binge drinking and neighbourhood outlet density | No significant association between binge drinking and outlet density (bars or liquor stores); positive association between retail mix and binge drinking | Cross-sectional analyses, relying on self-report consumption data. |
| Stanley et al 2011 (212) | USA | underage use of, exposure to and/or access to alcohol |  | Physical, social and perceived availabilities and self-reported youth drinking. Cross-sectional multi-level logistic models, controlling for social availability and a range of other factors | No association between outlet density and youth drinking | Cross-sectional analyses, relying on self-report consumption data. |
| Tanumihardjo et al 2015 (85) | Wisconsin, USA | Problem drinking & consumption |  | Examine how proximity and density of outlets were associated with drinking and binge drinking. Multiple regression with limited controls | No effect for density or proximity on binge drinking, some evidence that drinkers lived in higher density areas than non-drinkers | Cross-sectional analyses, relying on self-report consumption data. |
| Taylor et al 2015 (213) | England, USA | Amenity problems |  | Examined association of on-premise outlets and perceptions of anti-social behaviour. Multilevel models. | higher densities will be related to more negative perceptions above and beyond other features of the respondent’s local area | Cross-sectional data. Low response rate. |
| Theall et al 2011 (214) | New Orleans, USA | Problem drinking and consumption | African Americans adults recruited at health care clinics | Examined association of densities of outlets with at-risk drinking. Heirarchical logistic regressions. | Densities affected drinking. Multivariate models liquor stores (off-premise) remained significant predictor. Stratified by gender - significant effect for women and not for men | Generalizability given sampling through health clinics of poor folk. Self-report alcohol use. No measure of length of residency. Cross-sectional data. |
| Theall et al 2009 (215) | Los Angeles, USA | Alcohol-related morbidities |  | Multi-level models of individual and neighbourhood effects on self-reported morbidity, controlling for individual and neighbourhood factors. | Significant positive relationships between off-premise density and STI, Violence and liver disease. Effects mediated by consumption, but still significant. | Cross-sectional analyses, relying on self-reported morbidity data, with no reliability reported. |
| Tobler et al 2009 (216) | Chicago, USA | underage use of, exposure to and or access to alcohol | Sample was urban, racial/ethnic minority, adolescents | A complicated structural model of various measures of social and commercial availability as well as outlet density on alcohol use in 8th grade, controlling for grade 6 alcohol use | No effect of alcohol outlet density on alcohol use. | Cross-sectional analyses, relying on self-report consumption data. |
| Treno et al 2006 (217) | Alaska, USA | Price | Survey with retail establishments | Examined association of outlet density and distribution costs with beverage price. Regression. | no significant impact for outlet density (either type) on price | Alaska - unique setting. Cross-sectional analyses. |
| Treno et al 2013 (218) | British Columbia, Canada | Price |  | examined the association of drink price at individual private (off-premise) liquor stores and the densities of government liquor stores, private liquor stores, bars and restaurants in local health areas. Examined whether pricing effects occur through lower quality goods rather than through discounting (measure off-premise price ratio to government store price). Multilevel modelling. | increase densities of private liquor stores were associated with lower mean price of beer and all alcohol/ no effect of densities of other types of outlets, including government (other off-premise) stores on any prices measure No effect on discounting patterns, with mean prices reflecting difference in brand quality carried. | Effect only found on beer - interpret that beer drink of choice for young people, who are most price responsive: price-conscious youth may be driving the availability changes. Privatisation was partial - new private stores had to compete with remaining government stores and had some regulation on permissible discounting allowed. Therefore, less than perfect private market setting/ but still found effect in this context 3) generalizability given the particularities of partial-privatisation. |
| Treno et al 2008 (219) | California, USA | underage use of, exposure to and or access to alcohol |  | Multi-level models with 50 zip codes sampled (30 respondents in each). Analyses examined the association between underage purchasing and density, controlling for other modes of access | Teenagers living in higher off-premise density areas were more likely to have successfully purchased alcohol. | Cross-sectional analyses, relying on self-report consumption data. |
| Truong & Sturm 2007 (89) | California, USA | Problem drinking and consumption |  | Logistic regression models were run to test the association between various measures of outlet density and heavy drinking. | Some types of on-premise outlets were associated with heavy drinking. No effects for others (e.g. restaurants) or for off-premise | Cross-sectional analyses, relying on self-report consumption data. |
| Truong & Sturm 2009 (220) | California, USA | underage use of, exposure to and or access to alcohol |  | Logistic regression models of the association between drinking and proximity to alcohol outlets, controlling for standard variables. | Both on- and off-premise outlets were associated with 'binge' drinking but not any drinking. | Cross-sectional analyses, relying on self-report consumption data. |
| Waller et al 2012 (221) | USA | Intimate partner violence |  | Multinomial logistic regression models were used to test the association between neighbourhood outlet density and self-reported IPV victimisation | No significant relationships between density and IPV or consumption | Self-reported IPV. Licence and individual data collected at different time points. Cross-sectional |
| Waller et al 2012 (222) | USA | Intimate partner violence (female to male) |  | Multinomial logistic regression models were used to test the association between neighbourhood outlet density and self-reported IPV victimisation | Higher rates of victimisation in high outlet density neighbourhoods | Self-reported IPV. Licence and individual data collected at different time points. Cross-sectional |
| Waller et al 2013 (223) | USA | Intimate partner violence |  | Multinomial logistic regression models were used to test the association between neighbourhood outlet density and self-reported IPV perpetration by males in a current heterosexual relationship, adjusted for neighbourhood and individual controls (including consumption) |  | Self-reported IPV. Licence and individual data collected at different time points. Cross-sectional |
| Wiebe et al 2013 (224) | Philadelphia, USA | Perception of safety | 10-18yrs school children | Examined how safe children felt on their way to school based on based on transportation mode, companion type, and neighbourhood characteristics. | Perceived safety lower in areas on high off-premise outlets. No association with on-premise | Sample 100% male African-American. Possible desirability bias with males reporting being fearful. Cross-sectional. |
| Wilkinson & Livingston 2012 (225) | Australia | Amenity problems |  | Logistic regression models were used to assess the link between self-reported amenity problems and self-reported estimate of distance to nearest alcohol outlets. | Once appropriate controls were included, only two relationships were significant: living closer to bars was associated with higher odds of being kept awake, and living closer to off-premise outlets was associated with property damage | Cross-sectional. Self-reported measurement of density. |
| Young et al 2013 (139) | Glasgow, Scotland | underage use of, exposure to and or access to alcohol | adolescents | Examined association between self-reported weekly drinking and various measures of proximity/density of off-premise outlets, controlling for some individual factors. | Only proximity measure was significantly associated with self-reported drinking | Cross-sectional analyses, relying on self-report consumption data. |

## Table 8 Studies completely at aggregate/ecological levels (n=55)

| Reference | Setting | Outcome | Description | Findings | Limitations |
| --- | --- | --- | --- | --- | --- |
| Berthelot et al 2015 (226) | Southern City, USA | Violence | Examined the association of outlets and violence. Negative binomial poisson regression. | Density of convenience stores associated violence. | Cross-sectional, aggregate data analysis. |
| Britt et al 2005 (227) | Minneapolis, USA | Violence & General Crime | Examine association of density of alcohol outlets and violent crime. | Higher rates of alcohol outlet density corresponded with higher rates of criminal violence. | Cross-sectional, aggregate data analysis. Populations are residential, likely to vary considerably from populations visiting hot spots at night. Confounders not included such as other land-uses which may influence criminal violence - ie. Public transport sites. |
| Brower & Carroll 2007 (228) | Madison, USA | Violence & General Crime | Examined association between high-density outlets, student neighbourhoods and crime. GIS – descriptive analysis. | Serious crimes peaked at bar closing times and clustered in the heaviest area of bar density. | Cross-sectional, aggregate data analysis. Excluded arrest databases, thus missing crime incidents that are not called-in to the dispatch office but may be picked up by police patrolling. |
| Cameron et al 2012 (142) | Manukau City, New Zealand | Motor vehicle crashes and drink driving, Violence & General crime | Examined the association between alcohol outlet density and police events. Spatial seemingly unrelated regression. | All three licence density categories were associated with a range of police events, but only off-licence density was associated with motor vehicle accidents. Violent offences are significantly positively associated with off-licence density and density of clubs and bars, but not density of restaurants and cafés. | Cross-sectional data analysis. Varying effects spatially had no obvious patterns, making policy interpretation difficult. |
| Ceccato & Uittenbogaard 2014 (229) | Stockholm, Sweden | General Crime | Examined association between characteristics of train stations (including having an off-premise outlet close by) and crime. Ordinary least square regression. | Stations with off-premise outlets nearby have higher crime during weekdays, holidays and spring. | Very specific setting and research question. |
| Crandall et al 2015 (230) | Chicago, USA | Violence & Mental health (including suicide) | Examined association of alcohol outlets and gunshot wounds. Combination of ordinary least squares and geographically weighted regression. | No association at city-level; five regions have a significant association between liquor outlets and gunshot wounds: package liquor was more predictive than on premise. Regions had greater proportions of African-Americans, female single-headed households, more of the population on social security income, less housing value and more per capita gunshot wounds. | Cross-sectional, aggregate data analysis. |
| Dale et al 2012 (231) | 12 municipalities, Sweden | Alcohol-related morbidities | Examined association of alcohol environment and injury in children and young adults. Regression. Included data on alcohol sales. | Local alcohol access and per capita alcohol consumption positively correlated with nonfatal injuries in boys 13–17 years. No other age or gender brackets significant associations. | Cross-sectional, aggregate data analysis |
| Day et al 2012 (232) | New Zealand | Violence | Examined association between proximity to alcohol outlets and serious crime. Negative binomial regression. | Outlet density (all types) increased with increasing quintile of serious violent offence rates. Off-premise density associated with violence irrespective of distance. | Cross-sectional, aggregate data analysis |
| Erikson et al 2015 (233) | Minneapolis, USA | Violence, General Crime, motor vehicle crashes, drink driving, Problem drinking and consumption | Examined how neighbourhood attributes (parks, non-alcohol outlets) might mediate the association of outlets with crime. | Alcohol outlet density was positively related to crime, with few mediating effects of other neighbourhood characteristics. | Cross-sectional, aggregate data analysis |
| Franklin et al 2010 (234) | Washington D. C., USA | Violence | Association of alcohol outlets and violent crime. Negative binomial regression. | Availability associated significantly with all violent crime: outlets are significantly and positive related to three of four crime categories (not significantly, but positively related to homicide): By premise category - on- nor off-premise sig related to homicide or assault, both sig-related to robbery, neither associated with sexual assault. | Cross-sectional, aggregate data analysis. |
| Freisthler et al 2005 (235) | Northern Californian city, USA | Child maltreatment & neglect | Examined physical availability of alcohol and drugs related to rates of child maltreatment. Generalized Least Square regression. | Bar density significantly associated with child protection: No significant association with off-premise and restaurants. | Cross-sectional aggregate data. Data no child maltreatment likely reflects differential rates of reporting/surveillance. |
| Freisthler et al 2007 (236) | 3 counties California, USA | Child maltreatment & neglect | Examined how neighbourhood characteristics are associated with rates of child maltreatment. Generalised Least Square Regression | Off-premise outlets positively association with child maltreatment. | Cross-sectional aggregate data. Data no child maltreatment likely reflects differential rates of reporting/surveillance. |
| Freisthler et al 2008 (237) | California, USA | Child maltreatment & neglect | Examined the association of outlet density with child abuse and assault. Zero inflated/negative binomial regression. | Density of off-premise outlets related to all three outcomes: density of bars was associated with child assaults. | Cross-sectional aggregate data. Data no child maltreatment likely reflects differential rates of reporting/surveillance. |
| Giesbrecht et al 2015 (238) | 14 States, USA | Mortality (Suicide) | Examined the association between outlet density and death by suicide. Used BAC taken from a national violent death registry. Hierarchical linear logistic regressions. | Off-premise outlet density positively associated with alcohol-related (BAC > 0) suicides among men: On-premise outlet density positively associated with alcohol-related suicides (BAC > 0 and BAC > 0.08) alcohol-consumption among men. | Not all suicides are BAC tested, BAC testing varies amongst the 14 states. |
| Goldstick et al 2015 (239) | Flint, USA | Violence | Examined the association of outlets and assaults. Poisson point-level spatial modelling. | Both density measures associated with increased assault across the three sub-populations with exception that juvenile assault rate does not increase with increased on-premise density: effects larger for off-premise than on-premise. Effect was greater for white than black assault victims. | Cross-sectional aggregate data. |
| Gorman et al 2005 (240) | Houston, USA | Violence | Examined alcohol and drug availability on crime. Spatial regression models. | Off-premise density in the target census tract only significant predictor once drug availability added to the model. | Cross-sectional aggregate data. |
| Groff 2014 (241) | Seattle, USA | Violence | Examined how crime occurred in street segments with different number of outlets. Zero-inflated negative binomial regressions. | Higher outlets per street segment increased crime. | Cross-sectional data. |
| Groff & Lockwood 2014 (242) | Philadelphia, USA | Violence & General Crime | Examined association of exposure to five street characteristics (including bars) and crime. Negative binomial regression. | Exposure to bars was positively associated with all three crime types at all distance thresholds - greatest effect for disorder crime. | Cross-sectional aggregate data. Spatial autocorrelation not robustly controlled. |
| Grubesic et al 2011 (141) | Cincinnati, USA | Violence | Calculated outlet agglomerations and then predicted expected violence around those clusters and different distances. | Assaultive violence has a propensity to cluster around agglomerations of alcohol outlets. This spatial relationship varies by distance and is also related to the characteristics of the alcohol outlet agglomeration. | Cross-sectional data, although clustering approach reduces some of the likely biases. |
| Grubesic et al 2013 (102) | Philadelphia, USA | Violence | Examined association between alcohol outlet density and violence. Controlled for alcohol expenditures and non-alcohol-related retail density as well as neighbourhood characteristics. Spatial and negative binomial regression. | Total and off-premise outlet densities significantly related to aggravated assaults. | Survey measure of alcohol expenditure is a proxy for an alcohol sales measurement. System of licensing means an unclear measure of off-premise outlets and on-premise outlets includes outlets that can sell beer for takeaway. |
| Gruenewald et al 2006 (103) | California, USA | Violence | Examined place and person potentials related to hospital discharges for assault. | Assault rates were significantly related to of off-premise densities, not bar density. | Cross-sectional aggregate data. |
| Gruenwald et al 2010 (133) | California, USA | Violence & Motor vehicle crashes & drink driving | Examined association of outlet density with hospitalizations for young persons. Zero-inflated negative binomial regression | Off-premise outlets positively associated with three outcomes in local area among both age groups. On-premise only sig related to older age group (21-29yr olds): Bars related to assaults and restaurants to traffic accidents. Off-premise protective of traffic injuries in older populations. | Cross-sectional aggregate data. |
| Han & Gorman 2013b (243) | Lubbock, USA | Violence | Examined spatial associations between on-sale alcohol availability, neighbourhood characteristics, and violent crime in a geographically isolated city. Geographically and globally weighted regressions. | Outlets association with violence. | Cross-sectional aggregate data. Confounders not measured include social capital, drug availability and other neighbourhood institutions. |
| Jennings et al 2014 (244) | Baltimore, USA | Violence | Examined association of neighbourhood police reported violent crime with outlet density using four years of crime data. Controlling for drug arrest counts. Negative binomial regression. | On- and off-premise outlet density was significantly related with violent crime. | Single measure of outlet density used with four years of crime data- assumes outlet numbers same over four years. |
| Liang et al 2011 (44) | Western Australia, Australia | Violence | Examined the association between density of outlets, sales from outlets and violence (with controls). Negative binomial regression. Included data on alcohol sales. | On-premise density predicted violence rates, as did off-premise sales (but not density). | Cross-sectional aggregate data. |
| Lipton et al 2013 (245) | Boston, USA | Violence | Examined the association of violence using police and emergency call data and outlet density and drug markets. Poisson regression. | Off-premise alcohol outlets positively associated with crime. Restaurant density positively associated with crime, excluding restaurants only selling beer/wine (not spirits). | Cross-sectional aggregate data. |
| Livingston 2008 (144) | Melbourne, Australia | Violence | Examined association of outlet density with assault. Spatial regression models with non-linear terms included and interactions explored. | Interactions with disadvantage were non-significant, density of general and on-premise outlets were positively associated with assault, packaged outlets had no effect. | Cross-sectional aggregate data. |
| Livingston 2010 (120) | Melbourne, Australia | Intimate Partner Violence | Examined the association between outlet density and domestic violence. | General and on-premise outlets were positively associated with domestic violence, but not packaged liquor. | Cross-sectional aggregate data. Likely differences in rates of reporting/recording of IPV offences in police data. |
| Livingston et al 2014 (246) | Glasgow, Scotland | General crime | Examined association between traffic crashes and alcohol outlets. Generalized additive models. | Outlets were associated with person and property crime. Models of change were non-significant or protective. | Cross-sectional aggregate data. No controls for spatial autocorrelation. |
| Lugo 2008 (247) | Madison, USA | General crime | Purely descriptive analyses with ANOVA and logistic regressions for particular questions. | Density of outlets was not explicitly tested in a model to predict crime, but noted strong associations between drink specials and crime. | Cross-sectional aggregate data. Limited analyses with few controls. Density never explicitly modelled in multivariate analyses. |
| Matheson et al 2014 (248) | Toronto, Canada | Deaths | Examined association of alcohol outlet density with premature mortality. Poisson regression. | Higher rates of premature mortality in neighbourhoods with higher rates of alcohol outlets. This effect was not evident looking only at bar density, suggesting takeaway alcohol is important. | Cross-sectional aggregate data. Combined measure of outlets for most analyses. |
| Mccord & Ratcliffe 2007 (249) | Philadelphia, USA | Drug Crime | Examined association of neighbourhood characteristics and drug-markets. Zero-inflated Poisson model. |  | Cross-sectional aggregate data. |
| Morton et al 2014 (129) | One county in New Jersey, USA | Child maltreatment & neglect | Examined relationship between child abuse and neglect and outlet density. Examined mediating effect of presence of neighbourhood substance use treatment services. | On-premise outlet density was positively associated with neglect; Off-premise outlet density was negatively associated with rates of physical abuse. | Cross-sectional aggregate data. Data no child maltreatment likely reflects differential rates of reporting/surveillance. |
| Morton 2013 (128) | One county in New Jersey, USA | Child maltreatment & neglect | Examined association of outlet density and child maltreatment. Spatial regression. | Outlet density was positively associated with child maltreatment | Cross-sectional aggregate data. Data no child maltreatment likely reflects differential rates of reporting/surveillance. |
| Nielsen et al 2005 (250) | Miami, USA | Violence | Examined association alcohol outlet density and violent crime. Spatial negative binomial regressions. | Significant effect for Latino crime but not black crime. | Cross-sectional aggregate data. |
| Pearson et al 2014 (251) | Auckland, New Zealand | Mental health (including suicide) | Assessing the association between packaged outlet density and the presence of any dual-diagnosis clients with at least one anxiety/mood client. Spatial logistic regression. | Significant relationship between density and dual diagnoses. | Measures of outcome are reliant on prevalence of mood/anxiety disorders. |
| Pridemore et al 2011 (252) | Cincinatti, USA | Violence | Examined the relationship between outlet density and assault. | Bars and off-premise outlets associated with assault. | Aggregate cross-sectional. |
| Pridemore et al 2012 (253) | Cincinatti, USA | Violence | Examined the relationship between outlet density and assault. | Off-premise, bar and restaurant density all positively associated with assault, with effects significantly stronger in less organised communities. | Aggregate cross-sectional. |
| Pridemore et al 2012 (254) | Cincinatti, USA | Violence | Examined the relationship between outlet density and assault. | Bars and off-premise outlets associated with assault, with some moderating effects of land use. | Aggregate cross-sectional. |
| Raleigh & Galster 2015 (255) | Detroit, USA | General Crime | Examined the association between outlet density and crime. | Number of licences to sell alcohol predicted both crime types. Off-premise outlets had a stronger link to most crime types. | Police data means likely underreporting of crime. |
| Richardson et al 2015 (256) | Scotland | alcohol-related morbidity & mortality | Examined the relationship between outlet densities and hospitalisation and death rates. | Significant associations between both on- and off-premise outlets and both outcomes, stronger for off-premise. | Temporal misalignment, limited controls. |
| Roman et al 192 (119) | District of Colombia, USA | Intimate partner violence | Examined the association between alcohol availability and IPV. | On-premise outlets were protective, while off-premise outlets were positively associated with IPV rates. Effects were much larger for weekend IPV than weeknight. | Aggregate cross-sectional. |
| Rossheim et al 2015 (257) | USA | Sexual health | Examined the association between outlet density and HIV prevalence. | On-premise outlet density significantly associated with higher prevalence of HIV, off-premise were protective. | Aggregated analyses, limited controls. |
| Schofield & Denson 2013 (258) | New York State, USA | Violence | Examined the association of maximum on-premise trading hours and IPV | Higher rates of violence were found in cities with later allowable trading hours. | Cross-sectional study comparing rates – no policy change in terms of hours. Potential confounds – i.e. different cities have different characteristics associated with both trading hours and violence |
| Schofield & Denson 2013 (259) | New York State, USA | Motor vehicle crashes & drink driving | Examined the association of maximum on-premise trading hours and drunk-driving | Higher rates of first-time drink-driving, but not repeat, were found in cities with later allowable trading hours. | Cross-sectional study comparing rates – no policy change in terms of hours. Potential confounds – i.e. different cities have different characteristics associated with both trading hours and crashes |
| Scribner et al 2010 (260) | 32 US colleges, USA | Violence | Examined the association of outlet density and assault, rape and robbery. Regression. | No effect on assault or robbery, significant effect for on- and off-premise density on rape. | Survey data used for some control measures. |
| Sebert-Kuhlmann et al 2009 (261) | Denver, USA | Motor vehicle crashes & drink driving | Examined the association of community-factors with pedestrian/traffic crashes | Significant association between density and crashes. | Very few controls, combined aggregate density measure. |
| Snowden & Pridemore 2013 (262) | Bloomington, Indiana, USA | Violence | Examined the association of outlet density and violence. | Restaurants were significantly associated with violence. Bars were marginal, off-premise non-significant. | Non-metropolitan college town as research site likely limits generalizability. |
| Snowden & Pridemore 2014 (263) | Bloomington, Indiana, USA | Violence | Examined the association of off-premise outlet density and nearby outlet characteristics with assault. Also examined business practice, staff, and patron characteristics. | Off-premise outlet density was associated with simple (but not aggravated) assault and licence characteristics were unimportant. | Low response rate (48%). Non-metropolitan college town as research site likely limits generalizability. |
| Snowden et al 2015 (264) | Milwaukee, USA | General crime | Examined the association of outlet density and robbery. | Off-premise outlet density and robbery were significantly associated. | Cross-sectional aggregate data. |
| Spoerri et al 2013 (265) | Switzerland | Alcohol-related deaths | Examined the association of on-premise outlet density and alcohol-related deaths. | Dose-response relationship between density of outlets and mortality. | No off-premise measure. |
| Toomey et al 2012 (266) | Minneapolis, USA | Violence | Examined the association of outlet density and crime. | Both on- and off-premise density were significant predictors of violence rates, with on-premise having a stronger effect. | Cross-sectional aggregate data. |
| Toomey et al 2012 (267) | Minneapolis, USA | General crime | Examined the association between outlet density and crime. | Both on- and off-premise density were significant predictors of violence rates, with on-premise having a stronger effect. | Cross-sectional aggregate data. |
| Weaver 2015 (268) | 2 shopping centres, USA | Amenity problems | Examined the association of neighbourhood characteristics of two sites and litter. | Littering higher at site in proximity with liquor stores. | Very specific settings. No controls for municipal/street cleaning variance between sites. |
| Zhu et al 2006 (269) | Houston, USA | Violence | Examined the association between outlet density and violence. | Significant association between outlet density and violence. | Combined density measure. |

1. Restaurant licences in Queensland appear to decrease from 2008 to 2010. This is due to the introduction of new liquor licence types January 2009 which makes it not possible to compare figure prior to 2008–09 with those following. [↑](#footnote-ref-1)
2. Municipalities have the power to set limitations of alcohol-trading hours, meaning closing hours can vary across local jurisdictions. [↑](#footnote-ref-2)
3. IPV refers to violence involving adults in an intimate relationship. Other forms of family violence (in particular child abuse and maltreatment) are examined in separate studies. [↑](#footnote-ref-3)
4. The dollar sign ($) symbol searches for terms with alternative spelling (i.e. neighbourhood searches for neighbourhood and neighbourhood) [↑](#footnote-ref-4)
5. A time after which no further customers are admitted to the pub or club, but those already in the establishment are allowed to stay and to order further drinks. [↑](#footnote-ref-5)
6. Several of the Australian studies have examined the impact of policy changes that involve the combination of a change in trading hours with a “lockout” requirement earlier in the evening. We have included these studies, but not studies of the effect of a lockout alone. The studies that have specifically evaluated the effects of lock-outs alone do not show any substantial effect. [↑](#footnote-ref-6)