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## Why is adolescent drinking declining? A systematic review and narrative synthesis

### Abstract

**Background-** Adolescent drinking has declined across many developed countries from the turn of the century. The aim of this review is to explore existing evidence examining possible reasons for this decline.

**Methods** – We conducted systematic searches across five databases: Medline, PsycINFO, CINAHL, Informit Health and Scopus. Studies were included if association between declining alcohol consumption and potential explanatory factors were measured over time. Narrative synthesis was undertaken due to substantial methodological heterogeneity in these studies.

**Results-** 17 studies met the inclusion criteria. Five studies found moderate evidence for changes in parental practices as a potential cause for the decline. Five studies that examined whether alcohol policy changes influenced the decline found weak evidence of association. Three studies explored whether alcohol use has been substituted by illicit substances but no evidence was found. Two studies examined the effect of a weaker economy; both identified increase in adolescent alcohol use during times of economic crisis. One study indicated that changes in exposure to alcohol advertising were positively associated with the decline and another examined the role of immigration of non-drinking populations but found no evidence of association. One study tested participation in organised sports and party lifestyle as a potential cause but did not use robust analytical methods and therefore did not provide strong evidence of association for the decline.

**Conclusions-** The most robust and consistent evidence was identified for shifts in parental practices. Further research is required using robust analytical methods such as ARIMA modelling techniques and utilizing cross-national data.

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## Introduction

Steady declines in adolescent alcohol use across several measures, including initiation and recent drinking, have been observed in developed nations in the past two decades. For instance, data from Health Behaviour in School-Aged Children (HBSC) survey (WHO 2018) showed declines in adolescent drinking in most high-income European nations between 2002 and 2014. Similar trends have also been observed in this period in Australia (Livingston 2014), New Zealand (Clark et al. 2013), Canada (de Looze et al. 2015; Elgar et al. 2011), Japan (Osaki et al. 2009) and the US (Esser 2017; Harding 2016).

The purpose of this manuscript is to systematically review empirical evidence exploring why adolescent drinking is declining, updating previous discursive reviews (Bhattacharya 2016; Pape et al. 2018) and using a more systematic approach. Numerous hypotheses explaining these declines have been proposed, but supporting empirical evidence is scant (Bhattacharya 2016; Kraus et al. 2019; Pape et al. 2018; Pennay et al. 2015). Hypotheses focus on changes in social influences, including family and parents, peers or school, or broader community influences such as alcohol policy, demographic composition or economic changes (Kraus et al. 2019; Pape et al. 2018). Commonly hypothesized explanations, each of which requires further investigation, are reviewed briefly below.

### **Potential explanations for declines in youth drinking**

#### *Changing social norms*

Social norms pertain to the way social influences shape an individual's attitudes and practices (Bachman et al. 1998). For example, perception of social approval has been shown to influence drinking among young people (Knee and Neighbors 2002; Kuther and Higgins-D'Alessandro 2003). Social norms relating to substance use vary for different birth cohorts (Ryder 1985), for example, Keyes et al. (2015) found that adolescents were less likely to consume alcohol if they matured in birth cohorts with restrictive alcohol-related social norms. A shift towards more constraining alcohol-related social norms could potentially underpin recent declines in adolescent drinking.

#### *Substitution with other substances*

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Alcohol and other drugs may act as substitutes for each other (Crosthair and Guerrero 2012), where preference for one substance might reduce use of another. Alternatively, alcohol and drug use may be complementary, and preventative measures against one may affect use of another (Pape et al. 2009). While adolescent drinking is declining in almost all high-income countries, trends in use of other substances are less uniform. Considerable political and social attention on tobacco and alcohol harm reduction in the early 2000s coincided with increased use of some illegal substances including cannabis in developed countries (Johnston et al. 2018; Kraus and Nociar 2016).

### *Changes in parental practices*

Parental drinking and attitudes to drinking may shape adolescent drinking (Ryan et al. 2011; Sallis et al. 2015). Epidemiological studies demonstrate that parental modelling (Chuang et al. 2005; Shortt et al. 2007; Spijkerman et al. 2007), monitoring (Barnes et al. 2006; Latendresse et al. 2008), alcohol supply restriction (Zwalm et al. 2008), and alcohol-specific rule setting (Van Der Vorst et al. 2007) strongly influence adolescent alcohol consumption (see also Ledoux et al. (2002)). Studies have also demonstrated the importance of more general aspects of parenting on adolescent drinking such as open communication between parents and children (Cable and Sacker 2007), general discipline (Mogro-Wilson 2008), and parental support (Nash et al. 2005) on adolescent drinking. Increased parental anxiety about risk of harm to children may also be a factor.

### *Demographic changes*

Immigration from non-drinking cultures may have played a role in reducing adolescent alcohol consumption in developed countries. Some have argued that acculturation is bi-dimensional, with immigrants integrating their cultures with those of the host country and potentially influencing the host culture over time (Cabassa 2003). Lower rates of drinking have been observed among school children where the prevalence of immigrant populations is high (Monshouwer et al. 2007; van Tubergen and Poortman 2010).

### *Changes in leisure time and increased use of digital technology*

Declines in adolescent drinking have occurred alongside increased use of digital technology. Adolescents today perform much of their socialising with peers online, which supplements

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and potentially replaces face to face interactions (Currie et al. 2009; Reich et al. 2012; Rideout et al. 2010). Virtual socialising may also have reduced both access to, and the need for, alcohol as a social lubricant (Bhattacharya 2016). Conversely, social media sites expose adolescents to alcohol marketing, potentially driving increases in underage drinking. Longitudinal studies have demonstrated the positive association between media use and alcohol use among young people (Hanewinkel and Sargent 2009; Robinson et al. 1998a; Van den Bulck and Beullens 2005).

### *Changes in alcohol policy and preventive interventions*

Key factors influencing drinking at a population level appears to be change in the availability and price of alcohol (Babor et al. 2010). Countries with more restrictive alcohol policies have lower rates of adolescent drinking (Brand et al. 2007; Gilligan 2012; Paschall et al. 2009). Alcohol policies regulate adolescent drinking by restricting sales to minors, increasing age limits, criminalising secondary supply, and increasing purchase price. Greater enforcement of these policies may decrease willingness to supply alcohol to adolescents.

### *Change in exposure to alcohol advertising*

Longitudinal studies have shown a positive association between exposure to alcohol advertising and adolescent alcohol consumption (Ross et al. 2014; Stacy et al. 2013) and there is evidence that alcohol advertising has declined in some settings in recent years (White et al. 2015). The development of advertising regulations and codes of practice for beverage industries prevent adolescent exposure to alcohol advertising. This could affect adolescent's exposure to alcohol advertisements and influence their drinking behaviour.

### *Broader shifts in adolescent lifestyles*

A growing body of literature suggests reduced risk-taking behaviours among adolescents (Arnett 2018; Bhattacharya 2016; Lewycka et al. 2018; Pickett et al. 2013). It is thus important to investigate whether reductions in adolescent drinking are part of a broader shift in adolescent lifestyle.

### *Economic changes*

Finally, economic changes may have influenced adolescent drinking, especially the 2007-08 financial crisis. The decline in drinking overlapped with the financial crisis, which may have

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resulted in adolescents becoming less financially secure and more conservative in their spending (Bhattacharya 2016). When combined with increased alcohol taxes, this may have rendered alcohol an “unaffordable luxury” (Jones 2017).

### *Summary*

While two reviews have compiled suggested explanations for the decline in adolescent drinking (Bhattacharya 2016; Pape et al. 2018), to our knowledge, no study has systematically examined evidence from existing empirical research. Bhattacharya (2016) narratively described plausible hypotheses to explain the decline in the UK. Pape et al. (2018) reviewed trends data to quantify declines across countries and hypothesised a number of explanations, but did not empirically review studies seeking to explain the decline.

In this paper, we critically review empirical research that has tested potential explanatory factors for recent declines in adolescent drinking, and assess the quality and strength of available evidence. Critical appraisal of such studies will provide more robust understanding of factors that drive or influence the trend, and identify directions for future research. We do not seek here to review the entire research literature of factors influencing adolescent drinking in general, but instead have limited our approach to studies that explicitly focus on change over time in drinking during this recent period of decline, as outlined below.

### **Methods**

#### **Design**

We followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al. 2009). The review was registered with the PROSPERO database.

#### **Eligibility criteria**

***Inclusion criteria*** - Quantitative studies were selected if they satisfied all of the following criteria: (i) sampling of adolescents from high income countries aged between 12-18 years, (ii) change in adolescent drinking involving at least two time points, (iii) change in the factor that may affect underage drinking involving at least two time points, (iv) association between the explanatory factor and adolescent drinking measured at least once cross-sectionally, (v) publication after the year 2000 (as declines typically started after this time), and (vi)

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publication in English. Journal articles, government reports and book chapters were all included so long as the study met inclusion criteria.

**Exclusion criteria** - Studies were excluded if: (i) they focused on a special sample (e.g. young detainees), (ii) if the explanatory variable related to individual or group interventions (e.g. a particular school prevention program) and therefore were unlikely to have driven a national-level decline, and (iii) no association was tested (e.g. some studies explored simultaneous declines in two factors without testing their association).

### **Search strategy**

A computer-based search was conducted in February 2018 by RV using five major electronic databases: PsycINFO, Medline, CINAHL, Informit Health and Scopus. The following search terms were used: (adolescen\*, under?age\*, teen?, young people, young person\*, youth\*, young adult\*), AND (underage drinking, alcohol consumption, alcohol intake, alcohol drinking or alcohol use) AND (trend\*, decline\*, chang\*, reduc\*). Mesh terms were used wherever available in addition to the keywords. The detailed search strategy is provided as a supplementary table. After removing duplicates, the first author reviewed titles and abstracts against inclusion criteria. Full-text review was conducted by two authors (RV and GC). The reference lists of all included papers were also searched. ML was consulted to review studies where eligibility was unclear (n=6) until a unanimous decision was reached.

### **Data extraction**

Data were extracted on study setting, sample size, study design, explanatory variable, time-points for trends, alcohol measurement, statistical methods and results (Table 1 and 2). One reviewer (RV) extracted these data and a second verified them (GC). Where disagreement arose, a solution was discussed and, if necessary, referred to ML and AP to achieve a consensus.

### **Quality Assessment**

To assess study quality, two authors (ML and RV) separately scored the studies using a modified version of the Newcastle-Ottawa Scale (NOS) for cross-sectional studies (Wells et al. 2012). NOS is primarily used to assess the quality of non-randomized studies based on three broad criteria: selection of study participants, assessment of the exposure and the outcome

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and appropriateness of the statistical tests. This was the most appropriate scale we could identify for our review, but it required small adjustments. An overall score of 5 or below was considered low-quality and 8 and above high-quality. None of the included studies received 5 or below scores. For some scoring categories such as sample size, non-response rate and comparability we used our own criteria. For example, a sample size of at least 2000 per survey year was given one star and a non-response rate of below 50% was given zero stars. For comparability, one star was assigned when primary control variables such as age, gender, social-economic status and education level were adjusted for, and two stars were assigned when additional variables were also adjusted for.

Finally, in an attempt to deal with the vastly different study designs in our review, we introduced an item called 'strength of inference' which was scored on a 3-point scale depending on the capacity of the design to assess the role of the specific factor considered in driving drinking trends. Thus, for example, the Autoregressive integrated moving average (ARIMA) studies (Gripe et al. 2018; Svensson and Andersson 2016) that specifically model the association between changes over time in key variables and policy impact studies that used panel designs with control sites scored three stars (Disney et al. 2013; Muller et al. 2010; Wagenaar et al. 2006). In contrast, studies that simply assessed changes in the association between key variables at different time points scored one. This is necessarily a somewhat subjective process, but provided most comprehensive quality assessment for our purposes. Quality assessment scores are provided in Table 3. Data were synthesised narratively given the heterogeneity of the study methods and analytical approaches.

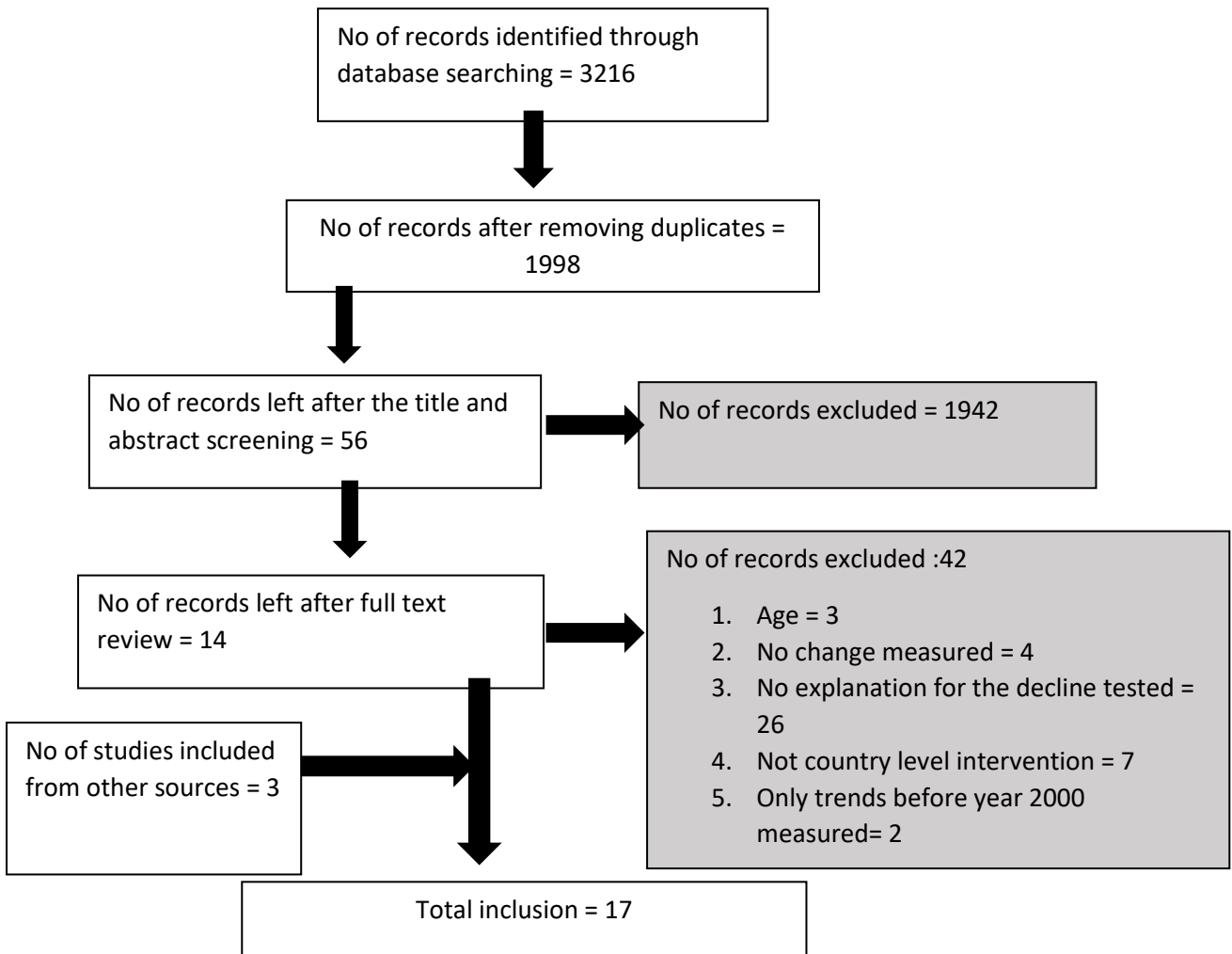
### **Results**

Figure 1 summarises the results of the search. A total of 3216 studies were retrieved using the search strategy shown in Figure 1. After removing duplicates 1998 were left for title and abstract screening. Following abstract searching 56 studies were identified for full-text review. From full-text review a total of 14 papers were identified for inclusion. An additional three more studies were identified; two through searching the reference lists of included studies (Chan et al. 2017; Pabilonia 2014) and one which was published in April 2018 after our search was completed but before we began extracting data from the selected papers (Gripe et al. 2018).



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Figure 1: PRISMA flowchart



## **Study characteristics**

The final sample included nine studies from Northern Europe, five from the US, two from Australia, and one from Japan. Sample size at any one wave ranged from 1,157 (Chan et al. 2017) to 127,093 (Disney et al. 2013). The age range of the samples was 11-18 years. Except for two, all studies drew on multi-wave cross-sectional national surveys on alcohol and other drug use, albeit using a wide variety of analytical techniques. The two others included longitudinal (Arkes 2007) and quasi-experimental designs (Wagenaar et al. 2006).

## **Changes in parental practices and family drinking**

Five papers examined change in parental practices and attitudes as explanatory factors for declining alcohol consumption among adolescents. de Looze et al. (2017) examined change in association between time and adolescent drinking and how it was affected by change in

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adolescent perceived alcohol-specific rule setting by parents. They found increased strict alcohol-specific parental rule-setting from 2007 (26%) to 2015 (60%) that was roughly contemporaneous with the decrease in adolescent lifetime and last-month alcohol use observed in the Netherlands from 2003 onwards. When changes in parental rule-setting on alcohol use were added into a model of drinking trends, the magnitude of the trend was reduced suggesting that new modes of parental rule-setting may partly explain the decrease in adolescent drinking. In another study de Looze et al. (2014) identified an increase in the perceived harmfulness of alcohol, alcohol-specific rule-setting and perceived quality of alcohol-specific communication between parents and children between 2007 and 2011. These attributes were associated with a significant drop in last-month alcohol use over the same period. Both studies included controls for demographic covariates and used interaction models to assess differences across sub-groups.

In Iceland, Kristjansson et al. (2016) tested parental monitoring of their children's whereabouts as a potential contributor to decline between 1997 and 2014. They found a negative association between parental monitoring and adolescent drinking alongside an increase in adolescent-reported parental monitoring and a decline in drinking from 2006 onwards. The study controlled for sex, family structure and parental education but did not account for age, ethnicity and study participants' education status. Osaki et al. (2009) explored the role of family drinking behaviour as a potential cause of declining alcohol use among high school students in Japan. They found that drinking among high school students and their fathers and older brothers decreased from 1996 to 2004. Family drinking pattern remained significantly associated with adolescent drinking over the period, and therefore, may have influenced decreases in adolescent drinking prevalence. In Australia, Chan et al. (2017) explored the effect of the prevalence of parental supply (at the aggregate level) on an individual's probability of consuming alcohol between 2004 and 2013. They found that the aggregate rate of parental supply declined alongside drinking rates and was significantly associated with individual drinking behaviour.

These papers were of varying quality in our assessment (see Table 3), with the de Looze (2017; 2014) and Kristjansson et al. (2016) studies rated the highest. For example, in the de Looze papers (2017; 2014), the reduction in the odds ratios (ORs) of the trend with the inclusion of parenting variables demonstrates clearly that some portion of the decline in youth drinking is

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linked with parenting. Across included studies there were varying study designs and some important weaknesses (e.g., in Chan et al.'s (2017) study, the inherent association between aggregate levels of parental supply and declining drinking as non-drinkers have no supplier). However, the five studies provide consistent evidence of parenting factors as potential drivers of declining adolescent drinking. These studies also support changes across several parenting practices in numerous settings, which further augment this conclusion.

### **Substitution of alcohol with other substances**

Three studies tested the theory of alcohol substitution or complementing with other substances (Gripe et al. 2018; Lanza et al. 2015; Verhagen et al. 2015). Two (Lanza et al. 2015; Verhagen et al. 2015) cross-sectionally examined the change in association between alcohol use and other substance use using regression techniques at different time points during the study periods while Gripe et al. (2018) examined the same association using statistically robust ARIMA models.

In these three studies associations between change in alcohol and cannabis consumption were tested. Verhagen et al. (2015) and Lanza et al. (2015) found a positive association between alcohol and cannabis/marijuana use, suggesting no evidence of substitution from alcohol. Similarly, in Sweden, Gripe et al. (2018) investigated the association between changes in alcohol use and cannabis use at the aggregate level using ARIMA modelling techniques data from 27 years of surveys, finding no association. Two of these studies (Gripe et al. 2018; Lanza et al. 2015) were of moderate quality (see Table 3) and evidence across them consistently suggests that the decline in drinking is unlikely to have been driven by drug substitution.

### **Demographic shifts**

One study by Svensson and Andersson (2016) examined whether immigration from lighter-drinking countries where alcohol was less culturally acceptable played a role in the decline in drinking among Swedish adolescents. The study reported an increase in both the immigrant population and the proportion of abstainers from 1990-2012. However, using ARIMA time-series analyses, the authors found no significant association between annual changes in the rates of immigration and non-drinking. While this study scored highly on our quality assessment (see Table 3), it had a number of limitations. While country of origin for immigrant population was considered, it did not control for religious affiliation or account for time spent

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in Sweden. Similarly, the effects of second-generation immigrants' alcohol use were not assessed.

### **Changes in alcohol policy and preventive interventions**

Five papers assessed the effect of alcohol policies on adolescent drinking behavior. Both Disney et al. (2013) and Wagenaar et al. (2006) used jurisdictional variations in policies across states in the US to assess potential policy impacts. Disney et al. (2013) examined the impact of Internal Possession (IP) laws (whereby people under 21 years are forbidden to have any alcohol in their body, assessed by blood, breath or urine tests) on underage drinking. Twelve states where IP laws were enacted between 1991 and 2009 were included in the analysis and drinking prevalence was compared before and after this. The authors found that IP laws contributed to declines in underage drinking, but when stratified by drinking status the effect held only for recent drinking, not binge drinking.

Wagenaar et al. (2006) examined the effect of Reducing Underage Drinking (RUD) coalitions that were formed in ten US-states to transform normative and policy contexts of adolescent drinking. They used the varying start dates of the coalitions to assess their impact on adolescent drinking between 1997 and 2003, finding evidence that the coalitions were significantly effective in the ten US states where they were formed. Another policy study assessed the effectiveness of broad cross-sectoral alcohol policies in the Dutch province of NoordBrabant (de Goeij et al. 2016). It found that the implementation of a cross-sectoral strategy to reduce youth drinking at the local level had at most a small impact on drinking rates.

Two other studies examined effects of changes in policy at the national level on youth drinking (Lintonen et al. 2013; Muller et al. 2010). In Germany, the introduction of alcopop taxes in 2004 did not result in an overall reduction in adolescent alcohol consumption, albeit with evidence for an effect on beverage preferences (Muller et al. 2010). This study was a simple pre/post design and was limited by its lack of a control site or adjustment for longer-term drinking trends. Finally, Lintonen et al. (2013) descriptively examined the drinking behavior of adolescents in Finland across periods with highly variable policy approaches. They found that adolescent drinking trends did not seem to respond to population-level policy changes such as tax rates, declining irrespective of tax increases or decreases. This study scored poorly on

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our quality assessment. Relatively strong studies showed that targeted alcohol control policies such as IP laws and RUD coalitions may reduce adolescent drinking (Disney et al. 2013; Wagenaar et al. 2006) in particular settings.

### **Changes in exposure to televised alcohol advertising**

One study by White et al. (2017) conducted on 12-17 year old Australian adolescents explored the effect of changes in alcohol advertising exposure on adolescent drinking. These changes were not the result of any specific regulatory changes, instead reflecting variation in industry marketing and adolescent media exposure. The number of alcohol advertisements adolescents were exposed to on free-to-air television decreased substantially from an average of 24 per month in 1999 to about 9 per month in 2011. In a multi-level model, the authors reported positive associations between alcohol advertising exposure, and past-month drinking and past-week risky drinking among adolescents. Thus, the decline in exposure to alcohol advertisements on television may have contributed to reducing adolescent drinking in Australia. However, exposure to advertisements from other media such as the internet, newspapers, movies and music were not accounted for. Thus, evidence to support the hypothesis that changes in exposure to alcohol advertising led to declines to adolescent drinking remains limited.

### **Economic changes**

Two high quality studies from the US examined how youth drinking rates were affected by country-level economic factors (Arkes 2007; Pablonia 2014). Both found counter-cyclical relationships between the economy and youth drinking. Arkes' (2007) study was conducted before the financial crisis, finding that increases in unemployment were associated with increases in all alcohol use measures. Pablonia (2014), whose data spanned 2003-2011, found that each percentage point increase in the unemployment rate during the financial crisis was associated with increased drinking in the last 30 days by 0.7%. Thus, contrary to the hypothesis that poorer economic conditions could result in decreases in adolescent drinking, both studies found that adolescent alcohol use increased (although not substantially) during periods of economic weakness (Arkes 2007; Pablonia 2014).

### **Change in leisure time activities**

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One study on Icelandic adolescents by Kristjansson et al. (2016) examined whether participation in organised sports and party lifestyles was associated with the decline in drinking between 1997 and 2014. It showed that participation in organised sports increased slightly from 2.3% of adolescents (2000) to 2.7% (2014) while participation in a party lifestyle decreased from 2.1% (2003) to 1.7% (2014). The authors found significant positive association between both these leisure time activities and past month alcohol consumption after controlling for gender, family structure and parental education. Overall this study did not provide strong evidence that declines in adolescent drinking could be associated with change in these leisure time activities because the prevalence of these behaviours changed little during a period of dramatic declines in adolescent drinking in Iceland. Further, participation in other leisure activities, including time spent on internet and digital technologies was not taken into account.

### **Discussion**

We examined empirical evidence testing potential explanatory factors shaping recent declines in adolescent drinking in developed countries. Identified studies examined seven potential explanations, but the evidence for each was variable, limited by both the number of available studies and the study designs involved.

We found the most methodologically robust evidence for changes in parental attitudes and practices in explaining the decline. It is important to note here that while three of these five studies (Chan et al. 2017; Kristjansson et al. 2016; Osaki et al. 2009) showed improvement in alcohol-specific parental attributes from the same time as declines in adolescent alcohol consumption began, both de Looze et al. studies (2017; 2014) only provide evidence on change in parental attributes from the year 2007. The five studies described above are also supported by other descriptive studies that have identified shifting parental practices, beginning from the early 2000s. For example, studies from Australia (Kelly et al. 2016), Sweden (Hallgren et al. 2012) and Finland (Raitasalo and Holmila 2017) identified declines in parental supply of alcohol, while other studies identified increases in parental monitoring (Gardner et al. 2012; Hallgren et al. 2012). These descriptive studies did not examine the association between these parental practices and adolescent drinking and were therefore not included in our review.

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In contrast, we found limited evidence and mixed results regarding the impact of alcohol policies in driving the decline in adolescent drinking. Literature suggests that population policies are effective at influencing adolescent drinking (Grube and Nygaard 2001), but the studies we identified (both primarily on taxation changes) found little evidence that recent declines in drinking had been influenced by price (Lintonen et al. 2013; Muller et al. 2010). Others have highlighted examples of alcohol policy changes increasing the availability and affordability of alcohol to adolescents during the period of declining trends (Svensson and Andersson 2016), providing further evidence that national alcohol policies have not triggered the decline. We did find some studies (Disney et al. 2013; Wagenaar et al. 2006) that showed that particular targeted policies have been effective, but these were limited in scope and unlikely to have contributed to the international declines. Future work is needed to compare trends across countries where different policy approaches have been implemented to explore how policy changes have influenced reductions in adolescent drinking.

One study provided evidence that changes in exposure to televised alcohol advertising occurred alongside changes in drinking among young people in Australia (White et al. 2017). These changes were not mandated and were likely offset by advertising through other channels such as the internet or social media. Further research is required in this domain.

We found little evidence to support the argument that the financial crisis in 2007-08 contributed to declines in adolescent drinking. Two studies found that underage drinking increased when the economy was unstable in the US. This is supported by evidence in some settings that disadvantaged young people's drinking has declined more slowly than that of others (Jackson et al. 2017; Liu et al. 2018; Torikka et al. 2017). Studies thus far have been limited to individual countries – future research might employ cross-national designs to provide stronger inference. Further thinking is also needed as to the most reliable economic indicator to measure affordability of alcohol by adolescents.

Considering three studies (Gripe et al. 2018; Lanza et al. 2015; Verhagen et al. 2015) we found no evidence to support drug substitution as a reason for declines in adolescent drinking. Only one study examined whether changes in cultural diversity in the population may have contributed to declining adolescent drinking (Svensson and Andersson 2016), finding no significant relationship over time between immigration from lighter-drinking cultures and adolescent drinking. More evidence is needed from other settings before excluding

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demographic change as an explanation. Finally, one study (Kristjansson et al. 2016) investigated whether change in organised sports participation and party lifestyle could be associated with the decline in adolescent drinking. Due to its weak analytical approach no conclusive evidence could be extracted from this study, but underlying trends make it unlikely that these factors were key contributors in Iceland.

### **Limitations**

Our search strategy included many terms to capture drinking trends for the target population, but we may not have identified all articles. Two studies (Chan et al. 2017; Pabilonia 2014) were not found in our original search because we focused only on those that explicitly identify themselves as examining the decline in youth drinking. One was published in April 2018 after our search was completed in February 2018 but before we began extracting data (Gripe et al. 2018). A focus on studies that explicitly investigated alcohol and explanatory factors in the same frame and the exclusion of qualitative and cross-sectional studies also reduced the scope of the review. The literature that we found was heterogeneous, preventing meta-analysis.

### **Future Research**

Research explaining the decline in adolescent drinking is still emerging. Few hypotheses have been tested and studies are limited by a lack of robust study designs and analytical approaches. Potential causes have been posited but have not yet been empirically tested. For example, changes in social influences, attitudes and norms of drinking (Beck et al. 2008; Thombs et al. 1997) have not been tested alongside the decline. This is despite the fact that drinking attitudes and norms have changed to some extent (Livingston and Callinan 2017), as healthy lifestyles (including veganism and alcohol abstention) becoming more socially acceptable (Bhattacharya 2016). Few studies looked at large-scale alcohol policies as drivers of recent declines; however, there are still many policies which have not yet been tested. White et al. (2017) investigated the change in exposure to televised alcohol advertisements as a potential factor for the decline. However, more research is needed to explore the effect of changes in advertising regulations as a potential driver. Additionally, none of the included studies comprehensively examined multiple potential explanations concurrently. Some



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researchers (e.g. White et al. (2018)) have drawn together multiple policy factors in analyses of youth drinking, but there remain important gaps to fill in this area.

Advances in digital technology provides adolescents with alternative social opportunities that do not require alcohol (Pennay et al. 2015; Twenge and Park 2017). Previous studies have shown that alcohol use is positively associated with time spent on social media (Anderson et al. 2009; Robinson et al. 1998b), yet just one study (Larm et al. 2018) examined the role of internet activities as a potential driver for the decline in adolescent drinking. We note that this study was published in August 2018, six months after our search and data extraction was completed. The study showed no association between social media/chatting or computer gaming and increase in non-drinking among adolescents from 2008-2012. There have also been few attempts to link changes in alcohol consumption to declines in other risk behaviours such as fighting (Pickett et al. 2013), an area worthy of more research.

The studies identified in this review varied in quality and scope. Most relied on repeated cross-sectional surveys, which provide important data but are subject to the wide array of biases common to survey research (Mann 2003). There remain important gaps in the literature; in particular, there has been little cross-national research, which would provide more variation in the potential explanatory factors (e.g. in some countries widespread Internet use occurred earlier than in others) providing stronger potential inference. Studies need to use more robust analytical methods and explore innovative data sources (e.g. cohort studies with repeated intakes).

### **Conclusion**

Despite limitations, this review provides valuable insight into the possible factors influencing recent declines in adolescent alcohol consumption. Overall, there is a lack of robust evidence for any of the explanations studied so far, with the most consistent evidence supporting shifts in parental practices. The literature remains limited in most other areas and more research is required. Once identified, factors that have most strongly influenced recent declines in adolescent drinking can inform policy and public health strategies to support and maintain the declining trends.

### **Declaration of Interest**

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The authors report no conflicts of interest.

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